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(ALL TIMES IN THIS BULLETIN ARE UTC)

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.

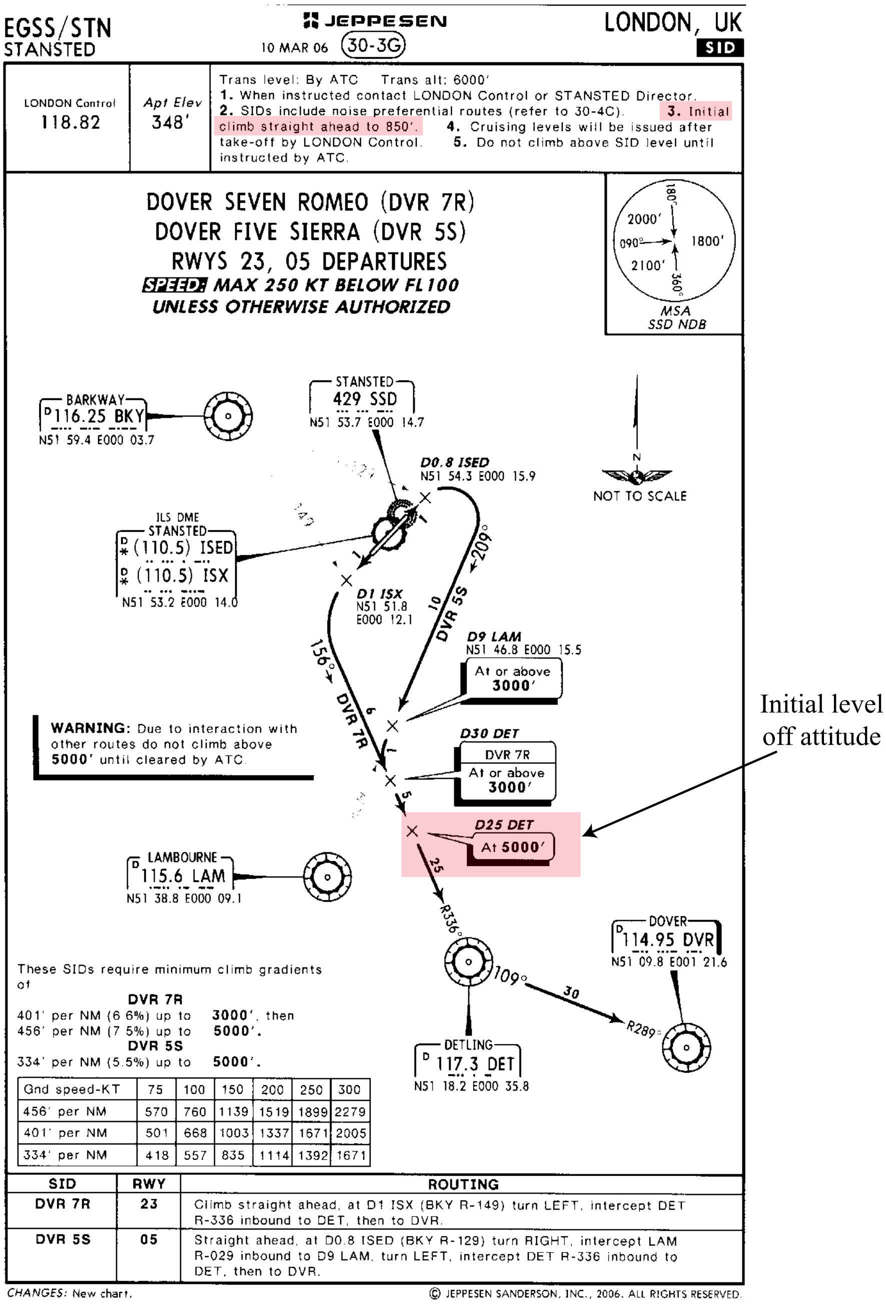

Figure 1

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.

[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.

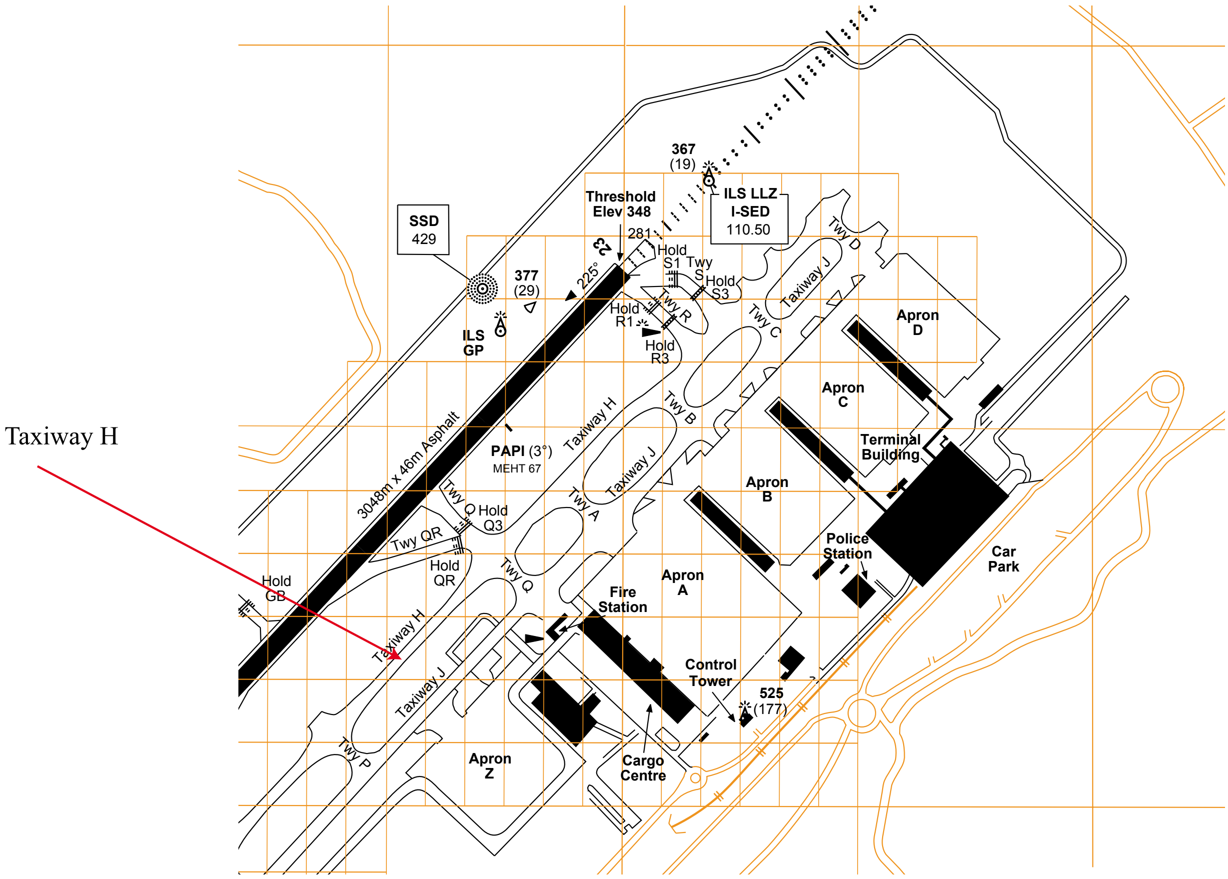

Figure 2

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

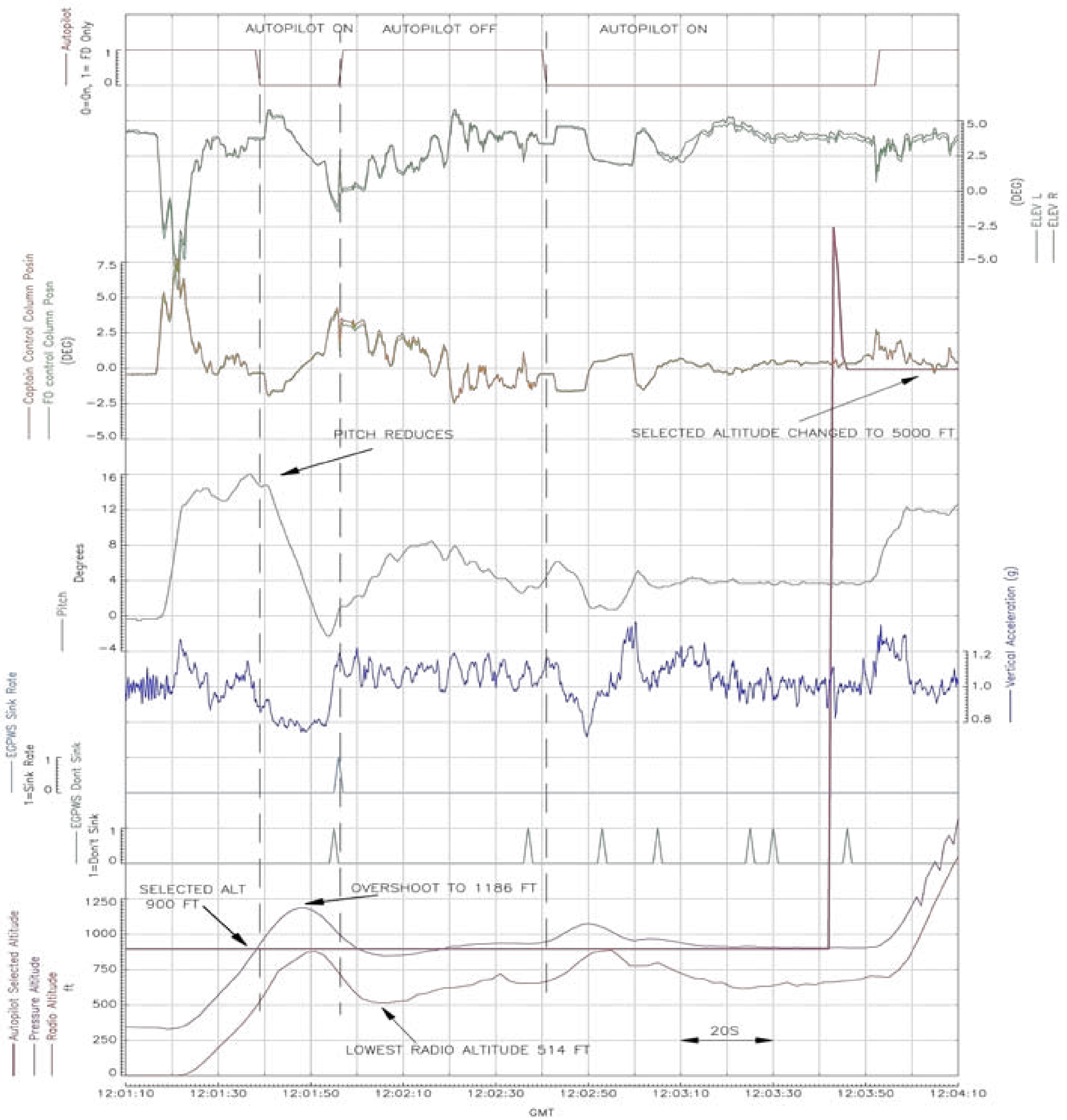

Figure 3

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.

ACCIDENT

Aircraft Type and Registration:	Hawker Hunter T7, G-BVGH
No & Type of Engines:	1 Rolls Royce Avon MK 122 turbojet engine
Year of Manufacture:	1958
Date & Time (UTC):	22 May 2007 at 1300 hrs
Location:	Exeter Airport
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Right main landing gear leg failed, damage to right wing and rear fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	2,350 hours (of which 35 were on type) Last 90 days - 19 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB examination of the aircraft

Synopsis

During the latter stages of takeoff from Exeter Airport, the aircraft swung sharply to the right. Application of left brake and rudder failed to correct the swing; the takeoff was aborted but the aircraft departed the runway to the right. During the deceleration, the right main landing gear failed, which allowed the right external fuel tank to hit the ground and burst. The pilot shut down the engine before the aircraft came to a halt. There was no fire and both the pilot and the passenger escaped unhurt. The cause of the accident was traced to a failure within the wheel brakes selector unit which allowed pressure to be applied continuously to the right brake unit during the takeoff run. The heat consequently generated, resulted in the right brake unit's seizure, causing the aircraft to swing uncontrollably.

History of the flight

The aircraft had taxied to Runway 26 from its parking place on the north side of the airport. The initial takeoff run was described by the pilot as normal, with no directional control problems. In the later stages of the takeoff run, as the nosewheel lifted from the ground and with the rudder pedals central, the right main wheel brake appeared to operate, with no pilot input, and the aircraft swung to the right. Despite the use of full left rudder and left wheel braking, the pilot could not bring the aircraft back onto the runway heading, so he aborted the takeoff. As the aircraft left the paved surface, the pilot deployed the brake parachute. During the deceleration, the right main landing gear collapsed, causing the right underwing fuel drop tank to hit the ground and rupture, spraying the fuselage with fuel. The engine was shut down and the aircraft came to rest on its two remaining landing gear legs, the right wing and rear fuselage. Despite the significant fuel spillage, there was no fire and the two crew members, who were uninjured, evacuated the aircraft prior to the arrival of the Airport Fire Service. Some witnesses reported seeing smoke streaming from the right wheel immediately prior to the loss of control.

Brake system description

The Hawker Hunter is fitted with a castoring nosewheel, differential main wheel braking being used to maintain directional control. Wheel braking is controlled by the brake selector unit which is operated through a series of levers and cams by a lever mounted on the forward face of the control column. The selector unit consists of two valves, one for each main wheel brake unit. Pulling the brake lever progressively opens both valves, allowing both main wheel brake units to be progressively pressurised. If the rudder pedals are moved during braking, a cam within the selector unit alters the position of each brake valve, thereby varying the pressure to each brake unit to provide differential braking. The aircraft was also fitted with a 'Maxaret' system (an early form of anti-lock braking) to prevent wheel lock-up under extreme braking or during operation on slippery surfaces.

Investigation

After recovery, an initial investigation was carried out by the aircraft's maintenance organisation. The right brake unit showed evidence of overheating so the brake selector unit and the right main landing gear Maxaret unit were removed for detailed examination at the AAIB. The Maxaret unit was tested and found to operate normally. Disassembly of the brake selector valve showed that the plunger which operated the right brake valve had become stuck in position 1.8 mm further 'extended' than the plunger of the left brake valve. In such a position, the right brake valve would remain partially open and hydraulic pressure would be applied to the right brake unit regardless of the position of the brake lever on the control column and/or rudder pedals.

Each plunger passes through a spring-loaded phosphor bronze sleeve within the unit, (Figure 1). The sleeve

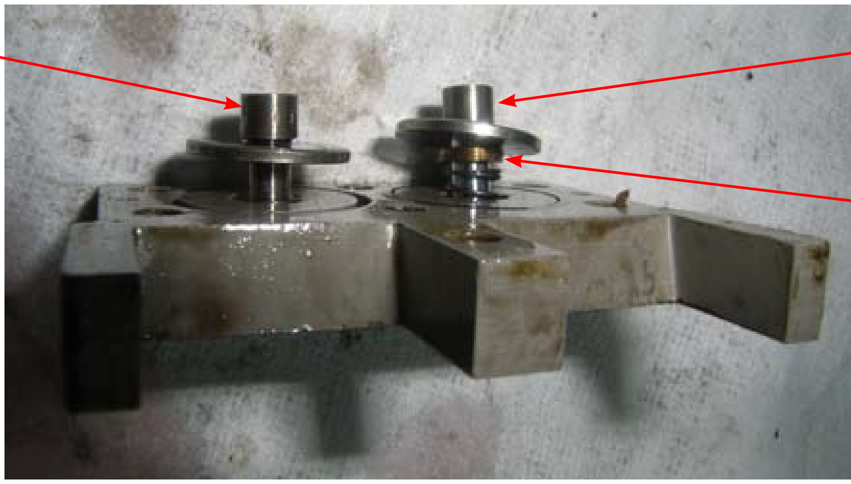

Figure 1

Brake valve plungers showing loose support sleeve on the right valve for the left brake valve was secure within its housing, while the right valve sleeve sprang from the unit during disassembly. The right brake valve plunger exhibited witness marks on its shaft, and these appeared to have been caused by contact with the sleeve during operation; the left valve plunger was undamaged. Measurement of the right valve sleeve showed that a clearance of 0.06 mm existed between the outer diameter of the sleeve and the hole in the housing in which it had been mounted. This clearance would have allowed a small degree of 'rocking' movement of the sleeve which, over time, produced the witness marks on the plunger shaft and, on this occasion led to it becoming jammed.

Conclusions

It is considered that as the aircraft completed its right turn onto Runway 26, the right brake valve plunger within the selector unit became jammed, resulting in a degree of pressure being continually applied to the right wheel brake. Given that the pilot did not have any directional control issues until the nosewheel left the ground, the level of braking to the right main wheel must have been low. As the aircraft accelerated down the runway, the heat build-up within the right brake unit would have been rapid and it is likely that it was sufficient to cause the brake unit to 'seize', just as the nosewheel lifted from the ground.

Safety action

The brake selector unit is not subject to a fixed life and it was not determined when this unit had been fitted to the aircraft. As a result of this event, the maintenance organisation has introduced routine spectrographic oil analysis of the hydraulic fluid within the brake system to allow early identification of component deterioration.

INCIDENT

Aircraft Type and Registration:	Eurocopter EC155 B1, G-ISSV
No & Type of Engines:	2 Turbomeca ARRIEL 2C2 turboshaft engines
Year of Manufacture:	2006
Date & Time (UTC):	10 March 2007 at 1801 hrs
Location:	Norwich Airport, Norfolk
Type of Flight:	Public Transport
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Fire damage to hoist electrical connector and oil cooler support fairing
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	5,107 hours (of which 47 were on type, including 30 hours simulator training) Last 90 days - 97 hours Last 28 days - 28 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was being refuelled on the ramp with the rotors running when a localised fire broke out in the area of the external connector for the electric hoist, on the upper right side of the fuselage. The fire went out as soon as electrical power was removed on shutting down the engines.

The investigation established that the fire was caused by the 28 volt DC electric hoist power supply shorting to the body of the hoist's fixed electrical connector and earthing through the carbon fibre composite fairing on which the connector is mounted. The short was probably caused by moisture ingress into the connector due to a damaged seal. A contributory factor was that the connector is always live whenever the electrical system is powered.

Three safety recommendations are made to the aircraft manufacturer.

History of the flight

The aircraft landed back at Norwich Airport after an uneventful VFR flight of 1 hour and 41 minutes to five North Sea platforms.

After disembarking the passengers on the operator's ramp at Norwich, a rotors-running refuel was commenced. One engineer supervised the refuelling at the hose connector at the rear of the fuselage and another stood at the front left door. The co-pilot then disembarked to obtain a weather update and check the load for the next sector. The wind at the time was from 240º at 10 kt. A company Sikorsky S-76 was parked approximately 25 metres directly behind G-ISSV.

Soon after the co-pilot returned to the aircraft, both crew members smelt an odour of 'antiseptic', which grew stronger with time. They initially thought it was emanating from the nearby aircraft paint hangar and asked the engineer at the front left of the aircraft to investigate. The engineer observed wisps of smoke coming from the right side of the helicopter and after crossing over to its right side, saw six-inch flames emanating from the hoist connector, which were being blown towards the engine intake. He signalled to the commander to shut the aircraft down and stopped the refuelling. The crew of the S-76 also saw the flames, which they described as resembling those of a "gas ring burner". The commander of the S-76 immediately radioed the crew of G-ISSV on the ATC ground frequency to inform them that they had an engine intake fire. The flames disappeared as soon as the engines were shut down.

The AFRS were summoned by ATC and were quickly in attendance, but the fire had already gone out by the time they arrived at the aircraft.

Throughout the incident there were no indications in the cockpit of a fire. The time from the crew sensing the unusual smell until the engines were shut down was approximately 63 seconds.

Aircraft information

General

The EC155 B1 is a twin-engine helicopter that can accommodate up to 12 passengers and two crew. The basic structure of the aircraft is of aluminium alloy, but composite materials are widely used in its construction.

G-ISSV was manufactured in 2006 and commenced operations from Norwich Airport in December 2006. The aircraft was primarily used to transport oil industry personnel to and from offshore platforms.

At the time of the incident it had flown 110 hours since new. There were no deferred defects recorded in the technical log.

Mission selector switch

The mission selector switch is a three-position switch, located on the overhead panel, which enables the crew to activate either the electric hoist or the cargo sling. The crew's pre-start checklist required them to check that the switch was in the OFF position.

Electric hoist

The aircraft was delivered with option 'OP45C07', which provides the wiring and hard points to accommodate a removable electric hoist but the operator had never installed one, as it was not required for the company's operations. The hoist is fixed to the upper right side of the helicopter and its electrical connector plugs into a fixed connector mounted on the oil cooler support fairing (Figure 1). According to the manufacturer, around 45 EC155 helicopters have been delivered with the hoist option to date.

Figure 1

Location of EC155 Hoist Fixed Connector (circled)

The hoist's fixed connector, identified as '24 DELTA', is manufactured from a part number CA3106F32-6PBF80 MIL-C-5015 specification circular bayonet connector. The female half of the connector is mounted on the sloping surface of the oil cooler support fairing on the engine deck and protrudes through the fairing. The fairing is constructed of carbon fibre composite material and is secured to the aircraft aluminium alloy structure by metal screws around its periphery.

When the hoist is not installed, a blanking or 'shunt plug' must be installed on the fixed connector. The shunt plug comprises the male half of the MIL-C-5015 connector, which has been modified in accordance with the helicopter manufacturer's specifications. The modifications include soldering a wire between two of the pins, to provide continuity for the monitoring circuit for the wire-cutting squib, and filling the backshell of the plug with potting compound.

The hoist connector provides the 28 volt DC power supply, and earth return, for the hoist's electric motor, the command signals for the hoist and a signal to fire the hoist emergency wire-cutting squib. The power for the hoist motor is supplied from electrical master box '2 ALPHA', located in the nose of the helicopter. The electrical circuit is protected by a single 130 ampere fuse and the supply to the hoist connector is live whenever the aircraft generators are on line, even if the mission selector switch is in the OFF position. The power supply is wired to contact 'W' of the connector and the earth return for the hoist motor is via contact 'X'. There is no means provided for the crew to switch off the 28 volt DC power supply for the hoist motor.

The connector incorporates an elastomeric seal, located at the interface of the mating surfaces between the two halves of the connector, which renders it weatherproof. The connector was originally designed with an O-ring type seal, which locates in a machined groove in the body of the fixed connector. G-ISSV's hoist connector, and other new connectors examined, were found fitted with square cross-section seals, but all nevertheless retained the groove for an O-ring seal. It is not clear when the change of seal type occurred, or why this change was effected.

Aircraft examination

The aircraft was examined in the operator's maintenance hangar at Norwich Airport. The hoist connector was fire damaged and the right side of the oil cooler support fairing was badly charred in the vicinity of the connector (Figure 2). Localised charring was also visible at three fastener locations around the edges of the fairing, where it attached to the aluminium framework of the fuselage. The fire damage was more evident on the external side of the connector and the fairing.

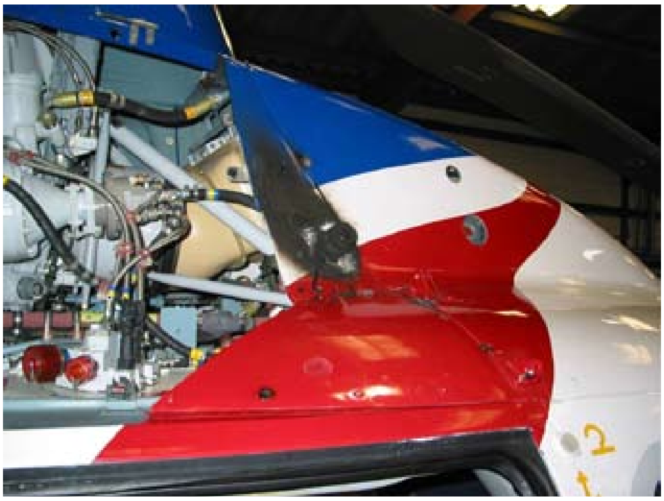

Figure 2

Fire damage to hoist fixed connector and oil cooler support fairing

Hoist connector examination

The fire-damaged connector was examined at the helicopter manufacturer's facility in France. On disassembly, evidence was found of arcing between the power contact ('W') and the body of the connector (Figure 3). The burning damage to the inner surface of the body was in the plane of the interface between the fixed connector and the shunt plug. The elastomeric insulator material in the vicinity of the power contact was heavily charred and partly burnt away. The heat damage was greatest in the vicinity of the power contact and the area of shorting on the connector body. The other contacts were free from significant heat damage.

Closer examination of the other contacts revealed the presence of verdigris deposits (the green deposits found on copper) on several of the pins and pin sockets. No evidence was found of any foreign object having been trapped between the fixed connector and the shunt plug.

The environmental seal between the two parts of the connector was destroyed in the region closest to the power and earth pins. The remaining 60% of the seal was heat affected, but intact. Examination showed that it was deeply indented around the circumference due to being crushed against the sharp edge of the O-ring groove (Figure 4). Several deep circumferential cuts were also visible on one part of the seal circumference.

Figure 4

Damage to hoist connector environmental seal

Figure 3

Evidence of arcing between power contacts and body of connector

The quality of the potting on the shunt plug was found to be satisfactory and no potential leak paths for moisture through the potting were found.

Fixed connector orientation

It was noted that the fixed connector on G-ISSV was installed with the power and earth contacts lowermost. The connector on another of the operator's recently-delivered EC155 helicopters was similarly oriented. However, inspection of another new EC155 at the aircraft manufacturer's facility showed that the fixed connector on this aircraft was installed with the power and earth contacts facing aft (Figure 5).

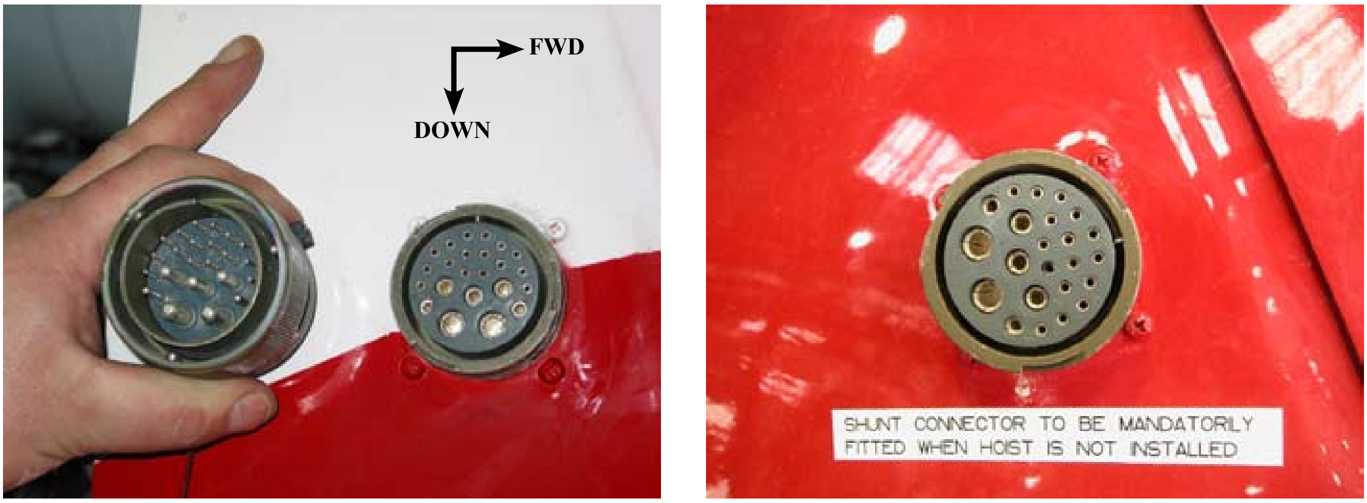

Figure 5

Differing orientations of hoist fixed connector

The orientation of the fixed connector is not specified in the instructions for installing the connector at aircraft build.

Additional information

Previous hoist connector fire

The AAIB became aware of a previous hoist connector fire in 2005 on an EC155 in China. Photographs of the fixed connector and shunt plug from this aircraft showed that the damage was very similar to that found on G-ISSV, with evidence of arcing between the power pin and the body of the shunt plug. The fixed connector on this aircraft had also been installed with the power and earth contacts facing downwards. No definitive cause for the fire was established.

Analysis

Hoist connector damage

The strip examination of the fixed connector and shunt plug showed that arcing had occurred between the positive contact 'W' for the hoist motor and the body of the connector. The fire damage to the panel and the charring around the three fastener holes is indicative that electrical current passed through the carbon fibre fairing and earthed to the aircraft structure. The electrical resistance of the shorting path was sufficiently high that the resulting current did not exceed the 130 ampere rating of the fuse.

The similarity of the damage observed on the hoist connector in the previous incident in 2005 suggests that both fires were caused by similar mechanisms.

Cause of arcing

In order for the positive supply to the hoist connector to short to the connector body, a conductive medium must be present. It was initially thought that a foreign object might have become trapped between the fixed connector and the shunt plug, prior to installation of the shunt plug. However, if this had been the case, it is unlikely that the aircraft would have been able to complete over 100 flight hours prior to the incident occurring and, furthermore, no evidence of a foreign object was found.

The widespread presence of the verdigris deposits on the hoist connector contacts suggests that moisture was present within the connector. Whilst it should have been resistant to the ingress of moisture, given that it was equipped with an environmental seal and the quality of the potting of the shunt plug was acceptable, the cuts in the seal could have provided a path for moisture from rain or aircraft washing, to enter the connector over a period of time. Once inside, it could have accumulated in the small gap at the interface of the fixed connector and shunt plug, until sufficient moisture was present to cause a short circuit.

The use of a square-section seal, whilst retaining the groove for an O-ring on the seal land, provides the potential for the seal to be damaged by being compressed against the sharp edge of the O-ring groove when the connector halves are assembled. To address this issue, the following Safety Recommendation is made:

Safety Recommendation 2007-072

It is recommended that Eurocopter modify the method of sealing the hoist connector '24 DELTA' on EC155 aircraft, to ensure that it is effective in preventing moisture ingress into the connector.

In this and the previous hoist fire incident, the fixed connector was installed with the power and earth contacts facing downwards. This orientation of the contacts could increase the likelihood of an electrical short if moisture is present within the connector. To reduce the likelihood of shorting, the following Safety Recommendation is made:

Safety Recommendation 2007-073

It is recommended that Eurocopter determine the most appropriate orientation for mounting the EC155 hoist fixed connector to minimise its susceptibility to shorting from moisture ingress.

Hoist motor power supply

The electrical supply to the hoist's fixed connector is, by design, live whenever the aircraft generators are on line. There is therefore no way for the flight crew to isolate the supply to the connector, other than taking the generators off line, or shutting down the engines, neither of which is acceptable in flight. If a hoist connector fire were to occur in flight, and the fire were to spread, the safety of the aircraft and its crew would be at risk. To provide this means of disconnection, rather than relying on a high-current electrical fuse, the following Safety Recommendation is made:

Safety Recommendation 2007-074

It is recommended that Eurocopter provide a suitable means to flight crew to allow them to switch off the 28 volt DC power supply to the hoist connector '24 DELTA' on EC155 helicopters.

Conclusions

The evidence suggests that the fire in the hoist connector was caused by the 28 volt DC hoist motor power supply shorting to the body of the connector and earthing through the carbon fibre composite fairing. The most likely cause of the short was moisture ingress into the connector, resulting from a damaged environmental seal. A contributory factor was that the power supply to the connector is always live whenever the aircraft generators are on line.

Safety actions taken

Following this incident, the operator obtained approval from the helicopter manufacturer to isolate the electrical supply to the hoist fixed connector by disconnecting the power cable at electrical master box '2 ALPHA'.

On 1 June 2007, Eurocopter issued Emergency

Alert Service Bulletin (ASB) 25A085, applicable to EC155 B and B1 helicopter versions with serial numbers below 6763. This was made mandatory by EASA Emergency Airworthiness Directive (AD) No 2007-0159-E, which became effective on 6 June 2007.

The ASB requires that operators inspect the hoist fixed connector '24 DELTA' within seven days of receipt of the ASB and, if required, reposition the connector so that the power and earth contacts 'W' and 'X' are facing aft. It also requires that the power supply cable to the hoist fixed connector be disconnected at the electrical master box '2 ALPHA', until such time as a grounding strap has been installed to the body of the connector, in accordance with the instructions provided in the ASB. This is to provide a low resistance path to earth to ensure that the fuse will blow in the event of the power pin shorting to the connector body.

As a further step towards eliminating this risk, Eurocopter proposes to replace the current connector used on the EC155 with the well-proven 'screw-type' connector used on the Dauphin series of helicopters. This would fulfill the intent of Safety Recommendations 2007-072 and 2007-073.

In response to the Safety Recommendation 2007-074, Eurocopter has stated that, although, it agrees with the principle of this recommendation, it would be difficult to comply with it because of the problems inherent in installing such a line contactor. As noted above, Eurocopter proposes, instead, to install a grounding strap between the external connector and 'ground', to ensure that the fuse in the power supply line would blow in the case of a short circuit in the connector. This step would clearly reduce the possibility of a short circuit in the connector causing damage but would not necessarily protect against a short circuit in the power supply line.

ACCIDENT

Aircraft Type and Registration:	Aerotechnik EV-97A Eurostar, G-CCLE
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2003
Date & Time (UTC):	7 August 2007 at 1500 hrs
Location:	Newhouse Farm, Hardwicke, near Hay-on-Wye
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Aircraft beyond economic repair
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	34 years
Commander's Flying Experience:	150 hours (of which 13 were on type) Last 90 days - 5 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During the takeoff roll the aircraft became airborne as it passed over a bump on the downhill grass runway. The right wing dropped and, following an initial attempt to abort, the takeoff was continued. The aircraft then struck a hedge before coming to rest.

History of the flight

The pilot taxied and lined up on the grass Runway 09 at Newhouse Farm (Hardwicke), with the intention to fly to Oxford. Having set one stage of flap, the pilot held the brakes and applied full throttle, noting the engine temperatures and pressures were normal. He released the brakes and began the takeoff roll on the downhill runway. To keep the weight off the nosewheel, he applied some back pressure to the control stick. After about three seconds the aircraft became airborne as it ran over a bump. The right wing then dropped and although left aileron was applied this had little effect. Due to the increasing bank angle to the right, the pilot elected to abort the takeoff, so he cut the throttle. The passenger, a co-owner of the aircraft, then shouted to the pilot to apply throttle again. The pilot duly applied the throttle and attempted to continue the takeoff. A few seconds later, and still with a right angle of bank, the aircraft hit the top of a hedge and cartwheeled before coming to rest beyond the hedge, upright and facing the direction of travel.

The pilot and passenger were not injured and, after making the aircraft safe, they exited normally. The aircraft sustained damage to the propeller, engine, landing gear and the leading edge of the wings.

The pilot, in his assessment of the accident, attributed the cause to his excessive back pressure on the control stick as the aircraft passed over the bump. This had allowed the aircraft to become airborne at too low a speed, leading to a stall and the subsequent right wing drop.

ACCIDENT

Aircraft Type and Registration:	Cessna 152, G-WACF
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1980
Date & Time (UTC):	20 August 2007 at 1334 hrs
Location:	Runway 06, Wycombe Airfield
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller and right wingtip bent, firewall creased and engine shock-loaded
Commander's Licence:	Student pilot
Commander's Age:	64 years
Commander's Flying Experience:	27 hours (of which all were on type) Last 90 days - 13 hours Last 28 days - 6 hours of which two were in command
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed heavily on the nose landing gear, which collapsed allowing the propeller and right wing tip to contact the runway.

History of the flight

The student was flying a circuit consolidation exercise on his fourth solo flight. His previous solo circuits had been carried out using Runway 24, but on this occasion Runway 06 was in use. Prior to flying solo, the student flew three circuits with his instructor, who was satisfied with his performance. The student then flew four circuits without incident, but on the fifth approach he realised that despite having a low power setting he was high and fast, and therefore he lowered the nose to lose height. The aircraft touched down heavily before bouncing into the air. On the second touchdown the nose landing gear collapsed and the propeller and right wing tip contacted the runway.

The Tower Controller reported that the student had bounced on his four previous solo circuits and on the fifth circuit he was seen to land heavily in a nose-down attitude. As the aircraft bounced back into the air, the controller noticed that the nose leg was bent rearwards, and then collapsed when the aircraft touched the runway for a second time.

The student reported that he had never landed on Runway 06 prior to the day of the accident and he found that in complying with the noise abatement procedures he had to fly the aircraft closer to the runway than he was used to, which left him higher than normal on the approach. The student was also of the opinion that when he found himself fast and high he should have gone round rather than attempt to land.

ACCIDENT

Aircraft Type and Registration:	DA40D Diamond Star, G-JKMG
No & Type of Engines:	1 Thielert TAE 125-01 piston engine
Year of Manufacture:	2006
Date & Time (UTC):	8 August 2007 at 1745 hrs
Location:	Chichester Goodwood Airfield, West Sussex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Rear door detached from aircraft, horizontal stabiliser damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	2,318 hours (of which 302 were on type) Last 90 days - 75 hours Last 28 days - 22 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During a sales demonstration flight, the rear passenger door detached from the aircraft and struck the horizontal stabiliser.

History of the flight

G-JKMG was being used to perform a sales demonstration flight. Prior to the flight both the front canopy and rear clamshell passenger door had been opened and closed numerous times. During the taxi out the front canopy was latched open to allow additional ventilation. This generated a red DOOR OPEN warning message on the Garmin G1000 avionics panel. Before takeoff the canopy was closed but neither pilot noticed that the red DOOR OPEN warning message did not extinguish. Once airborne both pilots realised that the door warning was still illuminated and the commander recognised that this was probably due to the rear passenger door being unlatched. At approximately 700 ft, as the commander reached for the door in an attempt to close it, the door fully opened. The hinges retaining the door failed and the door detached from the airframe. It passed over the fuselage and struck the right horizontal stabiliser causing significant damage. G-JKMG continued its circuit and landed without further incident. The door was later recovered from a field.

Door

The rear passenger door of the DA40 is a hinged, upward opening door of composite material. It is secured to the aircraft by two hinges mounted on the fuselage top and supported in normal operation by a gas spring strut at the rear of the door. In the closed position it is secured by two locking bolts projecting fore and aft. The forward locking bolt contacts a microswitch to extinguish the DOOR OPEN warning.

Pilot Assessment

The commander acknowledged that he did not secure the rear passenger door or identify the warning message prior to departure.

ACCIDENT

Aircraft Type and Registration:	Denney Kitfox, G-FOXX
No & Type of Engines:	1 Rotax 532 piston engine
Year of Manufacture:	2004
Date & Time (UTC):	28 August 2007 at 1630 hrs
Location:	Branscombe, near Exeter, Devon
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Substantial damage to wings, propeller and fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	67 years
Commander's Flying Experience:	544 hours (of which 1 was on type) Last 90 days - 12 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft stalled shortly after take-off and descended into trees in a near vertical attitude.

History of the flight

The aircraft took off from grass Runway 09 and, whilst still at a very low level, the right wing dropped and the aircraft turned right through 90°. During the turn the right wing struck a wire fence which removed the right wing tip. The pilot managed to recover the aircraft to straight and level flight before selecting a steep climbing attitude to avoid power lines. However the aircraft then stalled and descended wings level into a line of trees. The fixed landing gear struck the tree tops pitching the aircraft forward to a near vertical nose-down attitude. It came to rest with the nose touching the ground and the tail suspended in the tree canopy. The pilot, who was wearing a full harness, evacuated the cockpit and then returned to switch off the master switch and ignition. He was able to walk unaided back to the airfield.

Pilot assessment

The pilot had recently purchased G-FOXX and this was his first flight in this aircraft. He assessed the cause of the accident as a stall on takeoff due to his inexperience on type. He commented that, in hindsight, he would have been more thorough with his pre-flight preparation.

ACCIDENT

Aircraft Type and Registration:	Jodel D112, G-BIAH	
No & Type of Engines:	1 Continental Motors Corp A65-8F piston engine	
Year of Manufacture:	1964	
Date & Time (UTC):	29 August 2007 at 1150 hrs	
Location:	Priory Farm, Norfolk	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Engine shock-loaded, canopy damaged, engine cowling damaged, one wing distorted	
Commander's Licence:	National Private Pilot's Licence	
Commander's Age:	71 years	
Commander's Flying Experience:	271 hours Last 90 days - 2 hours Last 28 days - 2 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further telephone enquiry by the AAIB	

Synopsis

When landing downwind, following in-flight opening of a canopy door, the aircraft pitched over and inverted.

History of the flight

The aircraft was taking off from a grass strip into the prevailing wind which was north-westerly at an unrecorded speed but "fairly light" according to the pilot. During the climb out, the passenger side entry door flew open, probably because it had been incorrectly latched. The pilot decided to land as quickly as possible and executed a 180º turn to land downwind. The aircraft touched down but, during the landing roll, "the wind lifted the tail and turned the aircraft over".

In the pilot's assessment of the cause, he attributes "over-use of the rudder". When queried about this statement, he replied that, since qualifying in 1974, he had habitually used large amounts of rudder in an oscillatory motion (apparently not a sideslip manoeuvre) to slow the aircraft down on the approach. He tried this during the accident approach but did not find it effective.

ACCIDENT

Aircraft Type and Registration:	Rockwell Commander 112, G-BDLT
No & Type of Engines:	1 Lycoming IO-360-C1D6 piston engine
Year of Manufacture:	1975
Date & Time (UTC):	16 May 2007 at 1525 hrs
Location:	Exeter Airport, Devon
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to nose cowling, exhaust and propeller, both steps worn down
Commander's Licence:	Private Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	871 hours (of which 316 were on type) Last 90 days - 1 hour Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and telephone enquiries by AAIB

Synopsis

Whilst performing circuits, the pilot omitted to lower the landing gear and the aircraft landed wheels-up.

History of the flight

After the aircraft had had an annual inspection, the pilot and two passengers, who were also pilots, boarded G-BDLT with the intention of carrying out a couple of circuits before departing for Berry Head. On the first circuit, halfway down the downwind leg with the checks completed, the pilot was asked to orbit to the right before being given clearance to continue to finals. After three such orbits, clearance was received and the first circuit was completed without incident.

On the second circuit, the pilot was asked by ATC to orbit right again but this time at the beginning of the downwind leg, as the checks were started. After three or four orbits, clearance was given to proceed and the pilot requested a full-stop landing. The rest of the downwind checks were completed and the aircraft continued to land. Unfortunately, the pilot had omitted to lower the landing gear and the aircraft scraped to a halt on the runway. There was no fire and the occupants evacuated the aircraft normally.

It would appear that the interruption of the downwind checks had caused the pilot to omit to lower the landing gear. The aircraft was equipped with a warning horn which sounds if the throttle is closed, with flaps extended more than 15º, if the landing gear is not extended. During the recovery operation, the horn sounded when electrical power was reapplied to the aircraft and thus appeared serviceable. The pilot commented that, wearing noise-cancelling headphones, he did not notice it.

ACCIDENT

Aircraft Type and Registration:	Piper Pa-28-180 Cherokee, G-AVNU
No & Type of Engines:	1 Lycoming O-360-A4A piston engine
Year of Manufacture:	1967
Date & Time (UTC):	27 August 2007 at 1703 hrs
Location:	Lydd Airport, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Lower nose oleo bent, small crack to one torque link
Commander's Licence:	Private Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	1,700 hours (of which 1,450 were on type) Last 90 days - 31 hours Last 28 days - 14 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

History of the flight

Shortly after touchdown on asphalt Runway 03 the aircraft swung to the left and the right wing lifted. The aircraft continued the turn through 180º and ran onto the grass adjacent to the runway. The reported surface wind was 330º/8 kt. Both occupants were uninjured and vacated the aircraft through the normal exits.

Pilot assessment

The pilot assessed that nose gear failure was the most likely cause of the accident. However, a post-accident inspection by a maintenance company, revealed no pre-existing defects.

INCIDENT

Aircraft Type and Registration:	Slingsby T67M260, G-EFSM
No & Type of Engines:	1 Lycoming AEIO-540-D4A5 piston engine
Year of Manufacture:	1989
Date & Time (UTC):	23 November 2006 at 0945 hrs
Location:	Near Cambridge Airport, Bedfordshire
Type of Flight:	Public Transport (Training)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Possible cracking of the cockpit floor
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	2,000 hours (of which 300 were on type) Last 90 days - 38 hours Last 28 days - 20 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, information from the maintenance organisation and manufacturer and AAIB examination of the aircraft

Synopsis

Whilst attempting to recover from a spin during an aerobatic training flight, the instructor was initially unable to move the rudder pedals from their fully pro-spin position. He managed to free the pedals by applying a high pedal force and was then able to recover from the spin. The restriction delayed recovery by an estimated two and a half turns. The restriction had probably been caused when one of the pedals contacted a fixed bracket, probably due to a relatively small lateral displacement of the rudder pedal mechanism. The displacement could have been due to wear in the rudder pedal mechanism, deformation of a bracket supporting the mechanism and/or displacement of the bracket because of cracking of the floor structure to which it was mounted. Adequate checks aimed at ensuring sufficient clearance had not been specified, but detailed repetitive inspections mandated following the incident may be effective in detecting progressive deterioration of the mechanism. The inspection programme would not preclude the possibility of damage to the support bracket or its mountings (potentially allowing interference to free movement of the pedals) from remaining undetected until a subsequent inspection. Two Safety Recommendations have been made.

History of the flight

The incident occurred during a dual aerobatic training flight. The student pilot, who held a Private Pilot's

Licence, was undergoing training aimed at obtaining an Aerobatic Certificate from the Aircraft Owners and Pilots Association (AOPA). The purpose of the flight was to teach the student spin recognition and recovery, at both the incipient and fully developed stages. The instructor was seated in the left seat and the student in the right seat, each wearing a full harness. The weather was good, with no cloud.

The instructor reported that he carried out a demonstration spin to the left and recovery and the student repeated this, without incident. The third spin to the left was also an instructor demonstration, initiated and maintained with full left rudder. Following one turn for entry and stabilisation, the spin was allowed to continue for three turns. When the instructor initiated recovery, by first attempting to apply full anti-spin rudder, he found that he was unable to move the right pedal. After two attempts, the rudder remained fully deflected to the left. On his third attempt the instructor applied considerable force to the right pedal and it freed with a loud crack noise. He immediately applied full right rudder and made a normal recovery from the spin, in the usual one and a half turns. The instructor estimated that the control difficulties delayed the recovery by two and a half turns.

The aircraft was flown back to its base at Cambridge Airport, Bedfordshire, and landed without further incident.

Aircraft description

The Slingsby T67 Firefly is a single-engined low-winged monoplane, designed to be fully aerobatic (Figure 1). It is constructed principally of glass reinforced plastic (GRP). Two side-by-side seats are provided. The Firefly was first certificated in 1983, as the T67M, and a number of other versions were subsequently developed, including the 260 shp T67M260. In total, 280 aircraft have been built. Maximum takeoff weight of the T67M260 is 2,550 lb (1,157 kg).

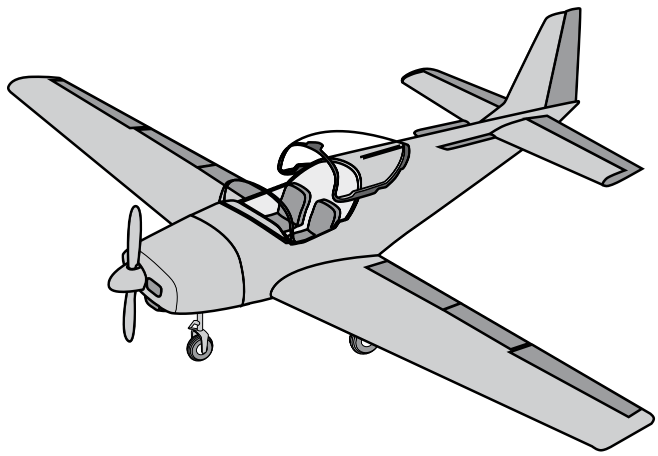

Figure 1

Primary flight controls are conventional, operated by dual cockpit controls. Rudder pedal assemblies are numbered from 1 to 4 across the aircraft from left to right (Figure 2). The pedals are mounted on two rotatable cross-shafts in the cockpit, known as rudder bars, with the left pedal of each pair (Nos 1 and 3) fixed to the left bar and the right pedals (Nos 2 and 4) fixed to the right bar. A crank arm on each bar is connected to rudder operating levers by a cable-fairlead system. Thus, a forward displacement of the No 1 pedal, for example, rotates the left bar and moves the No 3 pedal forward in unison, while the connection through the cable loop causes the right bar to rotate in the opposite direction and displace the Nos 2 and 4 pedals aft.

Each rudder bar is supported on two rotation bearings, each mounted on a bracket bolted to the cockpit floor structure. The support bracket bolts pass through the floor panel into captive nuts fixed to the underside of the GRP structure. Rudder bar end-float can be adjusted by fitting packing washers of varying thickness between the brackets and the ends of the bar.

Rotation of the rudder bars also steers the nosewheel, via

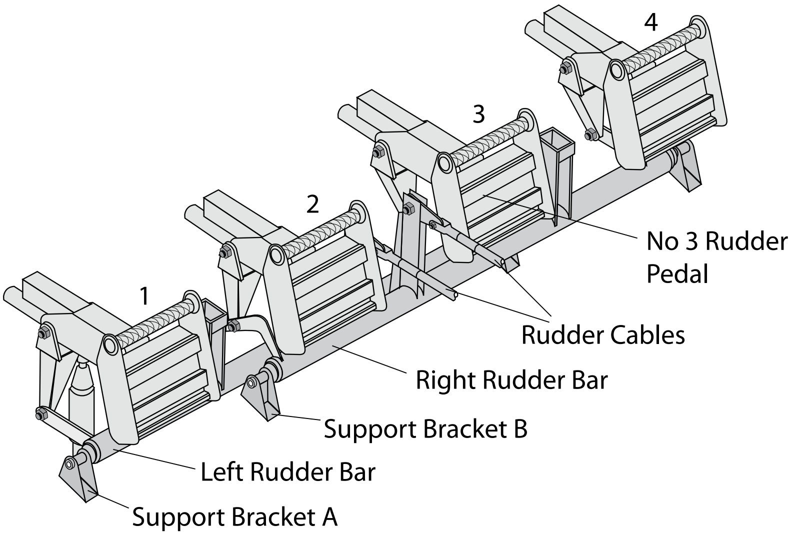

Figure 2

a control rod driven by a crank arm fixed to the right bar. Each pedal can be pivoted, by pushing a brake bar at the top of the pedal, to apply the brake on the respective main wheel. A slider mounting mechanism allows each pedal to be individually adjusted fore and aft to cater for variation in pilot leg length and then locked by a pin that locates in one of four holes in the slider.

Two adjustable stops fixed to the floor structure limit the forward rotation of the two rudder bars (ie the forward travel of the associated pedals). The rearward rotation of each rudder bar is limited by bottoming of the piston in the respective brake cylinder. These limitations constitute the travel stops for both the rudder and nose wheel steering systems.

The Pilot's Notes for the T67M260 provided information about normal spinning which may be summarised as follows: After initiation, the spin progressively stabilizes over about three turns, ending up with about 50º of bank and with the nose about 40º below the horizon. In a normal, developed spin the rate of rotation is about 2 seconds per turn and the height loss about 300 ft per turn, indicating a descent rate of around 7,500 ft min. Following recovery from the spin, the ensuing dive involves a height loss of around 700 ft. The initial flight control input specified for spin recovery is to apply full rudder to oppose the direction of turn.

Aircraft examination

Following the flight, the organisation that normally maintained the aircraft undertook a detailed inspection of the rudder control system, in conjunction with representatives of the aircraft manufacturer. The system was disassembled before the AAIB examination.

The maintenance organisation reported that, after prolonged attempts, it was found possible to produce interference between the No 3 pedal and a fixed bracket supporting engine control cables. With the No 3 pedal adjusted fully forward, pushing the brake bar of this pedal fully forward (thus applying full left rudder and full left wheel brake) positioned the top part of the pedal close to the bracket. If a left side force was simultaneously applied to the No 3 pedal, its edge could contact the bracket (Figure 3). It appeared that the pedal could possibly get caught behind the bracket and that a significant force on the right pedal could be required to clear the foul.

No signs were found that the engine control cable bracket was incorrectly sized or positioned. The aircraft manufacturer reported that, although no witness marks could be found to confirm a positive foul, their inspection showed there was excessive end-float (ie lateral movement) of the left rudder bar, estimated at around 1.5 mm, and that the left support bracket for the left bar (Bracket A in Figure 2) was angled over to the left. After removal of the rudder bars from the aircraft, cracking of the floor beneath Bracket A was found. No

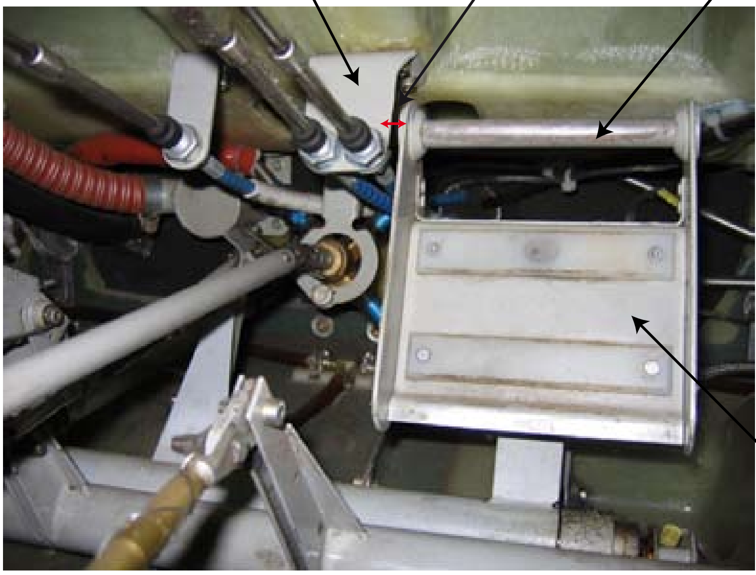

Figure 3
No 3 pedal clearance (similar aircraft)

evidence was available to indicate whether the damage had been present before the incident or had been caused by high forces applied while attempting to free the pedals during the incident. The degree to which the cracking would have allowed lateral movement of the left rudder bar could not be positively determined, but it appeared unlikely that it would have been major.

Background

No evidence was found to indicate that control deficiencies had been a factor in previous T67 accidents. A number of instances of restriction in T67 rudder pedal movement had been experienced. The restrictions reportedly had all been caused by interference between moving parts of the cockpit rudder, wheelbrake and steering mechanism (generally a pedal or brake bar or a pilot's boot) and either other parts of the mechanism or adjacent static parts of the aircraft.

At the time of G-EFSM's incident, procedures aimed at ensuring adequate rudder mechanism clearance were contained in a number of Service Bulletins (SBs) issued by the aircraft manufacturer over the service life of the T67, but were not incorporated in the Aircraft Maintenance Manual.

One of the SBs (SB 88, first issued 30 August 1996) specified an inspection for a potential foul between the No 3 pedal and both the mixture lever and the engine control cable bracket. The SB specified a minimum clearance of 3 mm between the pedal assembly and the bracket when left rudder and left brake were applied together with a left-hand side force sufficient to take up any free play. It was applicable to T67M260 and T67M260-T3A aircraft that did not have Modification M687 incorporated and was classified as Mandatory by the CAA. The inspection was required within 50 flight hours; no repeat inspection was specified.

SB 75 (first issued 8 March 1995) recommended an inspection and set-up procedure aimed at ensuring adequate clearance between the No 2 rudder pedal and a heater distribution box. If the clearance was found to be inadequate, a check of the end-float of both rudder bars was specified. If the clearance was greater than 0.8 mm, packing washers were to be added to achieve this limit. The manufacturer classified the SB as '*Highly Recommended*'. It was applicable to seven T67 aircraft, not including G-EFSM (Works Number 2072). The inspection was recommended to be carried out at the next 50 hour check or within one month of receipt of the SB; repeat inspection was not specified.

Cases of cracking of the GRP structure beneath Bracket A on T67 aircraft had occurred previously, and the manufacturer had issued a Service Bulletin (Slingsby Aviation SB 168, issued 19 September 2000) requiring an inspection of the area. The SB was categorised as '*Recommended*'. It recommended that, if damage were found, the GRP should be repaired and a strengthening doubler fitted. The inspection was recommended to be carried out during the next aircraft Annual Inspection. The aircraft manufacturer noted that a turn outside the permitted limits while towing imposes very high loads on the rudder system which it is not designed to take. Markings are painted on the engine cowl to show the limiting angle for the towbar, which is typically around 2 metres long. An over-travel to the right rotates the right rudder bar, via the nose wheel control rod, until it contacts the forward stop. Simultaneously, the left rudder bar is rotated rearwards, via the rudder cable loop, until the piston in the left brake cylinder bottoms. Over-travel to the left similarly rotates the right rudder bar rearwards, until the piston of the right brake cylinder bottoms. The left pedal is not driven forwards, as the rudder cable loop does not transmit a compression load.

Once the system has reached the stops, any further increase in steering angle is likely to cause overload damage, probably to the rudder bar support brackets or the floor to which they are bolted. The manufacturer noted that it would be impractical to design the system to withstand the high loads that can be generated in this situation.

Post-incident measures

Following the incident to G-EFSM, the manufacturer issued two additional SBs (Slingsby SB 187, for the T67M260 and two T67M200 aircraft, and SB 188, for the T67B, T67C, T67M-Mkll and the other T67M200 aircraft, both issued on 9 March 2007). The manufacturer stated that these SBs aimed to bring together the various check and adjustment procedures for rudder mechanism clearance provided in the previously published SBs. The intention was:

> *'to reinforce the importance of ensuring correct clearances and maintenance of the rudder operating mechanism, mountings and stops to ensure the required clearance for safe operation.'*

EASA Airworthiness Directive (AD) 2007-0132 was issued on 11 May 2007 mandating incorporation of the two SBs. The AD required some of the SB measures to be carried out before further flight and some within the next 50 flight hours and for checks to be repeated at intervals of 300 flight hours or 12 months, whichever occurred first.

Minimum rudder mechanism clearances specified in the SBs were generally in the range 10-20 mm (0.39-0.79 inch) but were considerably less in two areas, including that between the No 2 pedal and the steering arm bolt, specified as 1 mm (0.04 inch). The SBs stated:

> *'It must be noted that during the clearance checks that the pedals do not necessarily have a direct fore and aft load applied, there will be side loads on the pedal pads deflecting the pedal pad laterally or pivoting the pedal about its slider.'*

The magnitude of the lateral load to be applied during the checks was not specified but was intended to take up any free play in the mechanism.

SB 187 and SB 188 also specified a check of the rudder bar end-float and adjustment to a maximum of 0.8 mm for all aircraft, irrespective of pedal clearances. They also required a check that Bracket A was square to the floor, not 'lozenged' (Figure 4) and without deformation to its base. The SBs noted that:

> *'An identifiable cause for the distortion of the rudder support brackets is ground handling the aircraft with a vehicle, whereby the towing arm has been outside of the limitation markings on the cowling when the aircraft is turned.'*

The manufacturer considered that cockpit rudder mechanism clearances, while small in some areas, were adequate, provided the SB measures had been incorporated and the system was correctly adjusted and maintained.

The manufacturer also intended to issue an Advanced Information Leaflet (AIL No 01/2007), intended to clarify the rudder system set-up procedure. It was intended that the AIL would also include a warning against exceeding the towing angle limits and that consideration would be given to revising the Aircraft Maintenance Manual to emphasise the consequences of such an exceedence. The manufacturer also stated the intention of considering the possibility of introducing a towbar weak link or load-limiter device.

Discussion

The available evidence indicated that G-EFSM's rudder restriction had resulted from interference of the engine control cable bracket with the No 3 pedal. This would have required the pedal to have been adjusted fully forward and pushed and rotated fully forward. It appeared that it would be relatively easy to apply wheel brake inadvertently in this way when applying full rudder; this would not normally be of any relevance while airborne. While it appeared that a sufficiently high force applied to the No 2 pedal would be expected to free the mechanism, this could not be positively confirmed and involved the risk of damaging the rudder pedal mechanism or its mountings. The restriction was clearly a highly undesirable occurrence and in this case caused a significant delay in recovery from the spin.

The control restriction apparently resulted from excessive lateral displacement of the No 3 pedal. Such

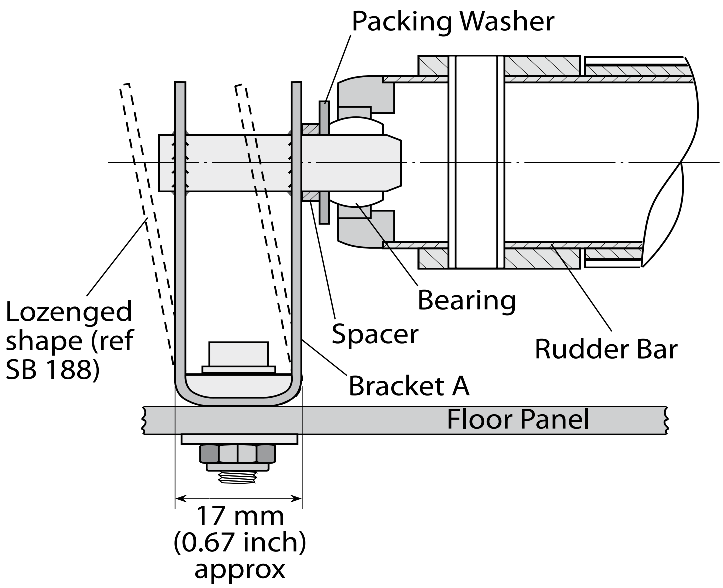

Figure 4

Rudder bar support bracket

displacement could result from wear in the No 3 pedal slider and/or excessive end-float of the left rudder bar. An increase in end-float could be caused by wear, by lozenging distortion of Bracket A and/or by tilting of Bracket A on its mountings.

The reported unloaded end-float in the left rudder bar, which was an estimated 0.7 mm (0.028 inch) outside the manufacturer's limits, should not have been sufficient on its own to result in a foul. However, only a small amount of additional lateral displacement of the No 3 pedal would be needed for interference to occur, given the minimal allowable clearance (3 mm (0.12 inch)) between the pedal and the cable bracket.

Cases of distortion of Bracket A had occurred previously, attributed by the manufacturer to an excessive steering angle during towing. It was noted that, whereas the left mounting bracket for the right rudder bar (Bracket B, Figure 2) had a lateral web member that would increase its resistance to either elastic or permanent lozenging under lateral loads, this feature was not present on Bracket A.

It was also apparent that the base of Bracket A was relatively narrow (Figure 4), and that side loads applied to the bracket would therefore be expected to generate higher loads in the bracket attachments and thus in the local floor structure than if the base were wider. In G-EFSM's case, weakening of the bracket attachment because of floor cracking could possibly have allowed the bracket to tilt and could therefore have contributed to displacement of the No 3 pedal. However, this could not be confirmed as it was unknown whether the floor cracking found had occurred before or as a consequence of the incident.

It was unclear whether loads applied by the pilot could deform the bracket. It was apparent that distortion could be the consequence of an excessive steering angle during towing, which would generate high forces in the rudder system as its travel was limited by stops within the rudder pedal mechanism. Primary stops on the nosewheel oleo would be required to prevent such excessive loads. However, the possibility of finding specific evidence that an excessive steering angle had caused any such distortion would be small. Thus the cause of the distortion found with G-EFSM and in the other cases could not be conclusively determined.

SBs issued some time before the incident had recommended inspection for cracking of the GRP structure beneath Bracket A and required inspection for adequate pedal clearance from the control cable bracket. However, no repeat inspections of these aspects had been specified. A further SB had recommended a one-off inspection and rectification of excessive rudder bar end-float in relation to a different rudder mechanism clearance problem, but had not been applicable to G-EFSM. There appeared to have been an expectation that normal engineering practice would ensure correct rudder bar end-float. Thus the detailed, repeated checks specified in the SBs issued after G-EFSM's incident represented a considerable improvement.

However, the checks, while likely to ensure the detection of wear before it became excessive, could not be expected to detect damage immediately to Bracket A or its attachment. Any deformation of the bracket or weakening of its attachment as the result of floor cracking could well occur suddenly and not necessarily be found until the subsequent scheduled check on the pedal mechanism. This could be up to 300 flights or 12 months later. In view of the small rudder mechanism clearances in a number of areas and the potential hazard of a rudder restriction, the following Safety Recommendations are made:

Safety Recommendation 2007-077

The European Aviation Safety Authority should review the rudder pedal system of the Slingsby T67 aircraft. Consideration should be given to improving both the lateral stiffness and strength of the rudder bar support brackets and the integrity of the attachments for the brackets, in order to prevent possible interference with the free movement of the rudder pedals. Consideration should also be given to requiring means to limit the loads applied to the rudder system during towing.

Safety Recommendation 2007-078

The European Aviation Safety Authority should require changes to the engine control cable bracket on relevant Slingsby T67 aircraft to increase its clearance from the No 3 rudder pedal, in order to prevent possible interference with the free movement of the rudder pedals.

ACCIDENT

Aircraft Type and Registration:	Zenair CH 601HD Zodiac, G-CBDT
No & Type of Engines:	1 Rotax 912-S piston engine
Year of Manufacture:	2002
Date & Time (UTC):	19 August 2007 at 0942 hrs
Location:	Oban Airport, Scotland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	The right main gear and nose gear collapsed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	420 hours (of which 95 were on type) Last 90 days - 24 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was taxiing along the runway at a higher than normal speed. When it turned to line up the right main gear and the nose gear collapsed.

History of the flight

The aircraft was taxiing at a higher than normal speed along Runway 19. The pilot planned to turn around at the end of the runway and depart from Runway 01, utilising its full length. The surface wind was northerly at 15 kt. With two occupants, fuel and a small amount of freight the weight of the aircraft was 1,100 lbs; its MTWA was 1,200 lbs. When the pilot applied the brakes, to slow the aircraft down and turn to line up on Runway 01, it skidded and then turned rapidly to the left. The right main gear and nose gear collapsed during the turn. The pilot and his passenger were uninjured and vacated the aircraft normally.

The pilot considers that the accident was caused by taxiing too fast. Skid marks on the runway confirm that this was likely to have been a significant factor.

The Zenair CH 601HD Zodiac is a home build aircraft that is normally assembled from a kit. This is the third undercarraige collapse reported to the AAIB in the past three years.

ACCIDENT

Aircraft Type and Registration:	Robinson R22 Beta, G-ODJB
No & Type of Engines:	1 Lycoming O-360-J2A piston engine
Year of Manufacture:	2003
Date & Time (UTC):	11 April 2007 at 1500 hrs
Location:	Leicester Airport
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Slight damage to skid gear and tailcone
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	1,440 hours (of which 1,200 were on type) Last 90 days - 140 hours Last 28 days - 40 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

On approach to land with the aircraft at just below maximum all-up weight, the pilot was unable to arrest the rate of descent and the aircraft landed heavily.

History of the flight

The aircraft had flown from its base near Loughborough to conduct training at Leicester Airport. The pilot reported that on approach to land he was unable to arrest the rate of descent and the aircraft landed heavily. He did not notice any damage to the aircraft and continued the flight. After returning to base the aircraft was examined more closely and found to have sustained damage to the skid landing gear cross tubes and tail cone. The pilot reported that the aircraft had behaved normally throughout the return flight and the chief engineer of the maintenance organisation responsible for its repair commented that the damage was such that the aircraft "would have flown quite happily".

The pilot stated that at the time of the occurrence, the aircraft was operating close to its maximum all-up weight, the outside air temperature was 20ºC and the wind was calm.

ACCIDENT

Aircraft Type and Registration:	Airwave Sport 3-L paraglider, no registration required
No & Type of Engines:	None
Year of Manufacture:	2006
Date & Time (UTC):	7 September 2006 at about 1830 hrs
Location:	White Rocks, near Portrush, County Antrim
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - None
Nature of Damage:	Minor damage to paraglider canopy
Commander's Licence:	'Club Pilot (Novice)' - no CAA licence required
Commander's Age:	53 years
Commander's Flying Experience:	Approximately 100 hrs
Information Source:	AAIB Field Investigation

Synopsis

After takeoff from a cliff-top soaring site the pilot did not find adequate lift either to remain level or to climb. He turned towards a nearby beach to land but, due to his rate of descent, he was unable to reach the beach and landed in the sea. He appeared uninjured from the landing and, remaining in his harness, attempted to gather his canopy and climb onto submerged rocks. Owing to the high tide and strength of the swell, his efforts to gather the canopy were unsuccessful and, despite attempts by others to rescue him, he drowned before being reached by the local inshore lifeboat. The pilot was not wearing a lifejacket.

The investigation found the pilot had been properly trained, including training in emergency water landing procedures. His equipment was fully serviceable. It is believed he was not able to soar due to his chosen flight path after takeoff which took him too far from the edge of the cliff and its associated band of lift.

Two safety recommendations are made.

History of the flight

The pilot had arrived at East Strand Beach at about 1700 hrs and had completed a short flight from a large sand dune situated on the beach. He then drove the short distance to White Rocks, a line of cliffs adjacent to the beach, where a colleague was already soaring. Whilst the pilot was preparing his equipment for a takeoff from the cliffs, another colleague arrived to do some flying. The two men had a short conversation before the second to arrive took off, flying along the top of the cliff edge towards the east. He successfully found lift and gained height, joining the other airborne paraglider, soaring up and down the length of the cliffs.

About ten minutes later, at approximately 1825 hrs, the two airborne pilots observed their colleague take off from the western end of the cliffs, flying towards the east. The takeoff appeared normal and, once airborne, the pilot flew parallel to the edge of the cliffs, but about 20 m from the cliff face, over the sea. The paraglider could be seen to descend as it progressed to the east and the pilot continued in this direction for approximately 650 m before starting a wide turn to the left, away from the cliff face. The paraglider canopy was by this time below the level of the cliff tops and continuing to descend. The pilot continued the turn so that he was heading back towards the cliffs in a westerly direction, by which time he was descending even more rapidly. A few seconds later the pilot landed in the sea, about 20 m out from the cliffs. The landing appeared controlled and the canopy continued to fly over the top of the pilot, landing in the water above some submerged rocks near the base of the cliffs. The pilot remained in his harness and no attempt to release himself was evident, either before or after his landing. The pilot appeared uninjured and could be seen trying to collect the canopy together and climb onto the submerged rocks. These attempts were hampered by the depth of the water and the large swell.

The two airborne pilots had witnessed the whole event and continued to fly above the scene, talking to each other over the VHF radios they carried. The pilot in the water was not carrying a radio and they were not able to communicate with him. They believed, however, that from his actions, he was not, at that point, in difficulty. After about two minutes, when the pilot could still be seen attempting to recover his canopy, one of the airborne pilots decided to land at East Strand Beach to try to make his way round the base of the cliffs to assist him. After landing, he found he was unable to get round the cliffs due to the depth of the water and the size of the swell and, concerned that his colleague was now getting into trouble, made his way to a lifeguard station on the beach to raise the alarm. Two canoeists in the sea off the beach also attempted to get to the pilot but, again, were prevented from doing so by the size of the swell.

The airborne pilot was getting increasingly concerned about the pilot in the sea, who had remained in his harness and was repeatedly being tipped head down in the rough water, his harness floating each time to the surface. Realising the other pilot was unable to get round the base of the cliffs, the airborne pilot landed on East Sand Beach and got a lift from one of the life guards back to the top of the cliffs. He intended to find a way down the cliffs to the sea but, on getting back to the top, he could see the pilot in the sea floating face down in the water.

The Coastguard received an initial call about the accident at 1835 hrs. Both the all-weather and inshore lifeboats were launched from Portrush and were quickly at the scene, although they too were hampered by the sea swell in trying to reach the pilot. A team from the Coastguard attended, to prepare an attempt at a rescue from the cliff tops and a search and rescue helicopter was scrambled. The inshore lifeboat was finally able to reach the pilot and he was taken on board the main lifeboat at about 1920 hrs UTC to be taken to a waiting ambulance in Portrush Harbour. Attempts to resuscitate the pilot were unsuccessful.

Equipment

The pilot was using a Sup Air Profeel XC2 harness, which he had purchased new in May 2006, and an Airwave Sport 3-L paraglider, which he had also purchased new a few months before the accident.

The Profeel XC2 harness, (Figure 1), was fitted with shoulder, lap and leg straps to secure the pilot. The shoulder straps were attached to the lap straps and both the lap and leg straps were fastened using quick release latches, which could be released by simultaneously pressing two tabs on the latch. A reserve parachute was carried in a pocket on the lower right side of the harness and an additional pocket was provided on the rear of the harness to allow stowage of personal items. The harness incorporated a 'Bumpair 17' back protection system, which was designed to provide cushioning in the event of a hard landing. The 'Bumpair 17' consists of a 40-litre multi-cell shaped foam 'cushion' extending from the pilots shoulders around the base of the harness and under the pilot's thighs, reaching its maximum thickness at the base of the spine and under the pilot's thighs. The foam is designed to release air and compress at a controlled rate, to minimise shock loading of the spine and legs.

The manufacturer's handbook provided the following advice regarding flying over water:

> *'Do not under any circumstances use any air-based protection (Bumpair, Cygnus-type Airbag, or Airtec) if there is any risk that you will land in water. If you land in water using a BUMPAIR, there is a real danger that its buoyancy under the base plate and behind the pilot's back will lead to the pilot's head being held under water.*
>
> *.... ……… flying over water, we recommend the use of a life jacket equipped with a collar which will keep the pilot's head above water in the case of a loss of consciousness'*

The Airwave Sport 3-L is certified as an intermediate level canopy with a minimum total flying weight of 95 kg and a maximum of 120 kg.

Figure 1

Profeel XC2 harness

In addition, the pilot was also carrying a 'flight deck', a detachable pouch attached to the paraglider harness containing a Garmin GPS, a digital anemometer and a Digifly portable variometer and flight computer.

The pilot was wearing a helmet but was not wearing a life jacket.

Technical investigation

During the rescue attempt the life boat crew were forced to cut the paraglider lines and harness straps to lift the pilot from the water, and to clear lines fouling the boat's propeller.

Examination of a video clip taken by one of the pilot's colleagues confirmed that the canopy was fully inflated and free from any tears or rips prior to the water landing. On examination, the canopy was found to have several large gashes in the material which were believed to have been caused by snagging on rocks whilst the paraglider was in the sea. The paraglider lines showed no evidence of pre-accident failure or unusual wear.

The harness showed no defects which would have contributed to the accident, or which would have prevented the pilot releasing himself from the harness whilst in the water.

Nether the pilot's GPS nor his flight computer had recorded any information relating to the accident flight.

Weather

Weather information was provided by witnesses, the Coastguard and the Met Office. From these sources it was determined that at the time of the accident there was a northerly wind of about 5 to 10 kt blowing onto the cliffs. Visibility was good and there was no cloud below about 2,000 feet amsl. The sea was subject to a spring tide, giving higher than normal sea levels, and the sea state was estimated to give rise to 1 metre waves every 5 seconds. The air temperature was about 14ºC.

Pilot's background

The pilot purchased a paraglider in 2001 and began flying, but without undertaking any formal training. In April 2002 he started training with a British Hang-gliding and Paragliding Association (BHPA) registered paragliding school and on 26 July 2003 qualified as a Club Pilot (Novice). This training included instruction in emergency techniques should a pilot land in water.

The pilot then continued to fly regularly from various sites around Northern Ireland and, occasionally, abroad. No log book has been found but it is thought he had flown about 100 hours by the time of the accident. He was considered to be a cautious pilot and colleagues commented that he would often position himself laterally too far from the terrain to achieve the best lift. He undertook no other formal training since qualifying as a Club Pilot although he had received coaching on occasion from approved BHPA qualified club coaches.

Medical

The post-mortem examination found no indications that the pilot was incapacitated prior to entering the water and determined that he had died due to drowning. There were no medical indications that he would have been unable to operate the release mechanism on his harness.

The pilot had complained to the other pilots that day that he was feeling tired. He worked as a plant operator at a local sports complex where, for a number of weeks due to staffing problems, he had been working additional hours. During the last two weeks before the accident he had worked in excess of 80 hours per week.

East Strand Beach and White Rocks ridge soaring sites

The East Strand Beach soaring site consists of a large sand dune approximately 100 feet high. This would normally be used when the wind was above about 12 mph and would give pilots the opportunity to soar up and down the length of the dune and, if the conditions were correct, to soar up to a nearby line of cliffs known as White Rocks.

White Rocks provided the second site and would normally be used in lighter wind conditions, typically below 10 mph. The cliffs rise almost vertically from the beach below to a gently sloping area about 140 feet above, on which there is a main road. Pilots used two sites to launch their paragliders from this sloping area, situated between the cliff edge and the road. If the wind was north-westerly the preferred launch site was about 240 m from the western end of the cliffs. If the wind was from the north or north-east the preferred launch site was at the western end of the cliffs.

Further inland, to the south of the road, the cliffs continued to rise again vertically for about a further 80 feet. At the base of the cliffs low tide exposes a gently sloping beach and some rocky outcrops. At high tide the sea comes up to the base of the cliffs but, depending on the height of the tide, is generally low enough to allow an adult to stand chest deep within about 20 m of the cliffs.

The three pilots were the only pilots known to have used the site on White Rocks and had begun using it about two months prior to the accident.

Soaring technique for White Rocks

Owing to the restricted area available and wind limitations, pilots would need to launch the canopy by the 'reverse launch' technique. This involved turning to face the canopy, pulling on the risers to inflate the canopy and bringing it into the air above the pilot's head. The pilot then checked the canopy was inflated properly and the lines were not tangled before turning himself into wind and running until he became airborne.

Once airborne at this site, the pilot needed to position the paraglider so that it was able to fly in the rising air above the cliff line. This required the paraglider to be flown above the edge of the cliff, and where there was sufficient lift generated, the pilot would be able to climb and soar along the cliff line. If the conditions allowed, pilots would be able to climb high enough to soar above the higher cliffs on the southern side of the road as well. Where there was insufficient lift generated, the pilot would have to descend away from the cliffs to make a landing on the beach below. When the tide was in, this limited the available beach area exposed for landing to that at East Strand Beach, about 200 m to the west of the cliffs.

When using the westerly launch site, pilots needed to turn immediately east in order to gain lift along the cliff line. However, should they gain insufficient lift to soar above the cliffs, in order to ensure they could reach East Strand Beach they were required to make a 180 degree turn by a pre-determined point. This point was recognisable as it was coincident with the eastern takeoff point, an obvious rise in the ground about 240 m from their westerly takeoff point.

BHPA publications

The BHPA Pilot Handbook is summarised on its front cover as '*The complete guide to paraglider and hang glider training and advancement*' and is the standard reference book recommended to BHPA members. Although it is not provided as part of the membership of the association, it can be purchased from the BHPA head office.

Chapter 18 deals with emergencies in flight and states the following about landing in water:

'The sad reality is that landing a hang glider or paraglider in water will almost always result in the pilot drowning……… An unplanned arrival in winter in a heavy swell off the British coast, dressed in full flying gear and with nobody on hand to effect an immediate rescue is going to be fatal. How good a swimmer you are is of absolutely no importance, as nobody can swim in a hang-gliding harness or wrapped in paraglider lines.

The main reason that paraglider pilots rarely survive a water landing is that they become entangled with the canopy and its lines. So the priority is to get clear of the equipment. Do not be tempted to hang onto it, especially if you have come down in the sea, where there may be waves.

To prepare for the landing, remove your gloves, sit back in the harness and loosen your leg and chest straps. If you are using quick-release buckles, these can be fully released just before splash down.

Try to land downwind, allowing the canopy to over-fly away from you. Do not flare, as this may cause the canopy to land on you. …. Having landed, release yourself from your harness if necessary and swim away'

The BHPA Technical Manual provides guidance to instructors. Section 2, Chapter 1, Page 9 deals with landing emergencies and states:

'Water landings – paragliders

Instructors must stress the probability, except within the most strictly controlled environment, that a water landing is not survivable and must be avoided at all costs. Pilots should, if flying near water, make sure that a safe dry landing is within easy reach at all times.

If, however, it is impossible to make a dry landing (even with the risk of injury) then, the real danger lies in the potential for entanglement with the paraglider suspension lines. It is therefore imperative to get clear of the paraglider as quickly as possible. On approach sit well back and unclip the chest strap and loosen the leg straps. On entering the water release the leg straps (or riser-to-harness connectors) and FLOAT clear with the minimum of movement. If an inflatable life jacket is worn it should be inflated.'

It is not known how much study the pilot had made of the BHPA publications.

Previous events

The last recorded fatal accident of this nature recorded by either the BHPA or the AAIB occurred in February 2002 at Calpe, Spain. The pilot landed in the water between 5 and 10 m from the shore line but was unable to release himself from his equipment and drowned. The harness was fitted with foam protection for the lower back but it was an older design based on a mountaineering harness and did not make use of quick release buckles. This made it difficult for the pilot to release himself from the harness whilst in the water.

Analysis

It is evident that after getting airborne the pilot flew too far from the cliff face to benefit fully from the band of lift. This was consistent with his cautious approach to flying, commented on by his colleagues. His likely desire to position himself away from the cliff face on this occasion denied him the necessary lift required to either maintain, or gain, height.

The situation was compounded by the wide turn made by the pilot to head back to East Strand Beach, which took him further away from the lift band and so increased his rate of descent. This, combined with the fact he had gone some 400 m beyond the normal turnback point, left him with no realistic chance of reaching the beach.

The weather and the canopy were both suitable for the pilot's level of experience and, in the absence of any identifiable technical or medical factors, it is unlikely that there were any problems encountered by the pilot that might have affected his ability to control the paraglider. It is, however, possible that the pilot's decisions were adversely affected by the level of fatigue he was reportedly suffering due to his long working hours.

The pilot's training, as part of the BHPA, would have included specific details on the hazards of water landings and the techniques to adopt in order to improve the chance of survival. This information was also available in various books which the pilot would have been able to obtain, although it is not known if he had done so.

Once the pilot had entered the water, the witnesses did not see him attempt to release his harness. His observed attempts to gather the paraglider, suggest that the pilot was concerned about losing this valuable equipment had he done so.

The harness lap and leg straps would have made swimming difficult and would have hampered the pilot's attempts to climb onto the submerged rocks. The buoyancy from the Bumpair air bag in the harness would also have tended to push the pilot's head underwater, this being compounded by the pilot's lack of a life jacket. These facts, together with the sea state presented by the spring tide and prevailing weather, resulted in a set of circumstances that significantly increased the likelihood of drowning.

Comment

None of the pilots flying at White Rocks at the time of the accident was wearing a life jacket. The pilots interviewed stated that they found them uncomfortable and believed that they would always be able to land either on the cliffs or East Strand Beach and therefore chose not to wear them.

Safety Recommendation 2007-075

It is recommended that the British Hang Gliding and Paragliding Association (BHPA) highlights this accident to its members and reinforces the importance of using the appropriate safety equipment.

During the course of the investigation AAIB Inspectors were concerned about the proximity of the White Rocks paragliding site to the road. The layout of the road means that drivers might easily be distracted by the sudden appearance of a paraglider in close proximity to their vehicle.

Safety Recommendation 2007-076

It is recommended that the Ulster Hang Gliding and Paragliding Club, in co-operation with the Police Service of Northern Ireland, reviews the suitability of White Rocks as a paragliding site and advises its members accordingly.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2005

2/2005 Pegasus Quik, G-STYX
at Eastchurch, Isle of Sheppey, Kent
on 21 August 2004.

Published November 2005.

3/2005 Boeing 757-236, G-CPER
on 7 September 2003.

Published December 2005.

2006

1/2006 Fairey Britten Norman BN2A Mk III-2 Trislander, G-BEVT
at Guernsey Airport, Channel Islands
on 23 July 2004.

Published January 2006.

2/2006 Pilatus Britten-Norman BN2B-26 Islander, G-BOMG, West-north-west of Campbeltown Airport, Scotland
on 15 March 2005.

Published November 2006.

3/2006 Boeing 737-86N, G-XLAG
at Manchester Airport
on 16 July 2003.

Published December 2006.

2007

1/2007 British Aerospace ATP, G-JEMC
10 nm southeast of Isle of Man (Ronaldsway) Airport
on 23 May 2005.

Published January 2007.

2/2007 Boeing 777-236, G-YMME
on departure from London Heathrow Airport
on 10 June 2004.

Published March 2007.

3/2007 Piper PA-23-250 Aztec, N444DA
1 nm north of South Caicos Airport, Turks and Caicos Islands, Caribbean
26 December 2005.

Published May 2007.

4/2007 Airbus A340-642, G-VATL
en-route from Hong Kong to London Heathrow
8 February 2005

Published September 2007.

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