INCIDENT

Aircraft Type and Registration:	Boeing 737-800, TC-JGR
No & Type of Engines:	2 CFMI CFM56-7B26 turbofan engines
Year of Manufacture:	2006
Date & Time (UTC):	16 October 2006 at 1101 hrs
Location:	On departure from London Stansted Airport, Essex
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 93
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	44 years
Commander's Flying Experience:	10,500 hours (of which 7,000 were on type) Last 90 days - 230 hours Last 28 days - 82 hours
Information Source:	AAIB Field Investigation

Synopsis

TC-JGR was cleared to depart from Runway 05 at London Stansted Airport, Essex, on a 'Dover Five Sierra' Standard Instrument Departure for Istanbul Ataturk Airport, Turkey. Soon after takeoff the aircraft was observed in a "steep" nose-down attitude. It then flew level, at 500 ft aal (900 ft amsl), for approximately 6 nm before being instructed to climb immediately to 5,000 ft amsl. Having been given further climb clearances, the aircraft subsequently reached its cruising level and later landed at Istanbul Ataturk Airport without further incident.

History of the flight

The operating crew reported at 0630 hrs for a two-sector day from Istanbul Ataturk Airport, Istanbul, Turkey to London Stansted Airport and return. The first sector to Stansted was uneventful.

Prior to pushing back from Stand 63 Left, at Stansted, the crew received clearance from ATC to depart from Runway 05 to Istanbul on the 'Dover Five Sierra' (DVR 5S) Standard Instrument Departure (SID). Figure 1 shows the 'DVR 5S' SID plate used by the crew. The co-pilot was the pilot flying for this sector and he briefed the commander on the departure. After an uneventful pushback and taxi out the aircraft was transferred from the Ground Controller to the Tower Controller.

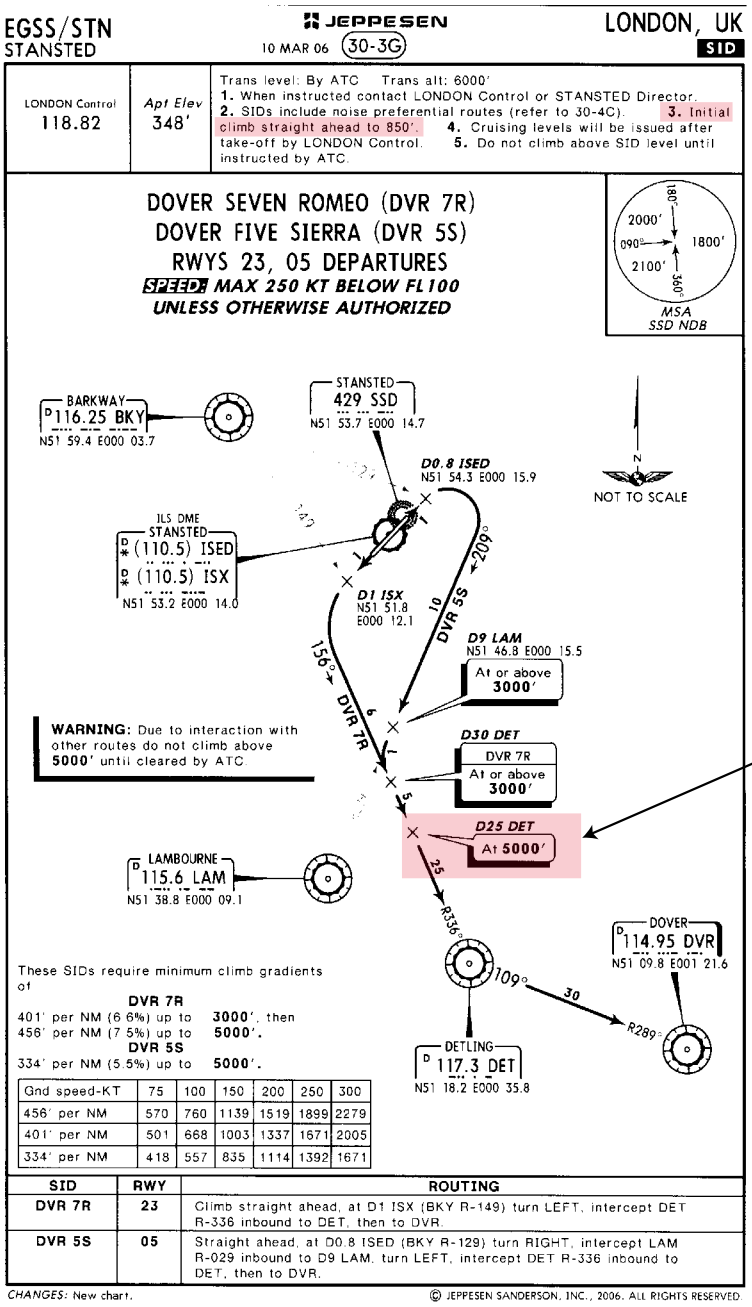

Figure 1

DVR 5S SID plate used by the crew

The Tower Controller cleared TC-JGR to "line up and wait" on Runway 05 after a landing Airbus A319 (A319). Once the A319 had vacated the runway TC-JGR was cleared to take off. Shortly after takeoff TC-JGR was transferred to the London Air Traffic Control Centre (LATCC).

Approximately one minute later the crew of the A319 transmitted on the Ground frequency "SEE THE AIRCRAFT ON CLIMB OUT? THE 737 [Boeing 737] ON CLIMB OUT JUST RAPIDLY LOST HEIGHT, JUST CLIMBING AWAY NOW." Upon observing the aircraft the Ground controller brought it to the attention of the

Tower controller who checked to see if it was still on his frequency; it was not. The Tower Controller then attempted to contact the LATCC controller by direct line, without success. At this point the aircraft had levelled off and was flying the ground track for the 'DVR 5S' SID. The Duty Watch Manager, having been made aware of the incident by the Ground Controller, contacted the LATCC Group Supervisor by phone and made him aware of the incident. The LATCC Group Supervisor then informed the appropriate LATCC controller.

After an initial delay, due to congestion on the frequency, the crew of TC-JGR made an initial call to the LATCC with their callsign only. Being aware of the situation, the controller asked the crew "JUST CONFIRM YOUR ALTITUDE?" The crew replied "900 FT" to which the controller replied, "CLIMB NOW IMMEDIATELY TO ALTITUDE 5,000FT [AMSL]" which the crew acknowledged. At this point, due to its altitude, the crew of TC-JGR were advised that they were outside controlled airspace. When the controller positively identified TC-JGR on his radar screen he gave it further clearance to climb to FL70, which the crew acknowledged. The controller asked TC-JGR "WHY DID YOU LEVEL OFF AT 900 FT? DID YOU HAVE A PROBLEM OR WAS IT A PROBLEM WITH YOUR FMS [FLIGHT MANAGEMENT SYSTEM]?" They replied "WE COULD NOT CONTACT YOU AND ALSO THE FMS."

Shortly afterwards, the LATCC Controller noticed that TC-JGR's Mode 'S'[1] readout was indicating that the crew had FL80 selected in the Altitude Pre-Selector, despite only being cleared to FL70. When questioned, the crew confirmed that they were climbing to FL70. The Mode 'S' readout then changed to FL70 on the controller's radar display. This incorrect selection and re-selection was later confirmed from the radar recordings of the incident.

TC-JGR was then given further clearances to climb to its en-route cruising level. It later landed at Istanbul without further incident.

Eyewitness' comments

The crew of the A319 that landed before TC-JGR took off witnessed the incident. As they taxied onto Taxiway 'H' they saw TC-JGR flying almost level at approximately 500 feet half a mile beyond the threshold of Runway 23. The aircraft then appeared to pitch down markedly before levelling again. The A319 crew thought the aircraft must have suffered an engine failure, due to its lack of climb performance. Figure 2 shows the taxiway layout at Stansted.

The B737 then proceeded to turn right in accordance with the 'DVR 5S' SID, with a shallow bank angle. The aircraft was still level and this was confirmed by the indications of '+05◊' on the A319's TCAS[2] (500 ft above the A319). The aircraft was visible just above the horizon as it tracked the departure route. The co-pilot informed the Ground Controller and the commander alerted the Tower Controller on the other radio. At this point the TCAS target changed to '+05◊↓ '; the down arrow indicated that TC-JGR had a rate of descent of 500 fpm or greater. Shortly after that, the TCAS target, alarmingly, disappeared from the Navigation Display. The crew continued taxiing and as they parked on stand they were then informed that the aircraft was now "climbing normally to the south."

Footnote

[1] Mode 'S' enables the ATCO to view certain pieces of data from a target aircraft. These include heading, indicated airspeed and pre-selected altitude.

Footnote

[2] The TCAS display on the A319 is integrated into the Navigation Display (ND). The TCAS system is left active after landing, switching automatically to standby, but it continues to display targets on the ND.

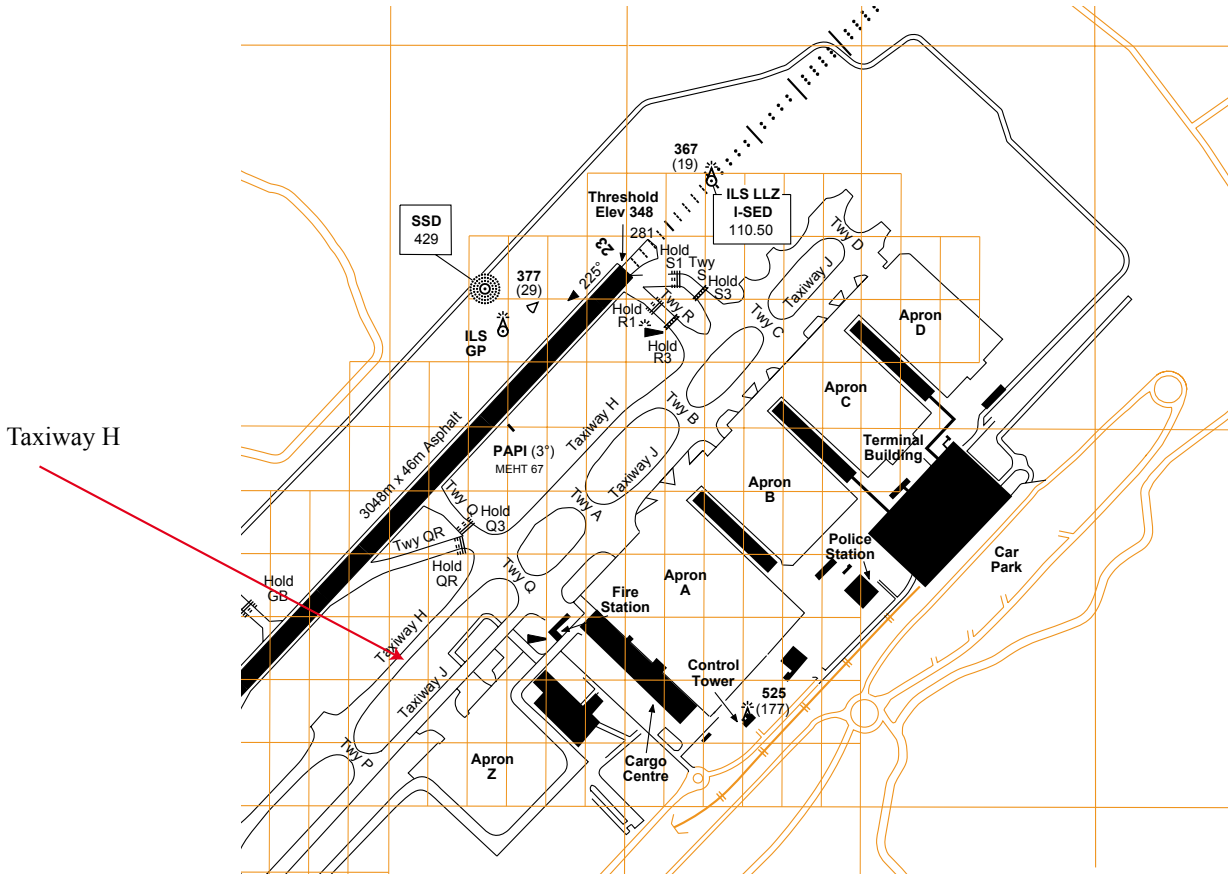

Figure 2

Stansted airfield chart

The commander of the A319 estimated that the B737 flew for three to five track miles before climbing. During this time the lowest TCAS indication was 400 ft and the highest 600 ft. For the majority of the time the TCAS was indicating 500 ft.

The commander later telephoned the Duty Watch Manager and advised him that he had witnessed the incident.

Operating crew's comments

The operating crew were interviewed by the AAIB in Istanbul, Turkey, three weeks after the incident.

Commander's comments

The commander stated that this was the first time he had operated from Stansted, but he had operated from London Heathrow Airport and Manchester Airport on "numerous" occasions without incident. He added that, even though the initial level-off altitude seemed "unusual", he believed that the vertical profile of the 'DVR 5S' SID did not allow for an unrestricted climb to 5,000 ft amsl due to the note on the plate of 'Initial climb straight ahead to 850' [500 ft aal]' as highlighted on Figure 1. He thus believed that the initial level-off altitude was 900 ft amsl, as briefed by the co-pilot prior to departure. He additionally believed that they would be given further clearance to climb from the en-route controller.

After takeoff the autopilot failed to capture the pre-selected altitude of 900 ft. As a result, the commander said he took control of the aircraft manually and, having flown above 900 ft, descended back to 900 ft. Once level at 900 ft amsl, the commander was "slightly alarmed" at the height and realised something was wrong. Even though he realised the aircraft was below the Minimum Safe Altitude (MSA) of 1,800 ft amsl, he was not overly concerned as he was in VMC. At this point, he said, his workload was very high.

Additionally, he stated that he did not remember the Altitude Pre-selector being set to FL80 instead of FL70 and he was aware of the items required in the initial call to the en-route controller.

After the incident the commander realised that he and the co-pilot had not registered the exact meaning of the 'Initial climb' note on the SID plate and thought this might have been due to a language issue. He added that the format of the plate was also "unsuitable" compared to those of the other major European airports into which he operates, where the initial level-off altitude is displayed more conspicuously.

In hindsight, he believed that an opportunity to clarify the initial level-off altitude with ATC was missed due to a breakdown in Crew Resource Management (CRM) during the briefing stage.

Co-pilot's comments

The co-pilot stated that he had previously operated without incident from Stansted, London Luton Airport and London Gatwick Airport. While he did not level off at 900 ft on his previous departures from Stansted, he too believed that they would be given further clearance to climb above 900 ft from the en-route controller. He was not aware of the items to be mentioned in the initial call to the en-route controller and did not remember incorrectly setting FL80, instead of FL70.

Air Traffic Control Officers' comments

Ground controller's comments

The Ground controller reported that, soon after the landing A319 had been transferred to his frequency, the crew enquired if he had seen the departing B737. Upon looking to the north-east he saw the B737 and noted that it was unusually low and levelling off from a descent about one mile from the end of Runway 05. He drew it to the attention of the Tower controller and the Duty Watch Manager. The B737 was observed to make a slightly wider than normal turn to a point approximately due east of the airfield, where it started to climb. It had flown 5 or 6 track miles before initiating a climb.

Tower controller's comments

The Tower controller reported that having given the B737 takeoff clearance he observed it make a normal takeoff. Having confirmed its squawk and observing an altitude of 900 ft amsl on the Aerodrome Traffic Monitor (ATM)[3], he transferred the aircraft to the LATCC before continuing to co-ordinate other zone traffic with the Stansted Radar controller. Upon being made aware of the incident, by the Ground Controller, he observed that the aircraft was still at 900 ft on the ATM. Having confirmed the aircraft had left his frequency he tried to call the LATCC Controller on a direct line to check its status, with no success. As a precaution he kept the runway clear of other aircraft in case the B737 needed to return to Stansted.

The Tower Controller observed the B737 in level flight at 900 ft, on or close to the SID track for about 5 nm

Footnote

[3] The ATM is a radar relay display that allows the Tower Controller to view the radar display remotely.

before it resumed a normal climb. When he eventually contacted the LATCC Controller he was informed that the aircraft was climbing normally.

Duty Watch Manager's comments

At the time of the incident the Duty Watch Manager was in the control tower. He reported that his attention was drawn to the B737 by the Ground Controller. Having been informed by the Tower controller that the aircraft had been transferred to the LATCC he immediately phoned the appropriate Group Supervisor at LATCC and advised him of the incident.

After passing a point south of Stansted, the B737 was observed on radar to be climbing. The LATCC Group Supervisor informed the Duty Watch Manager that the pilot had reported a FMS problem.

Recorded data

The National Air Traffic Services (NATS) provided the AAIB with radar data of the incident.

The Flight Evaluation Unit at Stansted provided the AAIB with a vertical and lateral profile relating to TC-JGR. This indicated that, after takeoff, the aircraft reached a height of approximately 700 ft aal, before descending to approximately 500 ft aal. The aircraft maintained this height for 6 nm before climbing en-route.

As a result of this departure they only received one noise complaint.

Flight recorders

The aircraft was fitted with a Cockpit Voice Recorder (CVR) and a Flight Data Recorder (FDR). Both were successfully downloaded by the operator, and the data provided to the AAIB. The CVR record for the incident, however, had been overwritten. Data was also extracted from the Enhanced Ground Proximity Warning System (EGPWS) by the system manufacturer.

The FDR contained data covering just over 26 hours of operation. Takeoff occurred at 11:01:23 and around 16 seconds later, at a pressure altitude of around 882 ft, the autopilot was selected ON (see Figure 3). The autopilot selected altitude was 900 ft and 'Altitude Acquire' was immediately engaged. A pitch-down command was signalled by the autopilot but, due to the rate of climb and late acquire, TC-JGR overshot the selected altitude. It climbed to a maximum of 1,186 ft before descending towards 900 ft. The pilot then commanded a nose-down attitude, selected autopilot OFF and flew the aircraft manually, from around 974 ft.

At this point, the first EGPWS "DON'T SINK" alert was triggered. This alert is triggered when a significant altitude loss is detected with the landing gear or flaps not set in a landing configuration. The alert includes an audio message and EGPWS warning lights. The amount of altitude loss permitted is dependent on the height above the terrain (radio altitude). Data downloaded by the EGPWS manufacturer indicated a recorded altitude of 737 ft radio altitude at the time of the alert. From the FDR, this constitutes a 143 ft altitude decrease from the peak of 880 ft recorded just after takeoff.

One second after the "DON'T SINK" alert, an EGPWS "SINK RATE" alert was triggered. Unlike "DON'T SINK", this alert monitors for excessive descent rates with respect to radio altitude, in all phases of flight. At the time of the alert, the EGPWS recorded a descent rate of 2,029 ft/min at an altitude of 694 ft agl.

After disconnecting the autopilot, the pilot flew the aircraft manually and descended to a minimum altitude

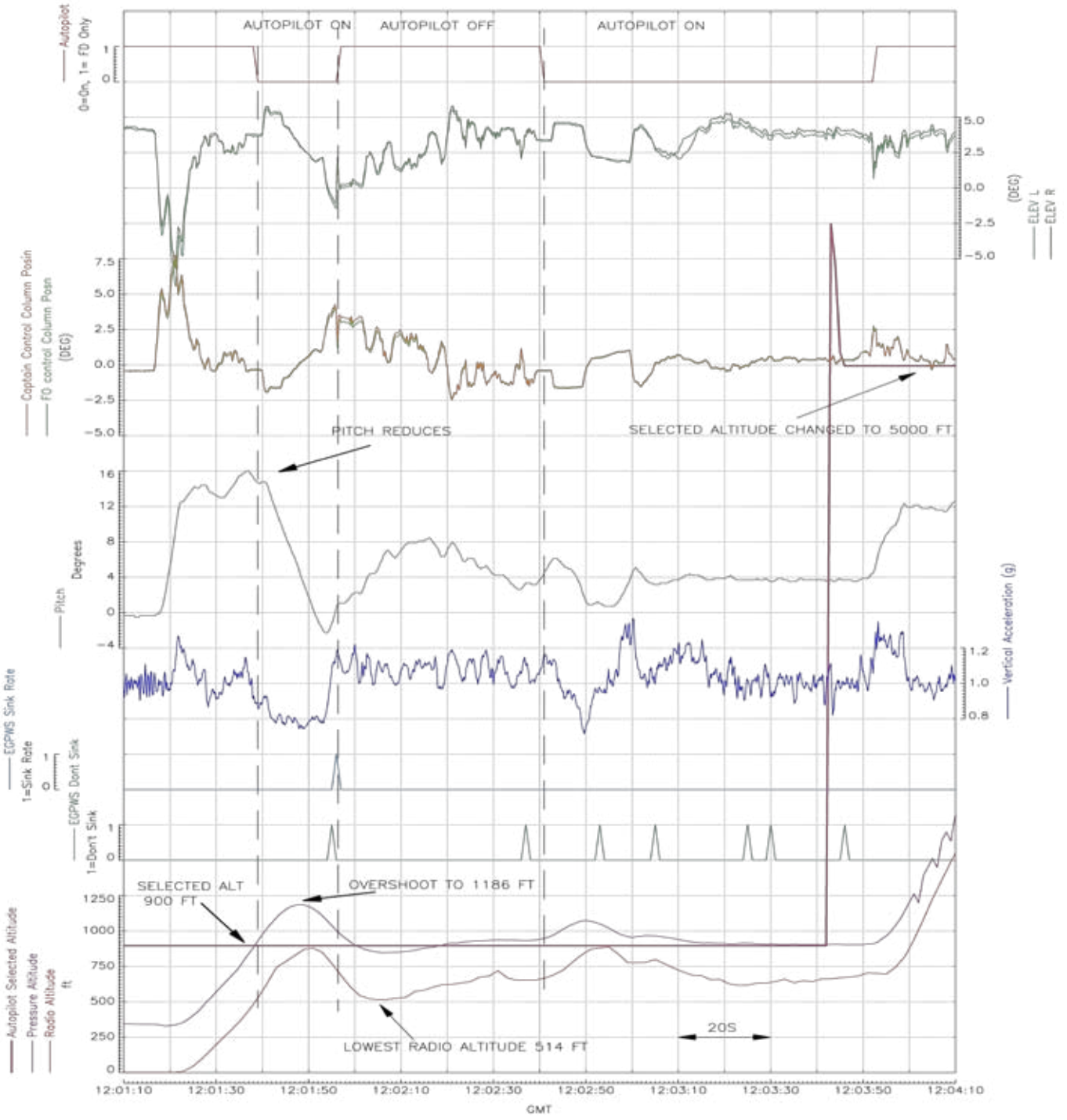

Figure 3

Flight data recorder (FDR) - TC-JGR

of 514 ft agl. A steady increase in altitude to 719 ft agl (938 ft pressure altitude) ensued, followed by an additional altitude decay, triggering a second "DON'T SINK" alert at 655 ft agl (932 ft pressure altitude). Pitch attitude was increased to 6° and the aircraft began to climb again.

Following this alert, the autopilot was re-engaged and, following an overshoot to 1,070 ft pressure altitude, the selected altitude of 900 ft was achieved. However, due to this overshoot and subsequent reduction to the selected altitude, five more "DON'T SINK" alerts were recorded by the EGPWS. At 11:03:42, the selected altitude was changed to 5,000 ft and 11 seconds later the aircraft began to climb. The remainder of the flight was uneventful.

At 11:04:21, the recorded Autopilot selected altitude was increased to 7,000 ft, where it remained for 70 seconds. This was then increased to 9,500 ft for seven seconds before being returned to 7,000 ft.

The aircraft manufacturer analysed the behaviour of the autopilot system during the events detailed above and concluded that it had performed as expected, with the overshoot to 1,186 ft explained by the 'late acquire' by the autopilot just after takeoff. Further simulations indicated that, had the autopilot remained engaged, only a slight undershoot below the selected altitude of 900 ft would have occurred.

Additional information

Airport information

London Stansted Airport is 329 ft amsl. Thus, approximately 900 ft amsl equates to 500 ft aal.

The crew of TC-JGR were using current Jeppesen SID plates. The 'DVR 5S' SID plate used by the crew of TC-JGR, is shown in Figure 1.

UK Departure figures

In 2006 there were a total of 1,058,387 departures[4] from all major UK airfields into the airways system via a SID.

Weather information

The METARs, issued 10 mins before and 20 mins after the incident, reported that the weather was 6 km visibility with scattered cloud at 6,000 ft aal.

UK Aeronautical Information Package (AIP)

Initial climb note on UK SID plates

Major UK airports, with a published SID in the UK AIP, include the note *'Initial climb straight ahead to 848 ft* [in the case of Stansted] *QNH (500 ft QFE)'* or *'No turns below 500 ft QFE'* on their SID plates.

This note was added after the accident involving G-ARPI, near Staines, Middlesex, on 18 June 1972. After this accident the CAA conducted an investigation into the safety aspects of noise abatement departures. Consequently they issued a report titled *'Safety Aspects of Terminal Area Procedures'*, in August 1974. One of the recommendations made in the report was for departing aircraft to climb straight ahead to 500 ft aal before initiating the first turn. As a result the initial climb note was added to the SID plates for all major UK airports. The CAA commented that while this report was published in 1974 their policy is still extant.

Initial call to en-route ATS unit

The UK AIP section, Gen 3-3-3, paragraph 9, *'Initial Call'* states the following:

> *'9 Initial Call*
>
> *9.1 Pilots of aircraft flying Instrument Departures (including those outside controlled airspace) shall include the following information on initial contact with the first en-route ATS Unit:*
>
> *a) Callsign;*

Footnote

[4] This figure was provided by the National Air Traffic Services (UK).

b) SID or Standard Departure Route Designator (where appropriate);

c) Current or passing level; PLUS

d) Initial climb level (ie the first level at which the aircraft will level off unless otherwise cleared. For example, on a Standard Instrument Departure that involves a stepped climb profile, the initial climb level will be the first level specified in the profile).'

Analysis

The co-pilot had operated from Stansted before, without incident. It is therefore likely he did not notice, on this occasion, anything different or untoward during his departure brief to the commander when he, the co-pilot, set 900 ft in the altitude pre-selector.

The commander commented that there might be a language issue with the *'Initial climb'* note on the plate. His initial doubt, during the co-pilot's brief, should have alerted him to seek clarification from ATC before takeoff. As he had operated out of other major UK airports before on "numerous occasions", he either interpreted the meaning of the note correctly or failed to notice it on the previous departures.

The aircraft was operating in VMC. Had it been in IMC and operating from an airport where terrain was more prevalent this incident could have quickly become more serious. Had this been the case the aircraft's EGPWS might have produced a "TERRAIN TERRAIN" and/or "PULL UP" alert. This would have caused the crew to climb, without clearance from ATC, in accordance with Standard Operating Procedures, thus avoiding a more serious outcome.

The LATCC controller was aware of the incident when TC-JGR came onto his frequency. If he had not been aware, there would have been a delay in him realising that the aircraft was at a dangerously low altitude. This would have been as a result of the crew not stating the required items in their initial call and TC-JGR being too low to show on the controller's radar. Subsequently the controller was required to make an extra transmission to ask the crew to clarify the aircraft's altitude.

To ensure the safety of the aircraft, the crew must ensure that they fully understand the meaning of all notes on any airport plate. If there is any doubt, clarification must be sought.

This is the first time this type of incident has been reported in the UK and with the large number of aircraft movements each year using a SID this isolated occurrence is deemed not justify a safety recommendation.

Conclusion

As a result of a misunderstanding of the notes on a SID plate and a breakdown in CRM, the crew did not comply with the prescribed altitudes on the SID and flew for several miles below the MSA. Had the MSA been more critical, this could have led to a more serious outcome.