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SPECIAL BULLETINS

None

COMMERCIAL AIR TRANSPORT

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ADDENDA and CORRECTIONS

None

(ALL TIMES IN THIS BULLETIN ARE UTC)

SERIOUS INCIDENT

Aircraft Type and Registration:	Airbus A340-642, G-VYOU
No & Type of Engines:	4 Rolls-Royce RB211 Trent 556A2-61 turbofan engines
Year of Manufacture:	2006
Date & Time (UTC):	12 December 2009 at 1657 hrs
Location:	London Heathrow Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 16 Passengers - 282
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	16,432 hours (of which 10,833 hours were on type) Last 90 days - 164 hours Last 28 days - 38 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

During pre-flight preparations, the estimated landing weight was used to calculate takeoff performance rather than the takeoff weight. The error was not detected and the aircraft took off using values for V_R and V_2 that were significantly lower than those required for the actual takeoff weight. The aircraft was slow to rotate and initial climb performance was degraded but the aircraft continued to destination without further incident.

Background information

The operator used a system whereby the aircraft's takeoff performance would be calculated off-aircraft. The relevant data would be entered into the Multi-function Control and Display Unit (MCDU) on board and a Takeoff Data Calculation (TODC) request would be sent via the Aircraft Communications Addressing and Reporting System (ACARS) to a central computer. The TODC receipt provided performance data that would be entered into the MCDU as part of the pre-flight initialisation of the Flight Management and Guidance System (FMGS).

History of the flight

During pre-flight preparations, there was a late change to the zero fuel weight (ZFW) and the crew requested a new flight plan. Subsequently, the loadsheet and performance procedures were conducted out of the normal sequence. On receipt of the loadsheet, the crew used the expected landing weight of 236.0 tonnes in the TODC request instead of the actual takeoff weight of 322.5 tonnes. The error was not detected and the aircraft took off using a V_R of 143 kt and a V_2 of 151 kt instead of the correct values of 157 kt and 167 kt respectively. In addition, the thrust used during takeoff was reduced too much from full thrust and a '*FLEX*'[1] temperature of 74° was used instead of the correct value of 63°. Although the crew discussed the unusually high *FLEX* temperature, it did not prompt the pilots to check the TODC. Correct figures for ZFW and fuel on board were entered into the FMGS and so the aircraft-calculated gross weight was correct.

During the takeoff roll, the PF noticed that the acceleration was slightly lower than it should have been but did not consider it particularly abnormal. He described the rotation as "slightly sluggish and nose heavy" and noticed that after rotation the aircraft settled at a speed below V_{LS}[2], which prompted him to reduce the aircraft pitch attitude in order to accelerate. He also noted that the rate of climb was low at between 500 and 600 fpm. The flaps were retracted on schedule and the aircraft continued its climb. At no time was full takeoff thrust selected. Later in the climb, the crew looked again at the TODC and realised their error.

Standard Operating Procedures (SOPs)

The operator's SOPs required crews to calculate an estimated takeoff weight based on the final ZFW. The estimated takeoff weight would be used to make an initial TODC request but no data from this TODC would be entered into the FMGS. When the final loadsheet was received, the actual takeoff weight would be verified against the estimated value used for the TODC and, if the difference between the two takeoff weights was within prescribed limits, the TODC data would be deemed to be valid and would be entered into the FMGS.

The SOPs required the loadsheet procedures to be led by the commander and checked by the co-pilot, and the TODC procedures to be led by the co-pilot and checked by the commander. Nine independent crosschecks were built in to the procedures including a requirement for the actual takeoff weight to be written on the TODC printout alongside the takeoff weight used for the calculation to provide a gross error check.

The operator's assessment of the cause

The operator believed that time pressure on the crew was likely to have contributed to the events in this incident. The late change of ZFW disrupted the usual loadsheet and performance procedures, which were conducted out of sequence. Because of the late change, the crew decided not to calculate an estimated takeoff weight for an initial TODC request, preferring to wait for the loadsheet to use the actual value. The landing weight entered in the takeoff weight field of the TODC request would have been acceptable as a takeoff weight on the Airbus A340-300, which the crew also flew. The operator considered that this might have been why the crew was not alerted to the error. Because no TODC was requested using an estimated takeoff weight, no gross error check could be made against the loadsheet takeoff weight. Finally, the crosschecks that were conducted by the crew were ineffective.

Footnote

1 '*FLEX*' (flexible thrust) is a term that refers to the reduced thrust that can be used during takeoff which still allows the aircraft to meet its takeoff performance requirements. A higher *FLEX* temperature corresponds to a greater reduction from full thrust.

2 V_{LS} represents the lowest selectable speed providing an appropriate margin above the stall speed.

Airbus Green Dot crosscheck

Some operators, although not the operator in this report, use Airbus' '*Less Paper Cockpit (LPC)'* concept, which uses an Electronic Flight Bag (EFB) to compute takeoff performance. The EFB output includes a value for Green Dot speed, which is the speed giving the best lift-to-drag ratio in the clean configuration. Amongst other uses, Green Dot speed is used as the engine-out operating speed in the clean configuration. The FMGS also calculates Green Dot speed from the ZFW, the position of the centre of gravity at the ZFW, and the sector block fuel, which are entered separately into the FMGS by the crew.

One calculation is based on the takeoff weight entered into the EFB and the other is based on the ZFW entered separately into the FMGS. A discrepancy between the two values for Green Dot speed would indicate a data entry error and would provide a trigger for the crew to check all the data.

Action taken subsequently by the airline

As a result of this incident, the airline reiterated to its crews the correct procedure for entering data into the TODC page on the MCDU and the importance of the independent crosscheck. A review was initiated to consider the adequacy of current TODC and loadsheet procedures.

The TODC format was altered to print a warning should a weight less than the maximum landing weight be entered in the takeoff weight field of the TODC request. It was recognised that this would not capture an error where a takeoff weight was entered that was lower than the actual takeoff weight but above the maximum landing weight. Consequently, the effectiveness of this change was to be monitored and the trigger level increased above maximum landing weight if possible to reduce the magnitude of error that would pass this check. The operator considered that incorporating a Green Dot gross error check into their SOPs would provide a significant enhancement to their procedures. At the time of writing, the operator was awaiting a response from Airbus as to how this could be accomplished.

Previous incidents of a similar nature

The AAIB investigated an incident to Boeing 767, G-OOAN, where the ZFW was inadvertently used instead of the takeoff weight in a computer-based takeoff performance calculation. In 2008, the BEA[3] issued a report, '*Use of Erroneous Parameters at Takeoff'*, which concluded that errors relating to takeoff data are frequent, and time pressure and interruptions contribute to the errors. The AAIB also investigated a serious incident to Airbus A330, G-OJMC, which took off with incorrect takeoff speeds programmed into the FMGS. The report referred to a number of other performance-related incidents and noted that in many of them the crew perceived the abnormal acceleration and took action. However, it also noted that there was no independent check of the performance data once it had been entered into the aircraft's flight management system. The report made two recommendations, which are reproduced below.

Safety Recommendation 2009-080.

It is recommended that the European Aviation Safety Agency develop a specification for an aircraft takeoff monitoring system which provides a timely alert to flight crews when achieved takeoff performance is inadequate for given aircraft configurations and airfield conditions.

Foonote

[3] Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile, the French equivalent of the AAIB.

Safety Recommendation 2009-081.

It is recommended that the European Aviation Safety Agency establish a requirement for transport category aircraft to be equipped with a takeoff performance monitoring system which provides a timely alert to flight crews when achieved takeoff performance is inadequate for given aircraft configurations and airfield conditions.

Analysis

The loadsheet and TODC SOPs developed by the airline were robust and contained numerous crosschecks to ensure takeoff performance data was calculated correctly. Despite this, the crew used incorrect information to calculate takeoff performance and, even though the pilots noticed the high *FLEX* temperature, it did not prompt them to investigate whether they had made an error.

Adding more crosschecks to the SOPs would probably complicate the procedures with no guarantee that a recurrence of a similar event would be prevented. The pre-departure phase of a flight is a dynamic environment where time pressure and interruptions can create conditions where diligent crews can perform robust procedures incorrectly. This highlights the need for an independent check of takeoff performance and this report endorses the recommendations made in the report into the serious incident to G-OJMC.

At the time of writing, the AAIB had not received a detailed response from the EASA regarding the recommendations but their nature is such that it will probably be a considerable time before a solution is operational. In the meantime, the Green Dot gross error check should provide a way to highlight that an error has been made in time for it to be investigated before departure.

ACCIDENT

Aircraft Type and Registration:	DHC-8-402 Dash 8, G-ECOZ
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2001
Date & Time (UTC):	1 November 2009 at 0949 hrs
Location:	London Gatwick Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 42
Injuries:	Crew - None Passengers - None
Nature of Damage:	Tailstrike, aircraft skin abraded and fuselage frames deformed. Runway surface damaged
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	10,260 hours (of which 902 were on type) Last 90 days - 180 hours Last 28 days - 50 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft's tail struck the runway after an ILS approach to Runway 08R at London Gatwick. The tailstrike was caused by the aircraft's rate of descent not being arrested during the landing flare. The commander retarded the power levers to flight idle shortly before the flare due to an increase in airspeed, probably caused by windshear. One Safety Recommendation was made.

History of the flight

The crew and aircraft were operating the first sector of a return flight from Newcastle to London Gatwick. They were aware of forecast strong and gusty wind conditions throughout the south of England. The commander was the PF and, once the PNF received the weather, he briefed for an ILS approach to Gatwick Runway 08R using Flap 15 in accordance with the company standard operating procedures. The ATIS for Gatwick reported the wind as 170°/17 kt with the direction varying between 140° and 210°. This was less windy than the crew were expecting and there were no reports of gusts. The First Officer (F/O) also received the VOLMET for the en-route and alternate airfields, almost all of which were reporting significant gusts of 25 kt or greater.

The aircraft, which was being flown with the autopilot engaged, captured the localiser and glidepath having been radar vectored onto the ILS centreline. The crew noted at this stage on the approach that they had about a 40 kt tailwind. There were significant variations in airspeed throughout the approach as the conditions became increasingly turbulent. The commander elected not to utilise reduced propeller RPM (N_P) for landing and selected max governing RPM (fine pitch) to allow a more rapid speed response to power lever movement. At about 700 ft agl the autopilot disconnected due to the turbulence. The commander immediately stabilised the aircraft and continued the approach manually with a target V_{REF} of 120 kt. At 500 ft the aircraft was cleared to land with the surface wind reported as 190°/12 kt gusting to 24 kt. During the final few hundred feet the speed varied between 115 and 135 kt with the torque varying between 0 and 20%. An average Flap 15 approach torque setting would be approximately 17%.

At 300 ft agl the commander was fully visual with the runway and asked the PNF to put the flight directors to standby. The aircraft descended slightly below the glideslope, with a visual indication of three red and one white light on the precision approach path indicators (PAPIs), and the commander added power to recover the aircraft onto the glidepath.

At about 40 ft agl the recorded data showed an indicated airspeed increase to 137 kt. The commander responded by reducing torque to 8%. The aircraft speed decreased to V_{REF} and stabilised with the rate of descent initially remaining constant at about the normal rate of 600 fpm. The aural radio altimeter counted down from 50 ft, in 10 ft increments, at a rate which sounded normal to the crew. At 25 ft agl, the commander became aware of an increasing sink rate and initiated a flare which increased the aircraft pitch from about 2.5° to 7.5° over three seconds. The FDR shows that the aircraft now had a significant tailwind with a groundspeed 10 kt greater than its airspeed. The flare did not arrest the rate of descent and the aircraft touched down heavily on both main gear and the aft fuselage.

The crew were aware that the TOUCHED RUNWAY caption illuminated following the landing. As the commander vacated the runway he called for the emergency check list for the touched runway caption. The F/O read this drill which, on the ground, only advises the need to contact engineering before the next flight. Therefore the aircraft was taxied to its parking stand before being shut down. The passengers disembarked normally.

Recorded information

The aircraft was equipped with a digital flight data recorder (DFDR) and cockpit voice recorder (CVR), both of which were successfully downloaded at the AAIB. Pertinent FDR data is included in the History of the Flight section and in Figure 1.

Meteorological data

The UK Met Office provided a detailed aftercast of the weather at the time of the accident. They reported that the local meteorological situation was dominated by low pressure to the north and west of Gatwick, maintaining a strong south to south-westerly flow over the Gatwick area. There was also a frontal band of cloud over the area at time, with evidence of heavy rain and indications of embedded cumulonimbus cloud.

The surface wind recorded in the METAR at 0950 UTC was 170°/13 kt, with gusts of 23 kt. The estimated 2,000 ft wind at the time was from 220°/60 kt. This gave an appreciable difference between the surface and 2,000 ft wind, indicative of the potential for severe windshear-induced turbulence. With a 2,000 ft wind of 60 kt, the Met Office would also expect there to be an element of friction-induced turbulence, due to the interaction of the earth's surface and the flow of air.

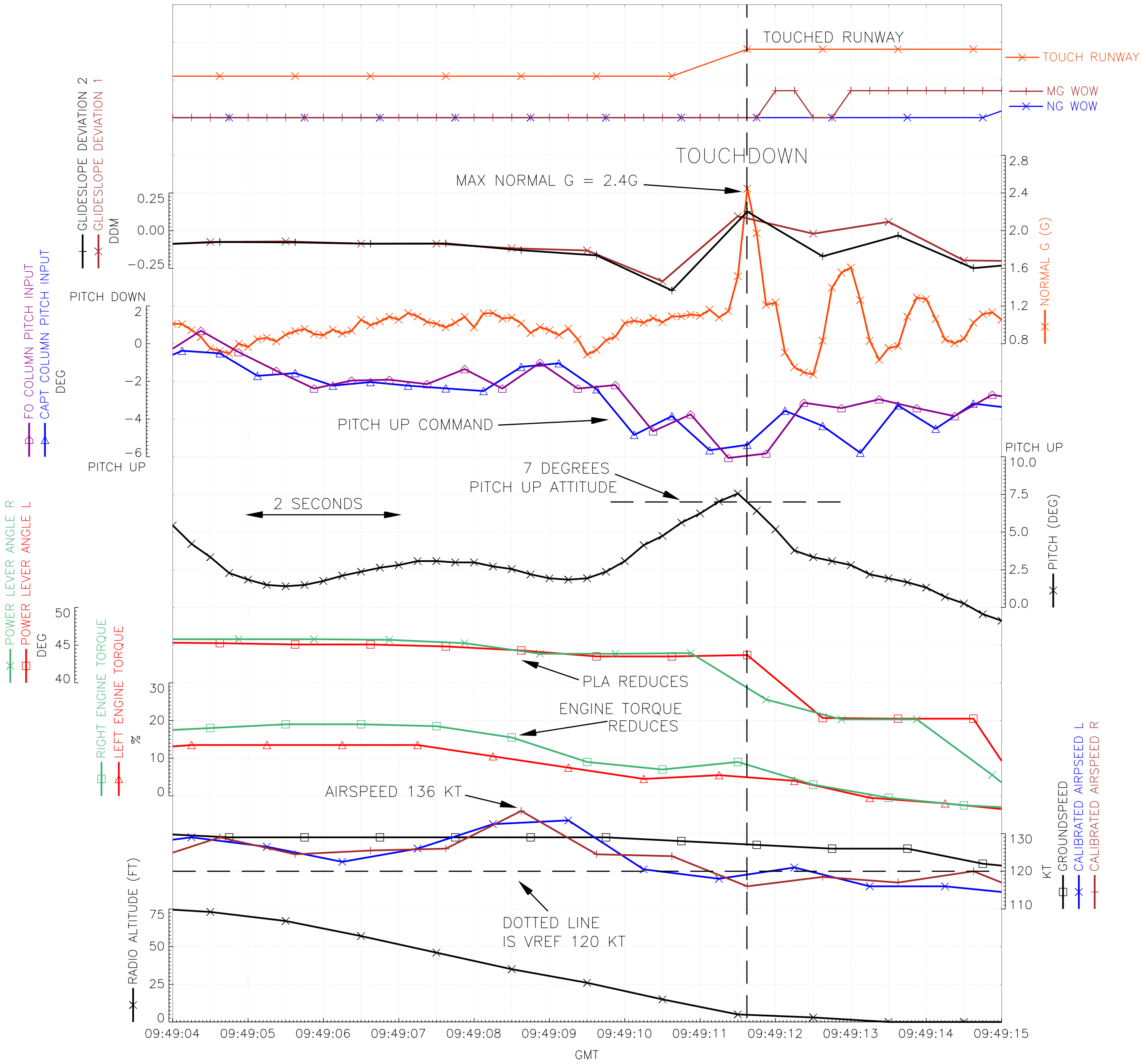

Figure 1

Structural damage

The fuselage lower skin was extensively damaged by abrasion over a region that straddled the centreline and extended some 2.25 metres longitudinally, and 0.75 metres laterally. Associated deformation of fuselage frames was also evident and the skin was fully penetrated by abrasion in the same area.

Ground marks - runway scrape

A scrape mark some two metres long was found on the runway near the threshold, approximately one metre to the right of the runway centreline. The scrape started at a point, and broadened to a maximum width of about 0.75 metres at its furthest point, consistent with the damage to the aircraft.

DHC-8-Q400 flap options

The operator had two landing flap positions approved for use, Flap 15 and Flap 35. There is no intermediate setting available. The operator's Operations Manual states that unless limited by weight or temperature, Flap 15 is recommended for normal landings on runways of 2,000m or greater length

To assist with ATC speed control requirements on approach, the company had issued an aircrew notice stating that all landings at Gatwick were to be with Flap 15.

The commander commented that in turbulent conditions he would prefer to conduct a Flap 35 approach. However, he was aware of the company Standard Operating Procedure (SOP) for Flap 15 landings at Gatwick and based on the ATIS, he did not feel the reported conditions warranted conducting a non-standard approach.

Tail strikes during landing

The operator's manual contains advice that deviation from the normal landing procedure is the main cause of tail strikes. It lists the most common causes as:

'● *Allowing the airspeed to decrease well below V_{REF}*
● *Inappropriate reduction in power.*
● *Prolonging the flare for a smooth touchdown.*
● *Starting the flare too high.'*

Flaring too high

The company manual stated:

'If the flare is started too high above the runway, airspeed will decrease below V_{REF} and the sink rate will eventually increase. There is a tendency to increase pitch to arrest the excessive sink rate. However, the correct action is to immediately reduce the pitch attitude and apply a small increment in power, flying the aircraft on to the runway before the airspeed reduces further. While the landing will be firm, taking this corrective action will prevent a tail strike. Remember, executing a go-around is always an option.'

Service Letter

On 11 September 2008 the manufacturer issued service letter DH8-400-SL-00-020. This letter stated that operators should include, in their procedures, an alert call at five degrees pitch (Pitch 5 call) and that:

'Descent rate control, below 200 feet agl., must be through power lever management rather than adjusting pitch.'

The manufacturer later commented that this was meant to reinforce to the flight crew that power management during the final stages of the approach is the appropriate means of adjusting the descent rate (while maintaining the appropriate V_{REF}).

Operator's Pitch Call

The operator's SOPs requires the PNF to make a warning call of *"PITCH"* if the pitch angle displayed on the pilot's ADI reaches six degrees during the flare.

Previous tailstrikes

The manufacturer was aware of a total of nine tailstrikes to DHC-8-Q400 aircraft causing significant damage. Their analysis of these events showed that typically power had been at or near flight idle prior to the initiation of the flare. The manufacturer stated:

> *'It would appear that training guidance appropriate to use of the POWER levers to arrest the sink rate has not been as effective as hoped, at changing the piloting "second nature" action of flaring to arrest a sink rate immediately prior to arriving on the runway. The result of a small POWER lever movement ahead of Flight Idle is an immediate reduction in the sink rate even before there is an actual increase in power due to the effectiveness of lift due to slipstream.'*

Operational Flight Data Monitoring (OFDM)

The operator was utilising a comprehensive set of OFDM event monitoring software. The system had an event 'high pitch on landing' set to report landings in excess of seven degrees nose-up at touchdown. This system had logged 403 events in the 24 months prior to this accident. a rate of one per 476 flights. No tailstrikes had occurred in this period. For the three months prior to 16 February 2010, the operator recorded 25 events, corresponding to a rate of one per 1,111 flights.

Tailstrike angles

The manufacturer commented that, in a worst case scenario, with a descent rate of ten feet per second, the tail will contact a crowned runway at a nose-up pitch of 6.5º. Marketing information from the manufacturer, relating to a further product stretch, had caused some confusion by referring to the Q400 as having an 8.5º rotation angle. This, supported by a large number of OFDM 'high pitch' landings with no damage, had led to a general belief amongst the operator's staff that tailstrikes at low pitch angles were impossible. (The Airplane Flight Manual rotation limit is 8° with rotation referring to take off and not landing.)

Approach pitch angles

The manufacturer utilised certification data to provide a range of approach angles for Flap 15 and Flap 35. A Flap 15 approach resulted in the aircraft being 2.5º to 3.5º nose-up at V_{REF}. Flap 35 data suggested that the aircraft would be 0.5º to 1º nose-up at V_{REF}, although the operator reported much lower figures were routine in normal service.

Analysis

Pitch 5 call

The aircraft's pitch angle increased beyond 5º two seconds before the tail struck the runway. There may have been time for the PNF to make a pitch call and the PF to assimilate the information and react. There is uncertainty, however, that this alerting call would have allowed sufficient reaction time for the PF to stop the increasing pitch rotation. The SOP alerting call at a pitch of 6º, one second before touchdown, was not made. During discussions following the accident the operator expressed concerns about additional pitch calls due to the possibility of the PNF becoming 'pitch fixated' on approach and this was the main reason why they had not adopted the Pitch 5 call outlined in the service letter. However, cognitively, it may be easier for the PNF to monitor pitch against a 5º standard than a 6º one. The Q400 ADI is graduated in 5º increments and thus the PNF does not have to interpret the instrument scale but just check to see if the aircraft symbol is on the 5º graduated line.

Flap selection

Company SOP's for Flap 15 landings at LGW were guided by the airport's desire to maximise runway utilisation.

A Flap 15 approach results in a nose-up angle on approach of 2.5º to 3.5º (based on certification figures). With a pitch limit of 6º and a nominal flare of 2º this allows only a 0.5º to 1.5º margin from a tailstrike. Consequently, late in the approach, there is little time available to use pitch to counter any sink that develops. The manufacturer's comment that pilots instinctively increase pitch to control sink appears to correlate with the operator's OFDM data. This reaction is likely to be more profound in pilots who have previously flown other types with larger tailstrike margins.

Likewise, pilots of this operator who have absorbed the company's general belief that tailstrikes are only likely above 8º, may think they have a margin of more than 3º (ie they can approach at 3º, flare to 5º and still have 3º to use to counter any sink). This may result in an increased flare which is an inappropriate response to sink. Where such a flare has been successful in eliminating the sink then no damage will have occurred and it is possible the pilots were unaware of the pitch attitudes attained.

In the turbulent conditions encountered during this accident, a large speed variation during the final few seconds, probably caused by windshear, caused the commander to reduce power. Although he subsequently flared to 7.5º, in an attempt to reduce the rate of descent, he was unable to prevent a heavy landing and consequent tailstrike.

Alerting ATC

Following the activation of the touched runway caution the flightcrew reviewed the required actions in the emergency check list. The only relevant information directed them to contact engineering support which they did once on stand.

Company publications had led crews to understand that a tailstrike would only occur at about 8 to 9° nose-up and the F/O was sure they had not reached those angles. It was not apparent to the flightcrew that a damaging tailstrike had occurred until after the aircraft was parked on stand, the passengers had disembarked and the commander had conducted a visual inspection. Only at this stage was information passed to airfield operations that a tailstrike had occurred.

The crew's first point of reference following a 'touched runway' warning is the emergency check list and this should ideally provide them with advice to support their decision making. A landing tailstrike is unlikely to cause significant risk to the aircraft occupants suffering the tailstrike, although debris left on the runway may cause damage to subsequent landing or departing aircraft. This potential hazard could be avoided by a runway inspection. Therefore:

Safety Recommendation 2010-028

It is recommended that Bombardier Aerospace modify the DHC 8-Q-400 (Aeroplane Operating Manual), "Touched Runway" Emergency check list to include the action "advise ATC"

Safety action taken

The operator intends to implement the wording of the safety recommendation in the next amendment to their check lists.

Conclusion

The approach was flown in difficult conditions. Flap 15 provides little pitch manoeuvre margin during the flare and the 'pitch six' call may be too late to prevent damage from occurring. The critical aspect of this approach was the rate of descent, which although normal for the approach, was not arrested by the landing flare. The reduction of the power levers to eight percent torque at 40 ft, just before the flare, resulted in a rapid reduction in lift across the wing. This reduction in lift could not be countered by the increased flare and led to the aircraft landing heavily on the runway.

SERIOUS INCIDENT

Aircraft Type and Registration:	DHC-8-402 Dash 8, G-FLBD
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2009
Date & Time (UTC):	23 February 2010 at 1230 hrs
Location:	Chania Airport, Crete, Greece
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 5 Passengers - 50
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	11,000 hours (of which 2,200 were on type) Last 90 days - 200 hours Last 28 days - 60 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

The aircraft was on the final approach to Runway 11 at Chania Airport. The crew were carrying out a visual approach using the VOR/DME altitude/range crosschecks to verify the vertical profile. The first 800 metres of the runway was not available and late in the approach the commander, who was the pilot flying, realised that he was positioned for the normal touchdown zone and not the displaced threshold. He adjusted the approach to land at the correct touchdown point.

History of the flight

The crew were to carry out a scheduled flight from Athens Airport to Chania Airport on Crete. The flight was also to be used for the commander's annual line check which was to be conducted by a Line Training Captain (LTC), who was occupying the jump seat.

They arrived at Athens Airport with adequate time to prepare for the flight and collected their flight documentation before carrying out the pre-flight briefing. A NOTAM for Chania Airport stated that the first 800 metres of Runway 11 was unserviceable and was indicated by closed runway markings. There was resurfacing work in progress and the new length for Runway 11/29 was 2,331 metres. The new Runway 11 threshold was equipped with threshold, side and end lights, with PAPIs installed at the displaced threshold of Runway 11. The crew discussed the NOTAM as it related to their flight, in particular the performance aspects which were not limited by the runway length. They agreed to review the performance implications when they contacted Chania ATC.

Having completed their preparations, the crew arrived at the aircraft some 30 minutes before departure. The LTC was unable to get his communications station box to work and, as he was unable to monitor the RT or intercom, he cancelled the line check. After a short delay due to some minor changes to the loadsheet, the aircraft departed approximately 10 minutes behind schedule.

The transit to Chania was made at FL190 and took approximately 40 minutes. Having listened to the ATIS, the commander carried out the approach brief which was to be a VOR/DME approach to Runway 11. The weather was good, with calm wind, CAVOK, temperature 13°C, dew point 8°C and QNH 1013 hPa. Given the weather conditions, the commander stated that he would probably carry out a visual approach but did not mention the displaced threshold.

Following the descent and with approximately 30 nm to go, the commander declared his intention to continue visually and adjusted the aircraft track to position onto a 10 nm final approach. The aircraft was configured in accordance with the standard operating procedures and the co-pilot monitored the approach by calling out the range and altitude crosschecks. The runway was clearly visible throughout the approach but both the commander, who was the pilot flying, and the co-pilot had forgotten about the displaced threshold and continued towards the normal Runway 11 touchdown point. The LTC began to be concerned that this may be the case and late in the approach he intervened. At the same time, the commander realised the situation and increased power to adjust the flight path for the displaced threshold. The aircraft touched down safely at the correct point on the runway and taxied to the terminal building.

Following a discussion about the incident, the crew did not recall any information regarding the displaced runway on the ATIS and ATC had not reminded them in any of their transmissions. The closed runway markings had not stood out in the bright sunlight and none of the crew could remember the PAPIs being illuminated.

Airport information

Chania ATC provided transcripts for the Approach (118.125 MHz) and Tower (122.1 MHz) controllers and the Automatic Terminal Information System (ATIS) (130.175 MHz) covering the relevant period. The reduced runway length was included in the ATIS information "HOTEL", issued between 1003 hrs and 1130 hrs, as well as the preceding and subsequent transmissions. It stated:

> "RUNWAY IN USE 11 CAUTION ADVISED RUNWAY 11 NEW THRESHOLD LOCATED 1017 METRES INWARDS."

Whilst the controllers did not include in their transmissions the reduced runway length, the Approach controller did confirm that the crew had copied "INFORMATION HOTEL". The information regarding the threshold had been included in all ATIS transmissions since 15 February 2010.

The airport authority also stated that the runway markings were correct and that the PAPIs were in order.

Analysis

The crew did not recall hearing the information on the ATIS regarding the displaced threshold. The commander considered that, having forgotten about the displaced threshold, he carried out a normal visual approach using the VOR/DME information provided by the co-pilot to adjust his vertical profile. His adjustment of the approach path ensured a safe landing but, following further consideration, a go-around followed by a second approach may have been a better option. Additionally, when a third crew member is present they should assist the operating crew at the earliest opportunity if they observe potentially incorrect practices or procedures.

INCIDENT

Aircraft Type and Registration:	Hawker 800XP, CS-DRP
No & Type of Engines:	2 Honeywell TFE731-5BR turbofan engines
Year of Manufacture:	2006
Date & Time (UTC):	14 March 2010 at 2047 hrs
Location:	London City Airport
Type of Flight:	Commercial Air Transport (Non-Revenue)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	33 years
Commander's Flying Experience:	4,300 hours (of which 1,200 were on type) Last 90 days - 60 hours Last 28 days - 20 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft encountered navigation problems after it departed from London City Airport with its heading reference systems misaligned. Safety action taken following a series of such events before 2008 has been effective but remains relevant.

History of the flight

During flight preparation, while the aircraft was parked on the general aviation apron at the western end of London City Airport, the pilots noticed that the compasses were taking longer than usual to align. During taxi the attitude and heading reference systems (AHRS) were selected to the SLEW mode in preparation for setting the correct heading.

The aircraft was instructed to backtrack Runway 27, vacate onto the loop taxiway at Hold K and hold short at Hold M. During backtrack the pilots accepted the offer of an immediate takeoff from the aerodrome controller, who advised that a landing aircraft was 4 nm from touchdown. The aircraft turned on the runway to face the takeoff direction instead of using the loop taxiway. The commander reported that all checks were completed according to the checklist but that, although both pilots were aware that the AHRS were selected to SLEW mode, the aircraft departed without the correct heading set.

The departure was uneventful until, in receipt of heading instructions, the crew were asked if the aircraft was experiencing navigation problems. The pilots realised that the aircraft was not maintaining the assigned heading and altered the flight path accordingly. No other traffic was affected by the event and the flight proceeded without further incident.

Previous occurrences

In its January 2008 bulletin the AAIB reported on the investigation of a series of events[1] in which aircraft departing Runway 27 at London City Airport experienced navigation problems attributed to misalignment of their heading reference systems. The investigation identified several magnetic anomalies, associated with the industrial legacy of the airport estate and construction of the loop taxiway, strong enough to affect aircraft heading reference systems. The report established that this only became an operational problem if pilots had insufficient time to realign the heading reference systems when lined up on the runway.

The report made six Safety Recommendations, initially to provide short-term procedural remedies and operator awareness, and in the longer term to change aerodrome standards with regard to magnetic anomalies. All the recommendations addressed to the UK CAA were accepted and action taken to address them. One recommendation to ICAO was also accepted.

Other information

The commander concluded that the cause of the occurrence was a "rushed departure". In a report submitted to the operator, he commented that crews should not accept such a departure, "especially from London City with the known heading problem".

The occurrence to CS-DRP on 14 March 2010 was the first similar occurrence at London City Airport reported to the AAIB since the January 2008 bulletin. The airport operator has stated that it continues to monitor the situation.

Discussion

The commander's comments and the absence of occurrences attributed to the magnetic anomalies at London City since January 2008 indicates that safety action taken since publication of the AAIB report highlighting the issue has been successful but remains relevant.

Footnote

[1] Incident to Raytheon Hawker 800XP registration CS-DRQ on 31 October 2009 et al, AAIB reference EW/C2006/10/10.

ACCIDENT

Aircraft Type and Registration:	Flight Design CT2K, G-IDSL
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2002
Date & Time (UTC):	17 April 2010 at 1045 hrs
Location:	Frensham Airstrip, Surrey
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Engine frame and nose leg bent, rudder pedal limit stop and right rudder pedal tube distorted
Commander's Licence:	Private Pilot's Licence
Commander's Age:	77 years
Commander's Flying Experience:	2,010 hours (of which 220 were on type) Last 90 days - 5 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After takeoff, the pilot had to apply more right rudder than usual to counteract a yaw to the left. This became progressively worse until the pilot ran out of rudder authority. Following two wide and slow circuits and two rejected landings, the pilot made a successful, but firm landing. He suffered no injury. Subsequent inspection of the aircraft identified that the rudder pedal limit stops and centring mechanism were damaged, which had restricted the travel of the right rudder pedal. Prior to the accident, the aircraft had been manoeuvred on the ground using a mechanical tug. The UK type certificate holder for the aircraft stated that they did not provide, nor approve the use of, mechanical towing aids for the aircraft. The right rudder pedal tube, engine mounts and nose strut also suffered damage.

History of the flight

The pilot had intended to make a solo flight to Calais from a private grass airstrip located to the south-west of the village of Frensham in Surrey. No defects were noticed by the pilot during either the pre-flight inspection or taxi checks and the aircraft was positioned for takeoff from Runway 07. The reported wind was from the north-east at less than 5 kt. The takeoff run appeared normal, but as the aircraft became airborne the pilot found that he had to apply more right rudder pedal than expected. Having applied what the pilot believed to be full right rudder pedal, the aircraft continued to yaw to the left. The pilot flew a wide left hand circuit at 60 kt and positioned the aircraft for landing on Runway 07. As the aircraft touched down, it immediately started to drift to the left, heading towards an area of soft ground adjacent to the side of the runway, before the pilot rejected the landing. Following a second unsuccessful attempt to land, the pilot positioned the aircraft at an offset heading to the runway, to allow for the aircraft's tendency to drift to the left on landing, and reduced the approach speed to the stall speed plus 5 kt. The pilot described the touchdown as firm, but with the slower approach speed and offset heading he was able to bring the aircraft to a stop whilst still remaining on the runway. When the pilot attempted to taxi the aircraft, application of the right rudder pedal resulted in only a gradual right turn. The pilot was uninjured.

The aircraft is a monoplane having a tricycle undercarriage with nosewheel steering. The nosewheel steering mechanism and rudder are both mechanically connected to the rudder pedal assembly, which incorporates limit stops and a centring mechanism. Inspection by a representative of the UK type certificate holder identified that the right rudder pedal limit stop and pedal centring mechanism had been damaged. When tested, the rudder pedals were found to have normal full range travel to the left, but only limited travel to the right. The type certificate holder considered that the damage was consistent with the nosewheel having been turned with sufficient force to deflect it beyond its normal operating range. It was considered unlikely that a pilot would be able to apply sufficient force to the rudder pedals to damage either the limit stops or centring mechanism. The right rudder pedal tube was also found to have been distorted, as well as damage to the nosewheel strut and engine mountings. The damaged mountings resulted in the front of the engine being approximately 35 mm lower than normal.

The aircraft was normally parked in a hangar, which it shared with a number of larger aircraft that required the use of a mechanical tug. The pilot stated that he was aware that the tug was being regularly used to manoeuvre G-ILSD, by connecting it to the nosewheel fairing attachment bolts. This had caused some cosmetic damage to the fairing and so the pilot had replaced the standard bolts with ones that had a slightly larger bolt head, making it easier to connect the tug. The pilot stated that damage to the right pedal limit stop and centring mechanism had most likely occurred when the aircraft had been manoeuvred using the tug. He considered that the distortion of the right pedal tube had probably occurred during the incident flight when he had attempted to apply full right rudder, and that both the nosewheel strut and engine mounts had been damaged during landing.

The UK type certificate holder for the aircraft stated that they did not provide for, nor approve the use of, mechanical towing aids for the aircraft type and that they had not issued a modification to the nosewheel fairing to enable such attachment. As a result of this event, the UK type certificate holder is considering the release of a service letter addressing the ground handling of the aircraft and the addition of an appropriate cautionary placard.

ACCIDENT

Aircraft Type and Registration:	Jabiru SK, G-BYIA
No & Type of Engines:	1 Jabiru Aircraft PTY 2200A piston engine
Year of Manufacture:	1999
Date & Time (UTC):	17 April 2010 at 1045 hrs
Location:	Fishburn Airfield, County Durham
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to both wings, right main landing gear; nosewheel, propeller, engine mountings and windscreen
Commander's Licence:	Private Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	216 hours (of which 15 were on type) Last 90 days - 2 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After a touchdown on an undulating runway the aircraft became airborne again and stalled. The pilot assessed that the probable cause of the accident was that he inadvertently retracted all of the flap, instead of retracting it to the first stage.

History of the flight

The pilot completed a full external and internal pre-flight check of the aircraft, with the intention of carrying out a number of circuits of the airfield, each one to culminate in a full-stop landing. Engine power and the pre-departure checks were carried out and one full-stop circuit was successfully completed. The pilot took off for the second circuit and during the downwind leg selected the first stage of flap. When established on final approach he selected full flap. The pilot reported that the approach, flare and initial touchdown were normal but, shortly after the touchdown, the aircraft became airborne again. The pilot also commented that the airstrip was undulating and quite bumpy. He initiated a go-around, applied full power and selected the first stage of flap. The pilot then noticed that the aircraft was not climbing and that the stall warning was sounding, shortly after which the right wing dropped and the aircraft hit the ground, first with the right landing gear wheel and then with the nosewheel. After the aircraft came to rest the pilot switched off all the systems and exited through the pilot's door. No injuries were sustained.

The pilot assessed that the probable cause of the accident was that he inadvertently retracted all of the flap, instead of retracting it to the first stage, and this allowed the aircraft to enter a stall.

ACCIDENT

Aircraft Type and Registration:	Luscombe 8A Silvaire, G-BSTX
No & Type of Engines:	1 Continental Motors Corp A65-8 piston engine
Year of Manufacture:	1947
Date & Time (UTC):	17 April 2010 at 1220 hrs
Location:	Kilkeel, County Down, Northern Ireland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller, engine, fuselage and empennage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	111 hours (of which 37 were on type) Last 90 days - 19 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot applied the brakes fairly hard after touching down on Runway 36 but did not hold the stick fully back, allowing the aircraft to tip forward onto its nose. The pilot was uninjured.

ACCIDENT

Aircraft Type and Registration:	Piper PA-18-150 (Modified) Super Cub, G-BEOI
No & Type of Engines:	1 Lycoming O-360-A4A piston engine
Year of Manufacture:	1976
Date & Time (UTC):	7 April 2010 at 1415 hrs
Location:	Parham Airfield, West Sussex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller tips bent, engine shock-loaded and minor structural damage to the nose
Commander's Licence:	Private Pilot's Licence
Commander's Age:	73 years
Commander's Flying Experience:	5,323 hours (of which 45 were on type) Last 90 days - 7 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Summary

On landing, the aircraft veered to the left and departed the runway into an adjacent field. The pilot attempted to taxi back onto the runway but the main wheels dropped into a rut on the runway edge and the aircraft pitched forward onto its nose.

The pilot was wearing a new pair of ex-service flying boots which made it difficult to locate and operate the brake levers. This may have contributed to him not being able to maintain directional control.

History of the flight

The pilot departed from Runway 04 at Parham Airfield towing a glider. It was his fifth aero-tow of the day from the runway, which was a mown grass strip approximately 660 metres in length and some 25 metres wide. He had not flown the aircraft for about three weeks, since a dual check lasting one hour, and it had been some six months since he had flown the aircraft prior to that. He was also wearing a new pair of recently purchased ex-service flying boots, which had thicker soles and heels compared to his normal footwear. The foot brakes on the aircraft were two upright metal levers in front of the rudder pedals angled forward towards the engine at an angle of about 45°. The brakes are operated using the heel of the foot.

The weather was good, with a wind of 310º/5-10 kt, visibility in excess of 20 km and scattered cloud at about 3,000 ft. The glider released from the tow at 1,500 ft above the airfield and the tug was descended back towards the runway.

A side-slipping approach was made to Runway 04, with a normal touchdown at the intended point. Shortly after, the aircraft veered to the left and, despite application of right brake and rudder, the pilot could not prevent the aircraft departing the left side of the runway into the adjacent field. After entering the field, the right brake seemed to take effect and the aircraft turned sharply to the right. As the brakes appeared to be working correctly and crossing the ground between the landing strip and the adjacent field had been uneventful, the pilot elected to taxi back onto the runway.

As the aircraft crossed the edge of the runway, the main wheels entered a deep rut and the aircraft pitched forward onto its nose. The engine stopped immediately and the pilot isolated the fuel and electrical system before vacating the aircraft.

Analysis

Although the braking system was unusual to the pilot, he had not experienced any previous difficulty using it to maintain directional control, even in crosswinds of 10-15 kt. He could not rule out a short-term fault with the brakes, such as air in the system, but a post-incident functional check found them to be operating correctly. The pilot considered that his flying boots made it more difficult for him to locate and operate the foot brakes, and it may have been this that had prevented him from achieving effective braking and maintaining directional control of the aircraft on the runway.

Had the aircraft been stopped in the field at this point, no damage would have occurred. On reflection, the pilot thought it would have been wiser not to taxi over the unfamiliar surface of the adjacent field and try to taxi back onto the runway. It would have been safer to shut down the aircraft and ground handle it back onto the runway.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-140 Cherokee, G-BRWO
No & Type of Engines:	1 Lycoming O-320-E3D piston engine
Year of Manufacture:	1973
Date & Time (UTC):	26 September 2009 at 1445 hrs
Location:	Humberside Airport, North Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Right wing detached and forward fuselage severely damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	858 hours (of which 756 were on type) Last 90 days - 21 hours Last 28 days - 7 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was making an approach to land on Runway 26. During the flare the aircraft rolled uncontrollably to the right and struck the ground. The aircraft came to rest inverted beside the runway, close to the fire training facility. The most probable reason for the uncommanded roll is that G-BRWO had flown through the wake vortex generated by a Sikorsky S76 which had landed immediately before it. One Safety Recommendation has been made as a result of this investigation.

History of the flight

After being identified on radar, the pilot of G-BRWO was given instructions by ATC to join on left base leg for Runway 26, and was informed that he was number two on the approach behind a Sikorsky S76 helicopter. A Cessna 150 had landed on Runway 20 and it was given clearance to backtrack and exit at Taxiway Echo. The S76 was given clearance to land at 1542:44 hrs and it subsequently descended into a low hover above Runway 26, before being given the following clearance "THE CESSNA 150 VACATING AT TAXIWAY ECHO, GIVE WAY TO HIM, CUT THE CORNER IF YOU WISH, VACATE CHARLIE FOR HELIPORT".

The pilot of G-BRWO was then given the wind conditions, 250º at 8 kt, and told to expect a late landing clearance. At 1543:33 hrs the S76 reported that it was clear of the runway and at 1543:47 hrs G-BRWO was cleared to land, which the pilot acknowledged. One minute and ten seconds after the acknowledgment of the landing clearance, ATC requested a position report from G-BRWO. After several unacknowledged transmissions and requests to other traffic regarding the whereabouts of the aircraft, the AFRS were put on local standby for a possible incident within the airport boundary. At this point the pilot of a Robinson R22 helicopter, operating on the airfield, asked if the controller wished him to check the approach to Runway 26. This offer was accepted and the R22 was cleared to fly towards the fire training facility. At 1547:32 hrs, the pilot of the R22 confirmed that there was an aircraft inverted close to the fire training facility. The AFRS were deployed to the accident site, arriving at the accident site at approximately 1549:30 hrs, where they proceeded to make the aircraft safe.

The pilot reported that the final approach was normal but after crossing the runway threshold, in the flare, the aircraft rolled uncontrollably to the right and the right wing then made contact with the runway surface. The right wing structure then failed and the aircraft became inverted. The cockpit door had become jammed by the remains of the right wing, but with the use of considerable force, the pilot was able to open the door and escape from the aircraft unaided before the AFRS attended the scene. The pilot received first aid before being transported to hospital. There was no fire.

Investigation

As part of the investigation, transcripts of the ATC communications, together with reports from the airport operator, ATC staff and AFRS were examined. These showed that after communication was lost with G-BRWO, the aircraft was misidentified as a Cessna 172 with two persons on board. During the emergency, several aircraft were in communication with ATC, including a commercial flight, which was given clearance to land on Runway 20 approximately one and a half minutes after the AFRS had been deployed to the accident. The reports show that during the initial phase of the AFRS response, the airfield's fire category remained unchanged and was not downgraded from Category 6 to Category 4[1] until four minutes after their deployment.

The fire training facility is positioned close to the threshold of Runway 26 and obstructs the view of the runway, immediately beyond the threshold, from the ATC tower, Figure 1. This prevented the ATC controller from directly observing the accident site. G-BRWO probably crossed the runway threshold approximately one minute after its pilot received clearance to land and the aircraft was located by the R22 pilot approximately three minutes after the accident. Approximately two minutes after being given the command to deploy to the location the AFRS units were at the scene of the accident.

Wake Turbulence

Every aircraft, including helicopters, produces wake vortices, which can be considered as two counter-rotating air masses trailing aft from the aircraft, Figure 2.

The vortices form when the weight of the aircraft or helicopter is supported by its wing, or rotors. In stable airflow these vortices will tend to drift slowly downwards and if in close proximity to the ground,

Footnote

[1] The fire fighting and rescue categories for airfields are determined by the maximum length and width of the largest aircraft using the airfield, and are defined in CAP 168 Licensing of Aerodromes Chapter 8 Table 8.1. Category 6 allows the operation of aircraft with a fuselage length of under 39 metres and a maximum width of 5 metres, Category 4 allows the operation of aircraft with a fuselage length of under 24m and a maximum width of 4 m

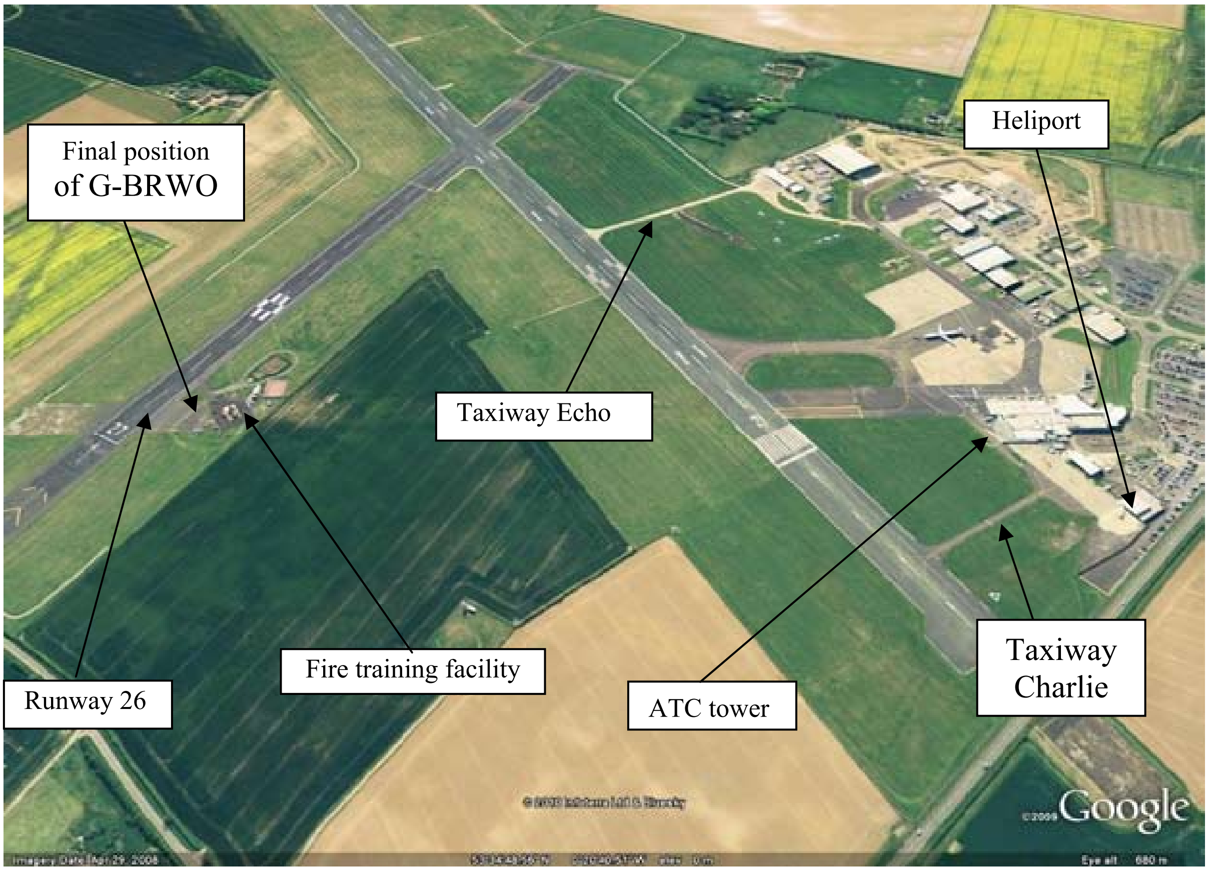

Figure 1

Humberside International Airport

(**Note**: At the time this picture was taken, Runway 26 was designated as Runway 27 hence the markings of '27'; the runway designation changed due to magnetic variation)

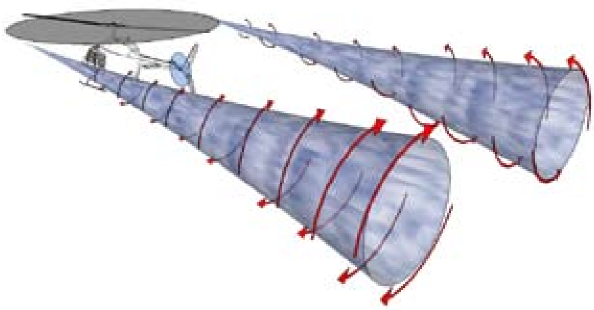

Figure 2

Typical helicopter wake vortices

move outwards from the track of the generating aircraft. The strength of the vortices generated increase with the weight of the aircraft and decrease as the aircraft's speed increases (for a given configuration). There is evidence from several research programs, primarily conducted on behalf of the US Federal Aviation Administration in the 1980s, to show that the vortices generated by helicopters are more powerful than that generated by a fixed wing aircraft of equivalent weight and speed, particularly during the final decelerating flare to a hover during landing. In July 1992 a Piper PA28 lost control during the initial stages of a go-around as a result of wake turbulence generated by a preceding Sikorsky S61N helicopter. This resulted in fatal injuries to the occupants of the PA28 and was investigated and reported in AAIB Air Accident Report AAR 1/93.

The dangers associated with wake turbulence are detailed in UK CAA CAP 493, *Manual of Air Traffic Services* (MATS), Section 1 Chapter 3 Sub Section 9, Aeronautical Information Circular (AIC) P64/2009 and CAA Safety Sense Leaflet 15c, entitled '*Wake Vortex*'. These documents describe the problems associated with wake turbulence, methods of wake avoidance and, in the case of CAP 493 (MATS) and AIC P64/2009, separation minima. The CAP and AIC split aircraft, including helicopters, into five categories; Heavy, Upper Medium, Lower Medium, Small and Light, dependant on their Maximum Take Off Weight (MTOW), and lay down separation minima between the different categories. The Piper PA28, G-BRWO is classified as 'Light'. Most helicopters, including the S76 are also categorised as 'Light' and therefore, according to CAP 493 (MATS) and the AIC, there was no requirement to increase the separation between the two aircraft, either during final approach or departure.

AIC P64/2009 Paragraph 3.4.1 states:

> *'…There is some evidence that for a given weight and speed a helicopter produces a stronger vortex than a fixed-wing aircraft. The initial acceleration manoeuvre, the landing flare and air taxiing may generate higher rotor wash velocities than those produced in stabilised hover.'*

CAP 493 (MATS) Section 1 Chapter 3 Sub Section 9.11 states:

> *'…9.11.2 When hovering or air taxiing, a helicopter directs a forceful blast of air downwards which then rolls out in all directions. To minimise this effect controllers should:*
>
> *a) instruct helicopters to ground taxi rather than air taxi when operating in areas where aircraft are parked or holding;*
>
> *b) not air-taxi helicopters close to taxiways or runways where light aircraft operations (including light helicopter operations) are in progress…*
>
> *9.11.3 Caution should be exercised when a helicopter or fixed-wing aircraft of lower weight category is cleared to land on a runway immediately after a helicopter of higher weight category has taken off from that runway's threshold. Additionally it should be borne in mind that the downwash and associated turbulence generated by a hovering helicopter can drift a substantial distance downwind and may therefore affect an adjacent runway.'*

However, there is additional advice given regarding the effect that this stronger vortex system from helicopters may have on following aircraft. CAA Safety Sense Leaflet 15c, section 6 provides the following additional advice:

> *'When following a helicopter, pilots of light aircraft should consider allowing a greater spacing than would normally be used behind a fixed wing aircraft of similar size, perhaps treating each helicopter as being one category higher than that listed in the AIC.'*

If this were the case, the S76 would be classified as 'Small' and accordingly there should have been a 4 nm separation between the two aircraft on approach.

Analysis

The position of the fire training facility prevented direct observation of the area of Runway 26 immediately beyond the threshold from the control tower. This resulted in a delay of approximately three minutes before ATC confirmed that G-BRWO had been involved in an accident and deployed the AFRS. The AFRS were on scene approximately two minutes later. After ATC's confirmation that an accident had occurred, aircraft movements were allowed to continue despite the deployment of the AFRS to the accident. This temporarily reduced the ability of the AFRS to respond to any subsequent incidents and the airfield Fire Category was not downgraded to reflect this until four minutes later.

Whilst the exact time could not be determined from the ATC transcript, there was approximately 1 nm separation between the S76 and G-BRWO crossing the runway threshold. The wind conditions at the time of the accident would have resulted in a wind speed of approximately 7.9 kt down the length of the runway and a cross-runway component of approximately 1.4 kt. In view of these conditions, it is unlikely that the wake vortex produced by the S76 would have dissipated prior to the arrival of G-BRWO over the runway threshold. In accordance with the minima defined in CAP 493 (MATS) and AIC P64/2009 there was no requirement for ATC to increase the separation between the two aircraft. However, there is information available which shows that the wake vortex system generated by a helicopter is more powerful, particularly in the transition to the hover, than that generated by a fixed wing aircraft of the same weight. The information contained in CAA Safety Sense Leaflet 15c suggests that pilots of light aircraft, following helicopters should, for separation purposes, treat the helicopter as being in one weight category higher than that listed in the AIC. This advice is not included in either CAP 493 (MATS) or AIC P64/2009. Therefore:

Safety Recommendation 2010-026

It is recommended that the Civil Aviation Authority review CAP 493 Section 1, Chapter 3 and AIC P64/2009 and provide clear advice regarding the potential hazards to fixed wing aircraft when following a helicopter in the same wake turbulence weight category.

Safety action taken

The response to the accident was reviewed by the airfield ATC Safety Management Committee to determine what changes could be made to improve the airport's response to a similar event and to minimise the possibility of a similar incident occurring. As a result of the review a CCTV camera has been installed on the site of the airfield's DME which provides a means for staff in the ATC Tower to view the threshold and approach path to Runway 26 and several changes have been made to the airfield operational procedures. The Emergency Orders section of the Aerodrome Manual have been amended to ensure that when the AFRS has been deployed, the airfield fire category is reduced to zero and all aircraft movements are suspended until advised otherwise by the fire officer in command. After consultation with the NATS facility at Aberdeen, Humberside ATC issued Temporary Operating Instruction 09/09 which states:

> *' … Light wake turbulence helicopters of AS365 Dauphin size or larger are to be considered in the small category when operating as the lead aircraft.*
>
> *When operating as the following aircraft these helicopters will continue to be treated as light category aircraft.*
>
> *When an arriving light aircraft is likely to fly through the vortex wake of a departing helicopter and there is less than 3 miles distance between them, a warning is to be passed 'Caution dissipating wake turbulence from the departing helicopter'.*
>
> *If controllers have any doubt whether a particular helicopter falls into this group then they should err on the side of caution and adopt the procedures above.'*

Conclusion

The uncontrollable right roll experienced by the pilot of G-BRWO was probably the result of the aircraft flying through the wake turbulence generated by the preceding Sikorsky S76. The airfield's response to the accident was delayed as the view of the accident from the ATC tower was obstructed by the airport fire training facility. However, the AFRS arrived at the accident site within two minutes of being given confirmation of the accident and its location, but aircraft movements continued at the airport despite the AFRS' deployment to the accident. The prompt safety actions implemented by the airport operator as a result of their review of the findings from this accident have addressed the airport-related issues highlighted in this investigation.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna F152, G-BMFZ
No & Type of Engines:	1 Lycoming O-235-N2C piston engine
Year of Manufacture:	1985
Date & Time (UTC):	18 April 2010 at 1248 hrs
Location:	Bodmin Airfield, Cornwall
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damaged beyond economic repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	260 hours (of which 238 were on type) Last 90 days - 1 hour Last 28 days - None
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Following a late touchdown, the aircraft overran the end of the runway and was extensively damaged when it ran down a slope and turned over onto its back. The pilot was uninjured.

History of the flight

The pilot reported that he made an approach to Runway 13 at Bodmin Airfield, with 40° of flap selected, and just as the aircraft was about to touchdown there was a strong gust of wind of approximately 20 kt, which came from behind the aircraft. The aircraft initially landed approximately a quarter of the way along the runway, before becoming airborne again and then touching down for a second time as it passed the intersection with Runway 03/21, which was approximately halfway along Runway 13. The pilot stated that at this point he glanced at the ASI and noticed that "the indicator needle was at 0 kt". He estimated that the ground speed was between 35 to 40 kt and with no indicated airspeed decided not to go-around. Despite braking hard, the aircraft ran off the end of the runway, down a steep slope and onto a road where the nose landing gear collapsed and the aircraft turned over onto its back. The pilot, who was uninjured, vacated the aircraft without assistance.

Airfield information

Runway 13 is 610 m long and at the time of the accident the grass surface was dry. Following the accident, the airfield manager inspected the runway surface and reported that there was no evidence of heavy braking.

Weather conditions

The air-to-ground operator at Bodmin Airfield reported that the weather conditions were good and described the wind as variable at 5 kt, with no significant gusts.

The Met Office has automatic observation equipment sited at Newquay Airport and Cardinham, which is approximately 5 km from Bodmin Airfield. At Newquay Airport the wind was recorded at 1220 hrs as 310°/10 kt and there were no observations of gusts between 1020 hrs and 1250 hrs. At Cardinham the wind was recorded at 1250 hrs as 290°/5 kt and there were no observations of gusts between 1050 hrs and 1350 hrs. The Met Office advised that, at the time of the accident, the air mass below 2,000 ft was slow moving and would have been unlikely to have caused a large gust.

Aircraft information

The ASI was marked in knots with the first indicator mark at 35 kt and the first numerical at 40 kt. The pilot reported that the ASI read correctly throughout the flight and neither he nor the maintenance organisation were aware of any faults on the aircraft.

ACCIDENT

Aircraft Type and Registration:	Taylor JT1 Monoplane, G-CEKB
No & Type of Engines:	1 Volkswagen VW 1834 piston engine
Year of Manufacture:	2006
Date & Time (UTC):	27 June 2009 at 1043 hrs
Location:	Great Oakley Airfield, near Harwich, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	69 years
Commander's Flying Experience:	1,160 hours (of which 857 were on type) Last 90 days - 12 hours Last 28 days - 2 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft experienced a significant engine problem soon after takeoff. The pilot apparently attempted to fly an abbreviated left-hand circuit at low height to land back at the airfield. During this manoeuvre the aircraft stalled, with insufficient height for the pilot to recover to controlled flight. The pilot was fatally injured in the subsequent ground impact.

History of the flight

The pilot left home at about 0830 hrs on the morning of the accident and travelled to the airfield at Great Oakley, where G-CEKB was kept in a hangar. He had a brief meeting with the airfield owner, during which the pilot appeared to be his normal self. When he left home, the pilot said he had no definite plans to fly. However, at some point he decided he would fly and subsequently 'booked out' for a 1030 hrs flight to Old Buckenham Airfield, about 37 nm north of Great Oakley.

A witness saw part of the pilot's pre-flight external inspection and also heard the engine start, initial taxi out and first part of the takeoff. He later described the engine note as sounding a little rough. The aircraft taxied along the grass taxiway adjacent to Runway 04 and then east along Runway 09 to take off from the start of Runway 27 (Figure 1).

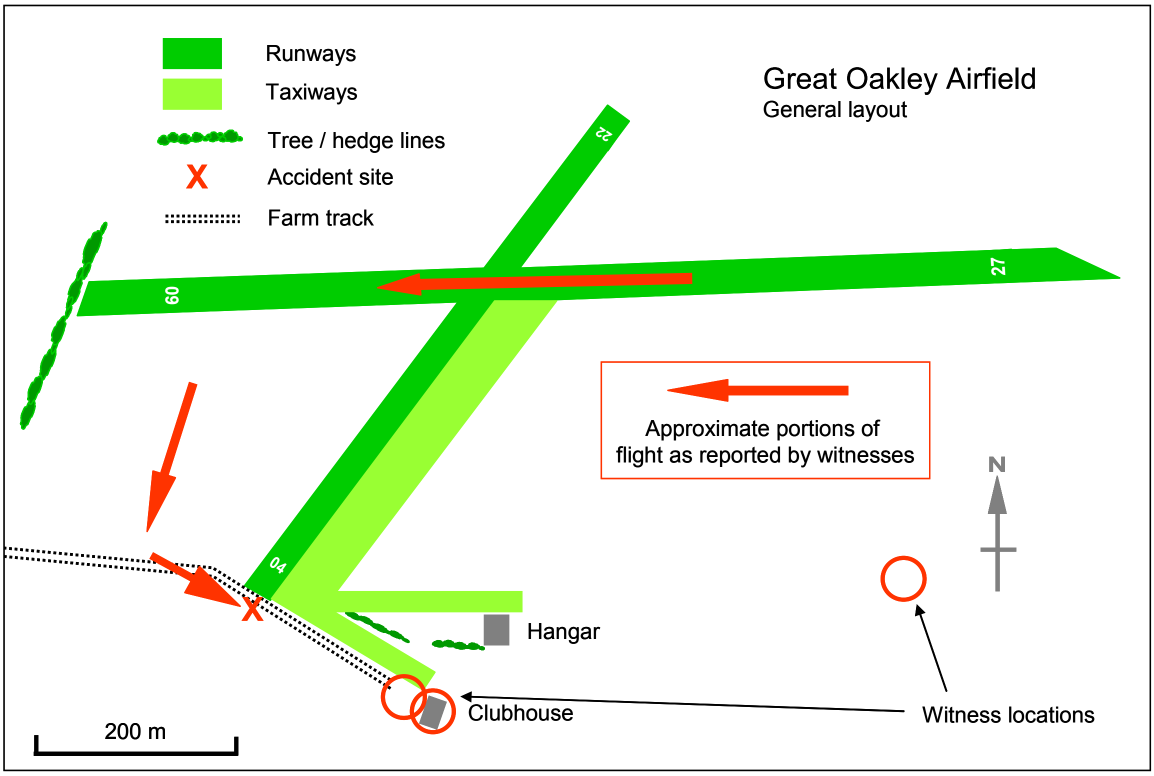

Figure 1

General layout of Great Oakley Airfield.
Portions of the flight seen by witnesses are shown

The aircraft was next seen by a witness adjacent to the airfield, whose attention was drawn to it by the abnormal sound of its engine, which he described as loud and sounding more like that of a tractor than an aircraft. When he first saw the aircraft it was flying about level at an estimated height of 60 or 70 ft, along the line of the runway. It maintained height for a few seconds, but then appeared to begin a descent. At about the same time the sound of the engine stopped, and he assumed the aircraft had landed. The aircraft had been in view for about 6 or 7 seconds.

There was an Air/Ground radio in the clubhouse, and the pilot carried a radio transceiver, but no transmissions from G-CEKB were received. A number of people were in and around the clubhouse; one saw the aircraft flying at an estimated height of 100 to 150 ft in a southerly direction, beyond Runway 04. It then turned left until it was heading directly towards the clubhouse, apparently maintaining height. The witness voiced a concern about the aircraft, which drew others' attention to it. It was then seen to roll briskly to the left to about 45° angle of bank. Immediately afterwards, the aircraft departed from controlled flight, rolled further to the left, adopted a steep nose-down attitude and descended rapidly, impacting the ground shortly before the start of Runway 04.

Most of the witnesses were inside the clubhouse and did not hear the aircraft. An eleven-year-old girl, who was outside the clubhouse and only about 200 m from the accident scene, saw and heard the aircraft as it flew towards her. Initially she thought the aircraft may have been going to land in the same direction (ie on one of the taxiways). She reported hearing the engine making a spluttering sound, causing her to think that there was something wrong. The noise then stopped, and was replaced with a whistling noise, just before the aircraft rolled to the left and descended rapidly.

Onlookers rushed to the scene to assist the pilot, but there were no signs of life. Emergency services, including an air ambulance, attended, but it was confirmed that he had sustained fatal injuries.

Recorded information

The pilot's Garmin GPS 89 satellite navigation unit was recovered from the wreckage. It had recorded a total of twelve tracks made by the pilot in the preceding three months, including the accident flight. Altitude information is not recorded on this model of GPS unit.

The track of the accident flight is shown at Figure 2. The recording starts at 10:37:20 hrs as the aircraft was taxiing prior to takeoff and ends at 10:42:43 hrs, near the accident site. The track shows that the aircraft entered Runway 09 and taxied part-way along it, before stopping for approximately one minute, presumably while the pilot carried out his before takeoff checks (position A of Figure 2). The aircraft then continued taxiing to the takeoff point. The average groundspeed between each GPS track point is presented in Figure 3.

Figure 2

GPS track of the accident flight.

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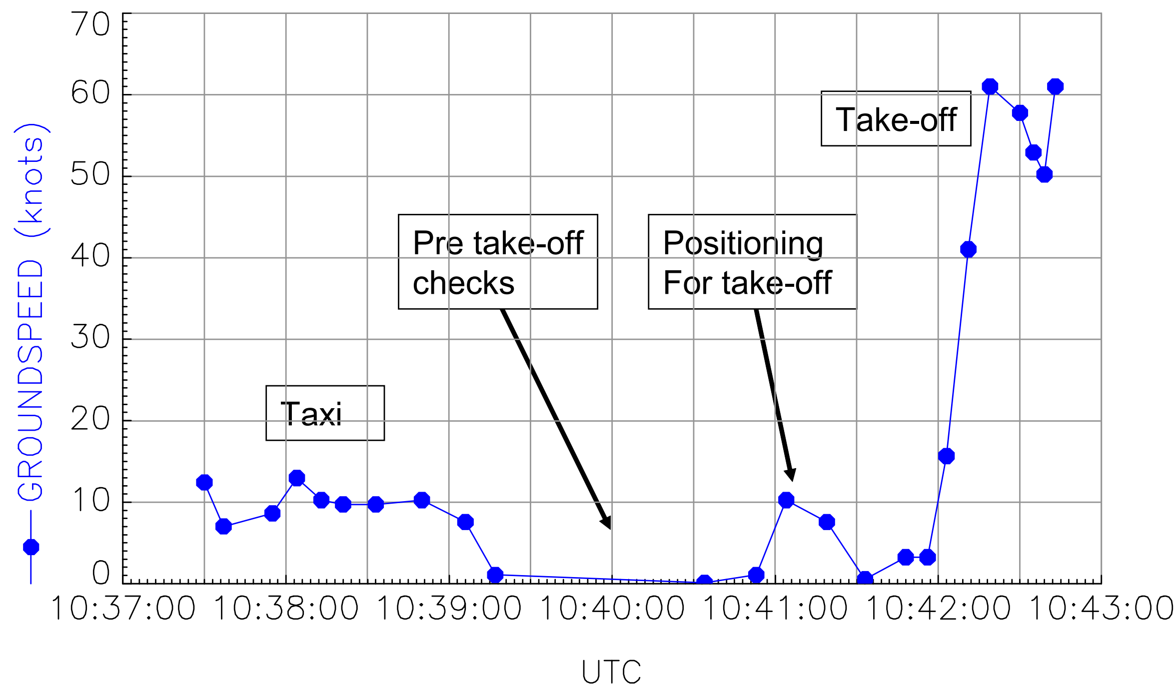

Figure 3

Accident flight calculated groundspeeds

Accident site and aircraft wreckage

The aircraft impacted the ground in a field of standing crops, just outside the airfield boundary. The ground track at impact was 065º(M). The ground marks were indicative of a near-vertical impact angle. Remains of the wooden propeller blades were driven a short depth into the ground at the centre of the ground mark.

The engine, instrument panel and fuel tank had separated from the fuselage. The engine block was relatively intact, though one of the rocker covers had detached in the impact and one of the engine intake manifolds had broken off at the point where it entered the cylinder head. Although the fuel tank was heavily disrupted, it still contained a significant quantity of fuel, which was noticeably green in colour rather than the normal blue of Avgas.

The fuselage came to rest on the edge of the airfield, having travelled forward and left from the initial point of impact and rotated 45° clockwise. The left wing was more heavily damaged than the right. The flying control surfaces were intact and still connected to the cockpit controls, with the exception of the aileron control rod connection to the bellcrank, which had failed on both wings.

Airfield information

Great Oakley is an unlicensed airfield, 3.5 nm south-west of Harwich. It has two grass runways, designated 04/22 (600 m long) and 09/27 (850 m long). The airfield is situated amongst gently undulating terrain and is surrounded by fields. At the time of the accident, these contained standing crops.

The surface of Runway 09/27 has a notable downslope 70 m from each end. Pilots are advised to treat these as overrun areas only. When taking off from the highest elevation, close to the Runway 27 numbers, the runway slopes noticeably downwards in the first and last thirds, with a more level section in the vicinity of the crossing runway. The downslope in the last part of Runway 27 ends at a substantial hedge line on the airfield boundary. The Runway 27 circuit is right-hand.

Pilot information

The pilot, who had a background as an aircraft technician, had flown regularly since gaining his Private Pilot's Licence in 1976. He held a valid Class 2 medical certificate. G-CEKB was the second Taylor Monoplane he had built; the first was completed in 1986, since when he had flown the type almost exclusively. He subsequently built G-CEKB, and first flew it in September 2008.

Witnesses interviewed at the flying club spoke highly of the pilot and reported that he was very conscientious with regard to operating and maintaining both his aircraft. They described him as having a conservative approach and being highly knowledgeable and experienced with regard to the Taylor Monoplane aircraft type. Members of the pilot's family said that he had devoted a significant amount of time and resources into building and maintaining the aircraft.

Pathology

A postmortem examination on the pilot revealed no underlying medical issues which could have caused, or contributed to, the accident.

Meteorological information

The airfield owner maintained a meteorological observation station. Data recorded by the station showed that, at the time of the accident, the temperature was 21ºC, with a relative humidity of 77%. The surface wind was west or north-westerly at about 3 to 5 kt. Based on the weather reports from airports at Stansted, Southend and Norwich, the visibility would probably have been about 10 km, with no significant cloud.

Aircraft information

General description

The prototype Taylor Monoplane first flew in 1959. It is a homebuilt, single-seat, Permit-to-Fly aircraft constructed from wood and fabric. It is equipped with a tailwheel landing gear. It is not equipped with wing flaps. The accident aircraft was fitted with a fixed-pitch propeller driven directly by an 1834 cc aero-converted Volkswagen (VW) engine which required Avgas 100LL fuel. As the aircraft had no electrical system, the engine was started by hand swinging the propeller.

G-CEKB history

The aircraft was built by the pilot over a period of some eleven years using a set of technical drawings and informal guidance from various sources. He had previously built another Taylor Monoplane, and had introduced various upgrades on the later aircraft, including a more powerful engine. The engine was modified from a standard 1600 cc VW automotive engine by increasing its capacity to 1834 cc and fitting a dual ignition system and oil cooler. The engine components were modified or supplied by a specialist supplier, but the pilot had assembled the engine himself.

Based on accounts from various witnesses, G-CEKB appeared to have suffered from engine-related problems dating back almost to its first flight in September 2008. It is believed that the pilot had performed a number of troubleshooting activities on the aircraft as a consequence, but he reportedly completed most of work on the aircraft himself, without assistance. Witnesses were not able to provide detailed accounts of the problems or first-hand knowledge of the rectification work carried out.

Some witnesses recalled issues concerning engine starting problems when the engine was warm and of the engine running rough, along with limited reports of an in-flight engine problem. There was also a report that the pilot had identified a large rpm drop when carrying out magneto checks. He had made a single entry in the engine logbook, dated 15 June 2009, highlighting the starting problems on the engine. It identified that he had removed both magnetos from the aircraft and disassembled them. The specialist spares supplier used by the pilot stated that he had exchanged the coils given to him by the pilot for newly overhauled ones. The pilot had reassembled the magnetos with new contacts and condensers and refitted them to the aircraft. He had also installed new spark plugs.

The same logbook entry, dated 15 June 2009, identified that the pilot had also adjusted the tappets. Some witnesses reported that he had fitted home-made shims to the rocker arm assemblies to increase the tappet clearances, after experiencing difficulty achieving the correct clearances. Additional reports suggested that the pilot had identified a concern regarding the security of the rocker arms on all four cylinder heads after finding them loose whilst investigating an engine problem. This was apparently addressed by applying 'Loctite' adhesive to the securing nuts. One witness reported that, in the days immediately prior to the accident, the pilot had determined that two of the engine's four cylinders were running cold. It is believed the pilot had attempted to rectify these various problems in the six weeks leading up to the accident. Much of this evidence was supported by findings from the wreckage examination, but as the pilot did not keep detailed maintenance records, an exact timeline of the specific problems and the resulting maintenance actions could not be fully determined.

The Light Aircraft Association (LAA) inspector who routinely inspected the aircraft and had a long-term association with the pilot, reported that he had arranged to assist the pilot in troubleshooting the engine issues, and to inspect the workmanship and conformity of any modifications, during the afternoon of the day of the accident. He was therefore surprised to discover that the pilot had flown the aircraft that morning.

Aircraft's stalling characteristics

On 18 September 2008, the pilot conducted a flight test in G-CEKB as part of the process of qualifying the aircraft for issue of a Permit to Fly. The flight test schedule required examination of the aircraft's stalling characteristics. The pilot recorded on the flight test form that the aircraft exhibited *'slight buffet'*, approximately 3 kt above the actual stall speed.

Other Monoplane owners and pilots familiar with the aircraft type explained that the aircraft is normally operated at speeds considerably above its stall speed because, with its relatively low inertia, it can lose airspeed relatively easily. They described how considerable power is required to maintain speed in a turn, adding that level turns with bank angles approaching 45º cannot be maintained without a loss of airspeed.

The aircraft's wing design does not incorporate 'washout', a feature which reduces local angles of attack at the wingtips and encourages inboard sections of the wing to stall before the outboard sections. This normally desirable design feature aids stall warning and helps prevent uncontrollable rolling moments caused by one wingtip stalling before the other, as well as helping to ensure aileron effectiveness at low airspeeds.

Engineering investigation

Fuel system

Although fuel was present in the tank, there was no fuel in the line to the engine, or in the carburettor bowl. Detailed inspection of the fuel pipe routing identified a significant restriction in the rubber hose caused by a clipping point, with an associated fracture in the hose; both were confirmed to be impact damage. The post-accident orientation of the engine would have allowed fuel to drain from the pipe out of the fracture. No other restrictions were found in the fuel system. The fuel pump had broken off in the impact, but its engine-driven shaft operated freely. The fuel pump contained residual fuel and showed no defects. The carburettor appeared to be serviceable. The aircraft was not fitted with an auxiliary fuel pump.

The fuel pump and carburettor were mounted on the top of the engine; this resulted in the fuel supply line from the tank following a 'U'-shaped profile with a number of turns to allow it to be secured to the engine block. There was no heat shielding fitted to the rubber pipe where it was routed alongside the engine and there were numerous diameter changes for in-line components such as the fuel filter and non-return valve. The flexible pipes used in the aircraft's fuel system were the correct specification for use with gasoline.

Fuel sample

The fuel sample recovered from the wreckage was laboratory tested against the specification for Avgas 100LL. It did not meet the requirements for appearance, vapour pressure, distillation, gum and lead content. The colour differed from the bright blue of Avgas 100LL and the high gum content suggested that the fuel may have been contaminated. Further analysis of the fuel and the gum residue showed the presence of higher boiling point components not consistent with Avgas 100LL. Comparison with a sample of unleaded motor gasoline (Mogas) indicated that some of these components may have come from the presence of Mogas. The presence of phthalate was also indicated in the gum residue. The presence of phthalate in fuel can be an indication that the fuel has been in contact with an elastomeric material, possibly during storage, and has leached out some of the plasticiser. It was not possible to confirm the source of the plasticiser.

Engine examination

A detailed strip of the engine was carried out which identified no mechanical failures, other than to the pushrods and rocker arm assemblies which had been distorted by the impact. This prevented any accurate assessment of tappet clearances. The rocker arms were fitted with unusual[1] rotating ball bearing tappet screws. These were identified as a performance tuning part supplied with the engine when it was purchased from the specialist supplier. The balls had flats which contacted the top of the valve when correctly orientated. However, it was noted that the ball could rotate changing the clearance and making it difficult to measure accurately. The fittings containing the balls could also be adjusted on a thread to change the gap. They had all been adjusted to the highest position to give maximum clearance. The home-made shims fitted by the pilot were present and the rocker arm retaining nuts were still secure and in place. Also of note was the fact that dirt was compacted by the piston into one of the cylinder heads fed by the fractured intake manifold. A piece of wood and fabric from the engine cowl had worked itself between one of the rocker arms and the top of the valve spring, on the side of the engine where

Footnote

1 The engine strip was conducted with the assistance of an engineer with broad experience of VW aero engines, who commented that he had not seen this kind of tappet arrangement used previously.

the rocker cover had been dislodged in the impact. The propeller hub also displayed circumferential scratch marks on its front face.

Ignition system

The aircraft was not fitted with an electrical power system; engine ignition was provided by a simple circuit consisting of a pair of chain-driven magnetos energising a dual high-tension lead and spark plug system. Neither magneto was fitted with an impulse coupling. The engine drive chain was intact and properly tensioned. The ignition leads were intact, with no continuity problems, though the distributor cap on each magneto had been shattered in the impact. The spark plugs were new and in good condition, but the electrode gaps on all eight spark plugs were exceptionally small and well below the normal range of 0.016 to 0.022 inch. The magnetos were removed, inspected and tested. The left magneto was correctly set up and produced a good spark. However, the right magneto's rotor cog, cam and points were set up such that it produced a weak spark at the wrong time. Misalignment of the rotor cog may have been caused by the impact, but even if this had been correctly set previously, it is likely that the magneto was not producing a strong spark before the accident.

Other information

Vapour lock

The LAA publish advice regarding 'vapour lock' in an engineering information leaflet on the use of unleaded Mogas in light aircraft.

Vapour lock is caused by vaporised fuel collecting and forming a 'bubble' which becomes trapped at a high point or constriction in a fuel pipe, preventing the passage of fuel to an engine causing it to cut out (or prevent it from being started). However, fuel can also vaporise at a localised hot spot or low pressure area in the fuel system without becoming trapped; a stream of vapour bubbles will then enter the carburettor along with the fuel, causing lean running and reduced power. If this form of fuel vaporisation is encountered, retarding the throttle can result in the reduced airflow into the engine giving a better fuel/air mixture for combustion, thus removing the symptoms of the problem. However, as the problem is exacerbated by an increasing engine temperature, the symptoms are likely to return as soon as an increased throttle setting is re-selected.

Vapour lock is most likely to occur in aircraft equipped with engine-driven mechanical fuel pumps and which do not have an additional fuel boost pump. If the engine-driven fuel pump is located (or as a consequence of aircraft attitude becomes situated) above the level of fuel in the fuel tank, the fuel pressure on the upstream side of the fuel pump is reduced below atmospheric pressure by the action of the pump 'sucking' the fuel, increasing the likelihood of fuel vapour forming on the inlet side of the pump. This problem is exacerbated by heating of the fuel within the supply pipe, particularly where unshielded pipes come into contact with the engine. The cylinder heads on this engine typically run at 140°C and can reach 180°C on a hot day. This can create significant residual heat build-up under the engine cowling when there is limited cooling airflow over the engine.

Engine failure after takeoff

An engine failure soon after takeoff requires a pilot to take effective action quickly. A safe airspeed must be maintained and a suitable landing area chosen. If insufficient runway length remains, an area beyond the runway must be chosen for a forced landing. Turning at low altitude following a complete or partial engine failure is extremely hazardous as the aircraft is at considerable risk of stalling whilst manoeuvring, so the area chosen must normally be within about 30º of the takeoff direction.

A pilot faced with a rough running engine after takeoff, or one producing insufficient power to climb safely, must decide quickly whether the best course of action is to land ahead, or to attempt to land back on the airfield. Although the best advice is generally to plan for the worst case and land ahead, in reality several factors may be involved. As well as the perceived seriousness of the problem, there may be a shortage of available forced landing areas, the considerable probability of damage to the aircraft and the pilot's proficiency or confidence to commit to an immediate forced landing.

The following advice to General Aviation pilots is given by the CAA in its publications *Safety Sense Leaflet 1a: Good Airmanship* and *General Aviation Safety Information Leaflet (GASIL) 1 of 2006*:

> *'In the event of engine failure after take-off, if the runway remaining is long enough, re-land and if not, never attempt to turn back. Use areas ahead of you and go for the best site. It is a question of knowing your aircraft, your level of experience and practice and working out beforehand your best option at the aerodrome in use.'*

> *'It is possible that in certain circumstances turning back to the aerodrome might be the option which minimises the risk of injury to the aircraft occupants, provided the pilot maintains a safe airspeed and sufficient height exists taking into account the extra drag from a windmilling propeller. However, in general, landing ahead is nearly always going to be the safest option in the event of an engine failure.'*

Analysis

General

There was no evidence to suggest that a pilot health issue may have contributed to the accident, and the flying weather was good.

Aircraft handling issues

The flightpath after takeoff was not consistent with the pilot's declared intentions, nor with local flying procedures. Had the pilot intended to return to land for any reason other than a very serious one, he probably would have flown a normal circuit to the north, back to Runway 27 or possibly Runway 22. The circumstances of this accident indicate that an unplanned event forced the pilot to change his intentions soon after takeoff, and that he was probably attempting to make an immediate landing back on the airfield. In the course of manoeuvring to land, he lost control of the aircraft and had insufficient height in which to recover.

The GPS groundspeed indicated apparently normal takeoff acceleration until the aircraft would have been approximately over the midpoint of the runway. However, the speed did not continue to increase but reduced instead as the aircraft turned crosswind.

The only witness who saw the aircraft immediately after takeoff thought the engine noise was abnormal. He described the aircraft starting a descent after the midpoint of the runway, accompanied by a reduction in engine sound. This may have been a feature of perspective and shielding, but if it occurred, one possible explanation is that the pilot decided to land ahead on the runway remaining, and the cessation of engine noise was a result of the pilot closing the throttle. However, the aircraft did not land ahead. This could have been due to the unfavourable runway slope and the unforgiving overrun area, or the engine power may have partially recovered. Whatever the reason, the engine must have been running and capable of producing some power for the aircraft to climb again, or at least maintain height. Sufficient power was also available for the pilot to initiate a turn to the left, albeit at a very low height.

The pilot's intentions are not known. He may have been positioning for a landing on Runway 04, on one of the taxiways or one of the many fields surrounding the airfield. Evidence from witness and GPS data, however, do show that that the pilot flew a tight pattern, at low height placing the aircraft relatively close to the Runway 04 threshold. A landing on one of the taxiways may have been possible from this position, or the pilot may have decided to try to land on the runway. Had he chosen to do the latter, it would have required a relatively late and tight left turn.

The safety message clearly stated in the CAA publications is that an attempt to turn back to the airfield from a low height following an engine failure has an associated high risk. Numerous accidents have resulted from pilots attempting to turn too tightly and/or allowing the airspeed to decay in an attempted turnback, with the inevitable result of a stall and then loss of control, with often fatal consequences.

Technical issues

The final position of the fuselage relative to the ground marks and the damage to the left wing are consistent with rotation of the aircraft following a left wing stall. The investigation confirmed that all damage to the aircraft structure and flying controls was a consequence of the ground impact.

A number of the engine problems mentioned by witnesses could be explained by features of the engine and its installation, as identified during the investigation.

The fuel system installation used on the accident aircraft would have made it more vulnerable to fuel vaporisation issues, as would the addition of Mogas into the fuel. The hot starting issues reported may, therefore, have been symptomatic of fuel vaporisation problems. The fuel system installation and use of Mogas may also have induced fuel vaporisation which caused or contributed to rough running of the engine during the accident flight. The first Monoplane built by the pilot had a different engine installation with the carburettor on the bottom of the engine, a gravity-fed fuel system and a fuel pipe routing which did not bring it into contact with the engine block. It was therefore less susceptible to fuel vaporisation and the pilot may not have encountered the symptoms prior to flying the new aircraft.

The flexible pipes used in the aircraft's fuel system were the correct specification for use with gasoline. It is therefore likely that the plasticiser contamination occurred while the fuel was in storage. Although it highlights the significance of using approved storage containers, plasticiser contamination is not considered to have contributed to the engine problems during the accident flight, as no gum deposits were found within the engine fuel system accessories which are sensitive to this issue. This was also consistent with the low operating hours of the engine.

The difficulty experienced by the pilot in achieving the correct tappet clearances may have been exacerbated by the unusual rocker arm arrangement. He had attempted to address the issue by fitting home-made shims, but this reduced the thread exposed to secure the retaining nuts for the rocker arms. This may in turn explain why he had to apply 'Loctite' to the nuts to prevent them from working loose. It was not possible to determine whether this solution had fully addressed the original concerns that initially prompted the pilot to adjust the tappets.

It is possible that the spark plug gaps were reduced by the pilot to compensate for the weak spark produced by the right magneto. The issues identified with both the spark plugs and the magneto may have had a detrimental effect on the performance of the engine.

The evidence of the dirt in the cylinder, the wood and fabric under the rocker arm and the scratches on the propeller hub indicate that the engine was still running at the point of impact.

Whilst the exact nature of the problem that became manifest during the takeoff and its cause could not be confirmed, the engine issues identified could, either alone or in combination, have resulted in power loss or rough running.

Defect troubleshooting

The pilot had taken considerable efforts to address the engine problems on his aircraft, but had not kept a comprehensive record of the work carried out. By working alone and not keeping a full record of the work completed, the task of troubleshooting defects in a logical manner over an extended period of time became more difficult, and this may have prevented the LAA inspector from being able to assist him effectively or to identify problems such as the incorrectly set up magneto.

LAA inspectors have experience and expertise which can be drawn upon by members when maintenance work is being carried out or certified. In order to benefit fully from this resource it is essential to record the work done and ensure that it is approved, where necessary, before further flight. The LAA has a downloadable template of a maintenance staging sheet for this purpose on their website.

Conclusion

The investigation concluded that the aircraft developed an engine problem almost immediately after takeoff, although the exact nature of the problem could not be positively determined. The pilot appears to have attempted to make an abbreviated left hand circuit at a low height, to land back on the airfield. During this manoeuvre, he lost control of the aircraft. It stalled and departed from controlled flight, with insufficient height available for the pilot to recover.

ACCIDENT

Aircraft Type and Registration:	EV-97 TeamEurostar UK Eurostar, G-CFNW
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2008
Date & Time (UTC):	17 October 2009 at 1140 hrs
Location:	Perth Aerodrome, Perth, Scotland
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller, nosewheel, engine firewall and cockpit floor
Commander's Licence:	Student
Commander's Age:	64 years
Commander's Flying Experience:	100 hours (of which 40 were on type) Last 90 days - 20 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The EV-97 TeamEurostar UK is a two-seat low-wing microlight aircraft, of aluminium construction, which is operated in the UK under a Permit to Fly. The student pilot was carrying out solo circuits in the aircraft, consisting of multiple 'touch-and-go' landings. The pilot reported that the wind was light and variable, and Runway 03 was active. On one of the landings the aircraft bounced immediately after touchdown and then touched down again with heavy contact on the nosewheel. The pilot aborted the landing attempt and applied full power to climb away. He requested a visual inspection from the tower during a fly-past and the tower controller reported no visible damage. As a precaution the pilot requested the airfield fire truck to stand by. The pilot subsequently landed uneventfully, but an examination of the aircraft revealed a minor propeller strike, a dent in the nosewheel rim and a slight buckling of the firewall and cockpit floor.

ACCIDENT

Aircraft Type and Registration:	EV-97 TeamEurostar UK Eurostar, G-IHOT
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2004
Date & Time (UTC):	18 April 2010 at 1110 hrs
Location:	Plaistows Farm Airfield, Hertfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right landing gear, propeller and leading edge of right wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	478 hours (of which 47 were on type) Last 90 days - 35 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was on final approach to grass Runway 33 in good weather conditions. The temperature was estimated to be 18°C and the wind was light and variable. The pilot completed a normal touchdown on the runway centreline but the left wing then lifted back into the air. The pilot was unable to maintain directional control of the aircraft and it veered to the right and departed the runway. The aircraft then struck the landing direction 'T' which sits on a raised tarmac and metal platform. The aircraft suffered damage to its propeller, landing gear and the leading edge of the right wing. The occupants, who were uninjured, released their harnesses and vacated the aircraft normally. There was no fire.

ACCIDENT

Aircraft Type and Registration:	Flight Design CTSW, G-CENE
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2007
Date & Time (UTC):	21 April 2010 at 1645 hrs
Location:	Barton Airport, Manchester
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nose landing gear collapsed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	548 hours (of which 82 were on type) Last 90 days - 8 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was returning to Barton having completed a four-leg day trip. The wind was slightly gusty from a north-westerly direction at 12 kt. Following a normal approach to Runway 27L, just before touching down, the pilot became aware that the aircraft was drifting towards the left edge of the runway. He applied rudder to correct the drift. The aircraft touched down, initially on the main landing gear. However, it then bounced and continued to drift, at low speed, towards longer grass at the left edge of the runway. The nose landing gear then contacted the runway surface, immediately collapsing and the aircraft quickly came to rest. The pilot shut down the aircraft normally. Both occupants were uninjured and exited the aircraft without difficulty.

The pilot considered that he should have performed a go-around when the aircraft had begun to drift to the side of the runway. Correcting the drift had taken his attention away from the flare and touchdown. The aircraft had touched down in a slightly flat attitude and the pilot thought the control column may have been moved forward in the bounce.

ACCIDENT

Aircraft Type and Registration:	Schempp-Hirth Flugzeugbau GMBH Discus B, G-CHOM
No & Type of Engines:	None
Year of Manufacture:	1985
Date & Time (UTC):	9 July 2009 at 1552 hrs
Location:	West of Gransden Lodge Airfield, Cambridgeshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	BGA Gliding Certificate with Bronze Badge and Cross-Country Endorsement
Commander's Age:	64 years
Commander's Flying Experience:	19,600 hours (of which 2 hours were on type) Last 90 days - 15 hours (gliders) Last 28 days - 8 hours (gliders)
Information Source:	AAIB Field Investigation

Synopsis

Approximately ten minutes into a flight following a winch launch, the glider was observed to be in a spin to the left. The indications were that it entered the spin while soaring and did not recover before it struck the ground. The pilot sustained fatal injuries.

History of the flight

Before taking a winch launch in the glider, the pilot received a brief on the latest BGA advice on winch launching. The briefing, with an instructor, did not include any discussion of intentional spinning during the pilot's forthcoming flight. The visibility was in excess of 10 km and there was cumulus cloud above 3,500 ft. One instructor described it as "a good soaring day". Another instructor, who witnessed the glider's takeoff, commented that it was a "textbook" launch. The aircraft was not carrying water ballast.

Data recovered from GPS equipment carried in the aircraft, showed that the glider soared to the west of Gransden Lodge for approximately ten minutes after being released from the winch cable. Witnesses on the ground then observed the glider established in a spin to the left; the angle of their observation and the GPS evidence indicated that the glider was passing approximately 600 ft agl when they first saw it. The glider then passed out of their line of sight, still spinning. Shortly before the end of the flight, the GPS recorded a series of positions close to each other, consistent with a spin.

An instructor, who was airborne and soaring nearby, saw the glider in a field and alerted another glider pilot by radio. They both landed, went by car to the accident site and found the glider in a field of rape. The pilot had sustained fatal injuries in the impact.

The radio in G-CHOM had been tuned to the same frequency as the radios in the instructors' gliders but no distress call was heard from the pilot.

Wreckage and impact information

The glider came to rest in an upright position, on a heading of 170°M, in a field of rape on the western edge of Gransden Lodge Airfield. The lower section of the cockpit area had been extensively damaged and the top of the seat back frame had been forced upwards consistent with the glider sustaining a high vertical impact. The canopy frame had broken and the canopy's transparent material was found scattered around the nose area of the glider. Whilst the aero-tow hook was full of earth, there was no other damage to the nose section.

The inboard leading edge of the left wing had delaminated and there was compression damage along the top of the wing and damage on the inboard trailing edge of the lower surface. The right wing appeared to be undamaged. There was some damage to the leading edge and lower surface of the left side of the tailplane. The mainwheel was in the up position and the elevator trim was set 5 cm from the rear position the full range being 8 cm. All the flying controls were assessed as being serviceable prior to the impact.

The damage to the rape crop indicated that the left wing and tail section were moving anti-clockwise, as viewed from above, when the glider made contact with the crop. The damage was also consistent with the glider having a relatively low forward speed at impact.

Centre of Gravity (CG)

The position of the CG at the time of the accident was calculated by the AAIB to be 400 mm aft of the datum, which placed it at the aft limit. The manufacturer reported that during flight tests the aircraft had been flown with the CG 415 mm aft of the datum, ie 15 mm beyond the aft limit, and stated that:

> *'no exceptional flight characteristics of the Discus has been reported in the test flight reports.'*

In calculating the CG during the investigation, it was noted that there was a discrepancy between the maximum and minimum seat weights recorded in the glider's weight and balance report, issued on 16 December 2004, and the placard found in the glider. This discrepancy had gone unnoticed since January 2005, with the risk that the glider might have been flown, unintentionally, with the CG outside of the approved limits. Whilst this discrepancy was not causal to this accident, it was brought to the attention of the BGA. They subsequently took action to advise their inspectors, and owners, of the importance of ensuring that the placard accurately reflects the status of the aircraft.

Recorded information

A Garmin II Plus GPS was recovered from the aircraft. There were a number of tracks saved in its data log, including the accident flight but, due to the model of the GPS equipment, altitude information was not recorded. The accident log started at 1504:08 hrs at Gransden Lodge Airfield and ended at 1552:11 hrs near the accident site, just to the west of the airfield. The evidence indicated that the glider commenced its takeoff at 1542:15 hrs. Radar data was requested but nothing was detected during the period of the accident, at or within the vicinity of the airfield.

Figure 1 shows the GPS track for G-CHOM, which is consistent with the glider soaring. The accident site was very close to the last recorded GPS position. The indications were that the aircraft's track at the point of impact was approximately 170ºM.

The average groundspeed between each GPS track point is presented in Figure 2 and shows that the groundspeed during the majority of the flight oscillated between 30 and 60 kt. The wind at 1552 hrs at 1,000 ft, 1,500 ft and 2,000 ft agl was estimated to be from 300° at 15 to 20 kt. There was no indication of the glider's rate of climb or descent.

The pilot

The pilot learned to fly with a University Air Squadron in the mid-1960s, before training as a commercial pilot and working for a number of airlines, flying jet aircraft on international routes. On his retirement from professional flying, he took up gliding and undertook his first solo glider flight (in a K21 glider) after 17 launches. He then converted onto the Junior single-seat glider followed by the Discus. Instructors who flew with the pilot described him as having good, accurate flying skills and exercising very sound judgement, consistent with his background as a professional pilot. He was developing his ability to find lift and maintain soaring flight for extended periods but most of his

Figure 1

GPS track of G-CHOM

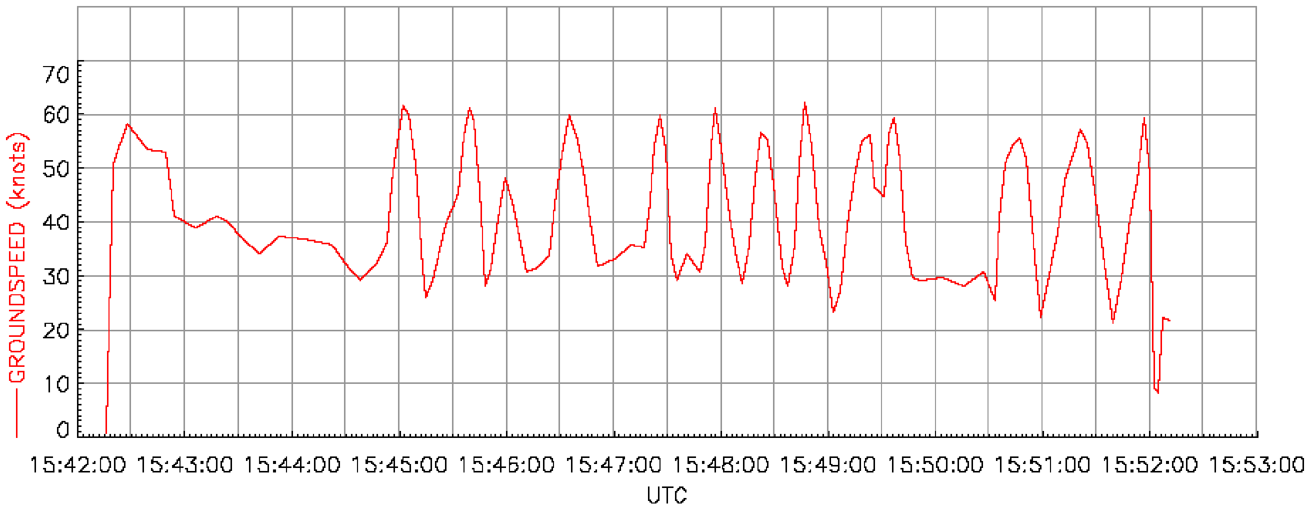

Figure 2

Speed of G-CHOM over the ground

winch-launched flights were of short duration. His last annual refresher flight, in March 2008, included a spin check. The instructor on that occasion commented in the pilot's log book:

> *'Spin check for annual refresher exceptionally well done.'*

The pilot was also a regular tug pilot at the gliding club and had flown a number of aero-tows on the day of the accident. He had a share in a Chipmunk aircraft which he flew a number of times a year.

Pathology

The postmortem examination report stated that the pilot died of multiple injuries, sustained in the accident, and that the accident was not survivable. No evidence of incapacitation was found.

A number of years before the accident, it had become apparent that some members of the pilot's family had a genetically-determined heart condition, which could produce abnormalities in heart rhythm or, possibly, sudden death. The health of the pilot's heart had been regularly investigated and this had revealed occasional abnormalities, for which he had been prescribed medication. For a short time between 2005 and 2006, the pilot's Class One medical certificate had been restricted to multi-crew operations. In 2008, when he had retired from professional flying, his certificate was changed from Class One to Class Two.

The pathologist stated in the postmortem report:

> *'Although no significant cardiac pathology was evident at the autopsy, the possibility that the pilot may have suffered an incapacitating abnormal heart rhythm cannot be entirely discounted, as this can occur without leaving any pathological evidence. However to invoke this as a likely cause of the accident would require other strands of the investigation to suggest that medical incapacitation of the pilot was probable'.*

Spinning the Discus Glider

No official data relating to the height loss per turn in a spin in the Discus B could be obtained. However, data from tests on similar glider types suggested that the duration of a turn in a developed spin would be of the order of two to five seconds, and the height loss would be about 200 to 360 ft.

The manufacturer provided extracts of a flight test report which stated that recovery from the spin is effected in not more than half a turn. The report added that the loss of height from the point at which recovery is initiated, by the standard method, to the point at which normal level flight is first regained is approximately 262 ft.

An experienced Discus pilot commented that the Discus B glider exhibited "entirely normal" characteristics when spinning. He offered the opinion that the aircraft was not likely to enter a spin without being provoked by its pilot. However, he added that if a thermal turn is mishandled and uncommanded roll occurs, the ailerons must be centralised. If, instead of centralising the controls, the pilot attempts to maintain the desired roll attitude with aileron, a spin may be provoked. Furthermore, he commented that a spin in the Discus is similar to that experienced in a Puchacz glider, in which the pilot of G-CHOM had flown his most recent annual check.

BGA analysis of spinning accidents

The BGA provided a comprehensive analysis of glider accidents in the United Kingdom since 1974, when their current records began. The analysis showed a total of 163 fatal or serious injury accidents involving stalling and/or spinning. Approximately half the accidents occurred during winch launches. The other accidents included a very small number resulting from intentional spins but, commenting on the remainder, the report stated:

> *'The overwhelming majority were cases of an inadvertent stall or spin near the ground.'*

In examining accidents not related to winch launches, distraction was often a factor. Discussion with the BGA, glider pilots, and instructors, indicated that the importance of centralising the controls in the event of uncommanded roll is well-publicised and generally well understood by glider pilots. During the discussions, some opinion was offered that a spin entry during thermalling flight was likely to be the result of mishandling the controls. However, as gliders are not equipped with flight recorders which measure control inputs, no data was available to support this.

Analysis

The flight appeared to have progressed normally until the glider entered a spin to the left from which it did not recover. The investigation established that the glider was serviceable and that the controls were intact prior to the accident. The dense crop of rape at the accident site appeared to have dampened the motion of the glider on impact. Nevertheless, there was sufficient evidence to establish that the glider struck the ground with relatively little forward speed, in a nose-down and left wing low attitude. The evidence at the accident site was consistent with the glider being in a spin to the left at the moment of impact.

The CG of the glider was calculated after the accident to have been on the aft limit and therefore in the permissible range. The manufacturer advised that the aircraft had been tested with a CG 15 mm beyond the aft limit and that no '*exceptional flight characteristics*' had been reported. The advice given also indicated that recovery from a spin would be achieved in not more than half a turn, during which the height loss would be about 260 ft.

No malfunction or failure was identified to account for the entry into the spin, which was either intentional or unintentional, and the pilot did not make any distress call on the radio during the accident sequence.

Intentional spin

The absence of height data meant that it was not possible to determine the vertical profile of the accident flight. The weather conditions were suitable for a spinning exercise and it is conceivable that the pilot soared to a safe height from which he could have executed an intentional spin and recovery. However, there was no evidence that the pilot planned to spin during the accident flight and, if the entry to the spin was intentional, it is not clear why a successful recovery was not achieved. He had demonstrated *'exceptional'* skill in recovering from a spin during his last annual check in 2008, when it had been a planned manoeuvre.

Unintentional spin

There was no evidence to suggest a cause for an unintentional spin. Distraction may have been a factor, though no distracting event could be identified. An unintentional spin may have begun at too low a height to permit recovery but the level at which the glider was first observed in a spin to the left suggests that there was sufficient height remaining for the pilot to effect a successful recovery.

In summary, there was insufficient evidence to account for the entry into the spin and the absence of a recovery from it. The possibility that the pilot may have suffered an incapacitating abnormal heart rhythm could not be entirely discounted as this can occur without leaving any pathological evidence.

ACCIDENT

Aircraft Type and Registration:	Skyranger 912S(1), G-CDTP
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2005
Date & Time (UTC):	9 May 2010 at 1500 hrs
Location:	Breighton Airfield, North Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nosewheel collapsed and propeller damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	70 years
Commander's Flying Experience:	541 hours (of which 41 were on type) Last 90 days - 7 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot flew the approach to Runway 29 at 65 mph and the surface wind at the time was reported as 030°/6 kt. He was aware that there was a crosswind from his right and, therefore, adopted the 'wing-down' landing technique. As he began to flare the aircraft, the speed reduced to 50 mph and the right wing suddenly lifted. Despite the pilot increasing the engine speed, the aircraft landed heavily on the nosewheel, which collapsed, and the propeller struck the ground.

The pilot commented that the accident occurred because he did not carry out the correct crosswind landing technique for this aircraft type, which required him to maintain 65 mph until the aircraft had touched down.

ACCIDENT

Aircraft Type and Registration:	X'Air 582(1), G-BZAF
No & Type of Engines:	1 Rotax 582/48-2V piston engine
Year of Manufacture:	2000
Date & Time (UTC):	13 June 2009 at 0717 hrs
Location:	Carland Cross, Cornwall
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damaged beyond economic repair
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	88 hours (of which 21 were on type) Last 90 days - 19 hours Last 28 days - 12 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further investigation by the AAIB

Synopsis

Approximately 15 mins after takeoff the pilot felt a "violent vibration" through the aircraft followed, by what he believed was a loss of lift from the right wing. The pilot subsequently flew a forced landing into a field of standing crops. After touchdown the aircraft nosed over onto its back. The pilot vacated the aircraft uninjured.

History of the flight

The pilot stated that he was planning to fly from Perranporth, Cornwall to Northrepps Airstrip, near Cromer, Norfolk. Approximately 15 minutes after takeoff, while flying below the cloud base of 600 ft agl, the pilot felt a "violent vibration" through the aircraft followed by a perceived loss of lift from the right wing. Having closed the throttle and transmitted a MAYDAY call, the pilot flew a forced landing into a field of standing crops near Carland Cross, Cornwall, approximately 5 nm east of Perranporth. After touchdown the nosewheel struck a rut causing the aircraft to nose over before coming to rest inverted. The pilot vacated the aircraft uninjured. After vacating the aircraft the pilot noticed that several battens on the right wing were protruding through the underside of the wing by about 6 inches. The aircraft was damaged beyond economic repair.

Engineering examination of propellers

Two of the three propeller blades were received by AAIB in November 2009. Both showed evidence of having been removed from the propeller hub by the use of a saw. The third blade and the hub were not made available to the AAIB. One of the blades received had been separated into two pieces along the blade's span and showed evidence of a partial bending failure in a forward direction at the hub end.

Both propeller blades were subjected to a detailed examination. This examination found the blade that showed the evidence of a partial bending failure had surface defects where the resin within the surface plies had cracked and local fractures of the carbon fibres within the weave had occurred. Cross-sections of the defects showed that the surface woven carbon plies were only weakly bonded and in some areas disbonding had occurred. Where disbonding had occurred, the unsupported carbon fibres appear to have fractured in compression due to the action of flexural stresses. It was not possible to determine why or when the surface plies in these regions had begun to disbond.

Dry fibres, where the glass fibres were poorly impregnated with resin, were observed close to the root end of the blade. Cross-sections of these areas showed evidence of crack growth into the surrounding plies, which could account for some of the delaminations near the root end. Such delaminations could potentially have led to a localised reduction in the stiffness of the blade. It was not possible to determine what damage was present prior to the impact with the ground. If the partial disbonding of the surface plies and crack propagation from the poorly impregnated fibres had occurred in flight, this may have reduced the stiffness of the blade, which could have resulted in vibration being generated.

There was no evidence of similar surface defects in the second propeller blade.

Photographic evidence

The pilot sent a number of digital photographs taken at the accident site both with the aircraft inverted and after it was recovered into an upright position. From the photographs it could be seen that when the aircraft had come to rest inverted one of the propeller blades was projecting vertically downwards and would have been in contact with the ground. The two other propeller blades appeared intact and undamaged. The photographs taken after the aircraft had been recovered to the upright position showed that the propeller blade that was projecting vertically upwards had damage at the leading edge in the area of the hub end of the blade.

Pilot's comments

The pilot commented that he kept the aircraft parked outside without covers on the propellers. He added that on the previous flight he flew through rain for approximately 35 mins. During the pre-flight inspection, prior to the accident flight, there was no sign of damage to the propellers.

The pilot believed that the apparent loss of lift was probably due to low level turbulence.

Aircraft importer's comments

The aircraft importer viewed the accident photographs. He commented that he has not known the battens to unseat themselves in flight. He believed the protruding battens are likely to have been pushed through the fabric of the wing as a result of the weight of the aircraft on them in the inverted attitude. He added that if a few battens did unseat themselves they would only come out

1 to 1.5 inches and would have no appreciable effect on the aircraft's handling.

He added that the propellers can suffer damage if flown through rain for more than a few minutes.

Discussion

Despite the limited choice of forced landing site available due to the relatively low cruise altitude, the field selected appeared from the air to be suitable. Although it contained standing crop which obscured the rut that caused the aircraft to overturn, the alternative fields were all much smaller.

The propeller examination showed evidence of partial disbonding of the surface plies, crack growth and a partial bending failure at the root end of one of the propeller blades but it was not possible to determine when this damage occurred. The pilot stated that he did not cover the propellers when the aircraft was parked, he had flown through rain prior to the accident flight and there were no visible signs of damage during his pre-flight inspection. As a result it is possible that the propeller cracked due to the latent partial disbonding and aerodynamic forces that affect the propeller in flight, causing the vibration experienced by the pilot. It is also possible that the damage to the propeller blade could have occurred during the accident and subsequent wreckage recovery.

FORMAL AIRCRAFT ACCIDENT REPORTS
ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2009

1/2009 Boeing 737-81Q, G-XLAC, Avions de Transport Regional ATR-72-202, G-BWDA, and Embraer EMB-145EU, G-EMBO at Runway 27, Bristol International Airport on 29 December 2006 and on 3 January 2007.

Published January 2009.

2/2009 Boeing 777-222, N786UA at London Heathrow Airport on 26 February 2007.

Published April 2009.

3/2009 Boeing 737-3Q8, G-THOF on approach to Runway 26 Bournemouth Airport, Hampshire on 23 September 2007.

Published May 2009.

4/2009 Airbus A319-111, G-EZAC near Nantes, France on 15 September 2006.

Published August 2009.

5/2009 BAe 146-200, EI-CZO at London City Airport on 20 February 2007.

Published September 2009.

6/2009 Hawker Hurricane Mk XII (IIB), G-HURR 1nm north-west of Shoreham Airport, West Sussex on 15 September 2007.

Published October 2009.

2010

1/2010 Boeing 777-236ER, G-YMMM at London Heathrow Airport on 28 January 2008.

Published February 2010.

2/2010 Beech 200C Super King Air, VQ-TIU at 1 nm south-east of North Caicos Airport, Turks and Caicos Islands, British West Indies on 6 February 2007.

Published May 2010.

3/2010 Cessna Citation 500, VP-BGE 2 nm NNE of Biggin Hill Airport on 30 March 2008.

Published May 2010.

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