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Air Accidents Investigation Branch

AAIB Bulletin 11/2014

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01252 512299

Air Accidents Investigation Branch
Farnborough House
Berkshire Copse Road
Aldershot
Hants GU11 2HH

Tel: 01252 510300
Fax: 01252 376999
Press enquiries: 0207 944 3118/4292
http://www.aaib.gov.uk

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ACCIDENT

Aircraft Type and Registration:	Cessna 310Q, G-BXUY	
No & Type of Engines:	Two Continental IO-470-VO piston engines	
Year of Manufacture:	1970 (Serial No: 310Q-0231)	
Date & Time (UTC):	15 November 2013 at 1158 hrs	
Location:	Hawarden Aerodrome, Chester	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 1 (Fatal)	Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Commercial Pilot's Licence	
Commander's Age:	58 years	
Commander's Flying Experience:	1,645 hours (of which 261 were on type) Last 90 days - 18 hours Last 28 days - 6 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The aircraft was approaching to land at Hawarden Aerodrome at the end of a flight from Lognes-Emerainville Aerodrome near Paris. The aircraft deviated to the left of the runway on final approach and appeared to witnesses to become unstable before it pitched up and rolled to the left. It struck the ground in a steep nose-down inverted attitude. The investigation concluded that the left engine lost power at a late stage of the approach due to fuel starvation. The pilot probably attempted a go-around manoeuvre, but the speed fell below the minimum single engine control speed, causing him to lose control of the aircraft. The cause of the fuel starvation was attributed to mismanagement of the aircraft's fuel system.

Background to the flight

The pilot acquired G-BXUY in 2002. In September 2008, the aircraft began an extensive refurbishment programme at Hawarden and the pilot did not fly it again until August 2013, after the work was complete. At that time, he flew four flights in the aircraft with an instructor and examiner, when he renewed his Multi-Engine Piston (MEP) rating and passed a routine Licence Proficiency Check (LPC).

The pilot, who was from the Hawarden area but had a home in Andorra, flew G-BXUY to Seo de Urgel Airport in Catalonia, 12 km south of Andorra, arriving there on 12 August 2013. He then used the aircraft to fly between airfields in Spain and France before, on 7 November 2013, flying it from Seo de Urgel to Lognes-Emerainville Aerodrome, to the east of Paris.

History of the flight

Weather conditions on 15 November were fine. The pilot filed a flight plan for a departure at 0900 hrs, but this was subsequently delayed and the aircraft actually took off at 1001 hrs. The flight routed south of Paris before turning onto a north-westerly track which took it across the Channel towards Bognor Regis on the south coast. It then flew an approximately straight line to Hawarden, passing to the west of Birmingham. The aircraft initially flew at about 1,500 ft amsl (due to controlled airspace around Paris), before climbing to 4,500 ft over northern France, maintaining that altitude until nearing Hawarden.

The pilot was in routine contact with Air Traffic Control (ATC) during the flight and transmissions between the pilot and ATC were recorded and available for analysis. During the aircraft's progress through UK airspace, the pilot requested, and was provided with, a basic air traffic service from several ATC units: London Information, Farnborough West, Brize Norton, Shawbury, and Hawarden. The only non-routine radio exchange occurred when the Farnborough West controller noticed that the aircraft's altitude reporting transponder was giving ATC an erroneous altitude reading, requiring him to verify the aircraft's true altitude with the pilot. The pilot made no transmissions to suggest that the flight was not proceeding entirely normally.

When the aircraft was 12 nm from its destination, the pilot contacted Hawarden ATC and was informed that Runway 22 was in use. The surface wind was reported as being from 280º at 5 kt. Another light aircraft was in the circuit on a training flight; the instructor of that aircraft later commented that the conditions were good enough for his inexperienced student to make his first attempts at landing the aircraft. The training aircraft was downwind as G-BXUY turned on to final approach, and was not therefore in confliction. The pilot of G-BXUY called "FINAL" and was cleared to land. He acknowledged with the words "CLEARED TO LAND, GOLF UNIFORM YANKEE". This was the last transmission from the pilot, made just over a minute before the aircraft crashed. Again, all transmissions between the pilot and Hawarden ATC had been entirely routine; there were no unusual background noises on the pilot's transmissions and he seemed calm and collected.

The aircraft continued towards the runway, watched by staff in the control tower as well as other airfield personnel and a number of witnesses on an industrial site adjacent to the runway. The approach seemed normal until its late stages, when the aircraft deviated left of the runway centreline. When the aircraft was at a low height (witness estimates ranged between 10 ft and 50 ft), it seemed to become unstable. The Tower controller reported the wings rocking, as if the aircraft suddenly experienced buffeting from a strong wind, and generally having the appearance that something was not right. She thought it likely that the pilot would go-around[1] from the approach.

Of the other staff in the Tower, some saw the initial 'instability' (which appeared also to include a yawing element), and most described seeing the aircraft pitch to an unusually high nose attitude. The aircraft may have climbed a short distance, before the left wing dropped

Footnote

[1] A manoeuvre in which the landing is discontinued and the pilot applies power (typically full power) to climb.

and the aircraft rapidly rolled to the left, striking the ground to the left of the runway (viewed from the approach).

Other witnesses also variously reported yawing motions and wing rocking before a pitch-up and roll to the left. Some also likened it to the aircraft suddenly experiencing turbulence from a strong gusty wind, or as if a student pilot was attempting a first landing. Most of these witnesses were on the side of the runway on which the aircraft crashed (the opposite side to the control tower). Several reported that the aircraft was deviating to left of the runway centreline, and probably over the grass, before the pitch-up and left roll occurred.

Those witnesses who described unusual engine sounds reported apparent changes in engine or propeller speed. One witness reported hearing alternating high and low "revving" and on looking up saw the aircraft yawing from side to side and the wings rocking. Another witness, who only heard and did not see the aircraft, reported hearing what sounded like a very sudden increase in propeller rpm for no more than a second before suddenly reducing again. Other witnesses reported engine sounds increasing in engine volume immediately before the accident, although some reported nothing unusual.

Rescue activities

Aerodrome Rescue and Fire Fighting Service (RFFS) appliances were quickly on scene and their crews began life saving activities on the two occupants, who were exhibiting signs of life at this stage. Both occupants had been wearing seat belts and both were initially trapped in the wreckage and treated in situ until freed with the use of hydraulic rescue equipment. Local fire and ambulance vehicles also arrived on scene. Despite the efforts of the RFFS staff and the paramedics, the pilot died at the scene from his injuries. The passenger was taken by ambulance to Chester hospital but succumbed to her injuries a short while later.

Recorded data

The aircraft was not fitted with a Flight Data Recorder, nor was it required to be. However, the pilot was known to use a flight planning and navigation application on his tablet computer and apparently did so for the accident flight. Although the tablet suffered extensive damage, track points associated with the accident flight had been recorded and were successfully downloaded for analysis. The nature of the system that was gathering the position data is such that it can use different sources of data for position fixes. However, recorded accuracy figures indicate that the system was using GPS satellite data as the source of the positional information. The flight path of the final approach and accident sequence is shown in Figure 1.

Recorded data from the pilot's tablet computer allowed a speed analysis of the latter stages of the flight. Speed and altitude data for the final approach and accident sequence is shown at Figure 2.

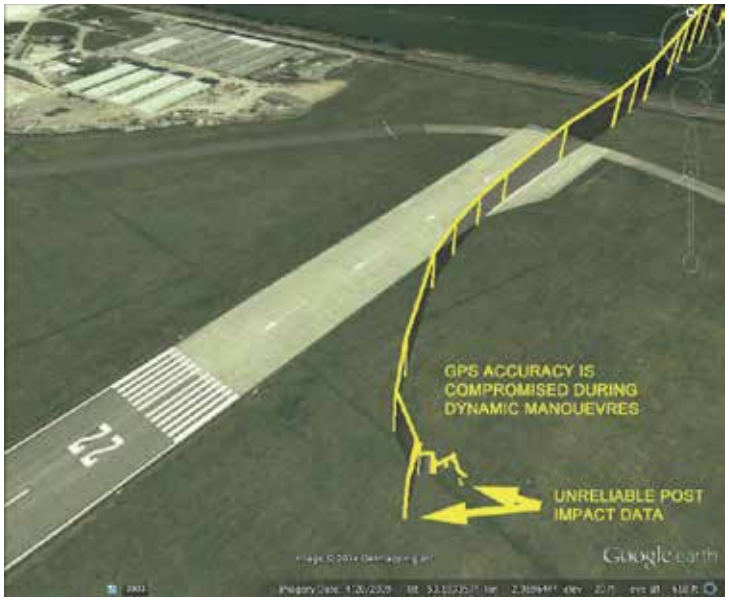


Figure 1

Recorded flight path: final approach and accident sequence

Aircraft information

The aircraft was a Cessna 310Q powered by two Rolls Royce Continental IO-470-VO engines. The fuel system for the aircraft consisted of four fuel tanks: two 51 US gallon (193 litre), wingtip-mounted, main fuel tanks and two 20.5 US gallon (78 litre) auxiliary fuel tanks in the outboard section of each wing (Figure 3). A pair of fuel selector switches, mounted on the cockpit floor, operated a fuel selector valve immediately outboard of each engine, which allowed each engine to receive fuel from its respective main or auxiliary tank, or to cross-feed fuel from the other main tank. The cross-feed, which was intended for emergency use, was the only interconnection between the left and right fuel systems.

The auxiliary tanks were designed for use in cruising flight so were not equipped with their own fuel pumps. For this reason, operation at less than 1,000 ft agl on auxiliary tanks was not recommended.

Each fuel tank is fitted with a capacitive sensor which provides fuel quantity readings to a pair of gauges in the cockpit. The gauges (Figure 4) automatically provide an indication of the fuel quantity in the fuel tanks selected by the fuel selector. A self-centring switch below the gauges allows the pilot to verify the contents of the other, non-selected tanks. Auxiliary tank indicator lights below the gauges illuminate when the associated auxiliary tank is selected for engine feed. The optional main fuel tank low quantity warning lights had not been fitted to G-BXUY. A dual fuel flow gauge was also fitted.

The aircraft had been fitted with two Hartzell PHC-C3YF-2UF three-bladed, constant speed propellers in accordance with Hartzell Supplementary Type Certificate SA234CH. Constant speed propellers and their control systems (governors) are designed to maintain the engine rpm selected by the pilot by automatic variation of propeller blade pitch angle. The propeller

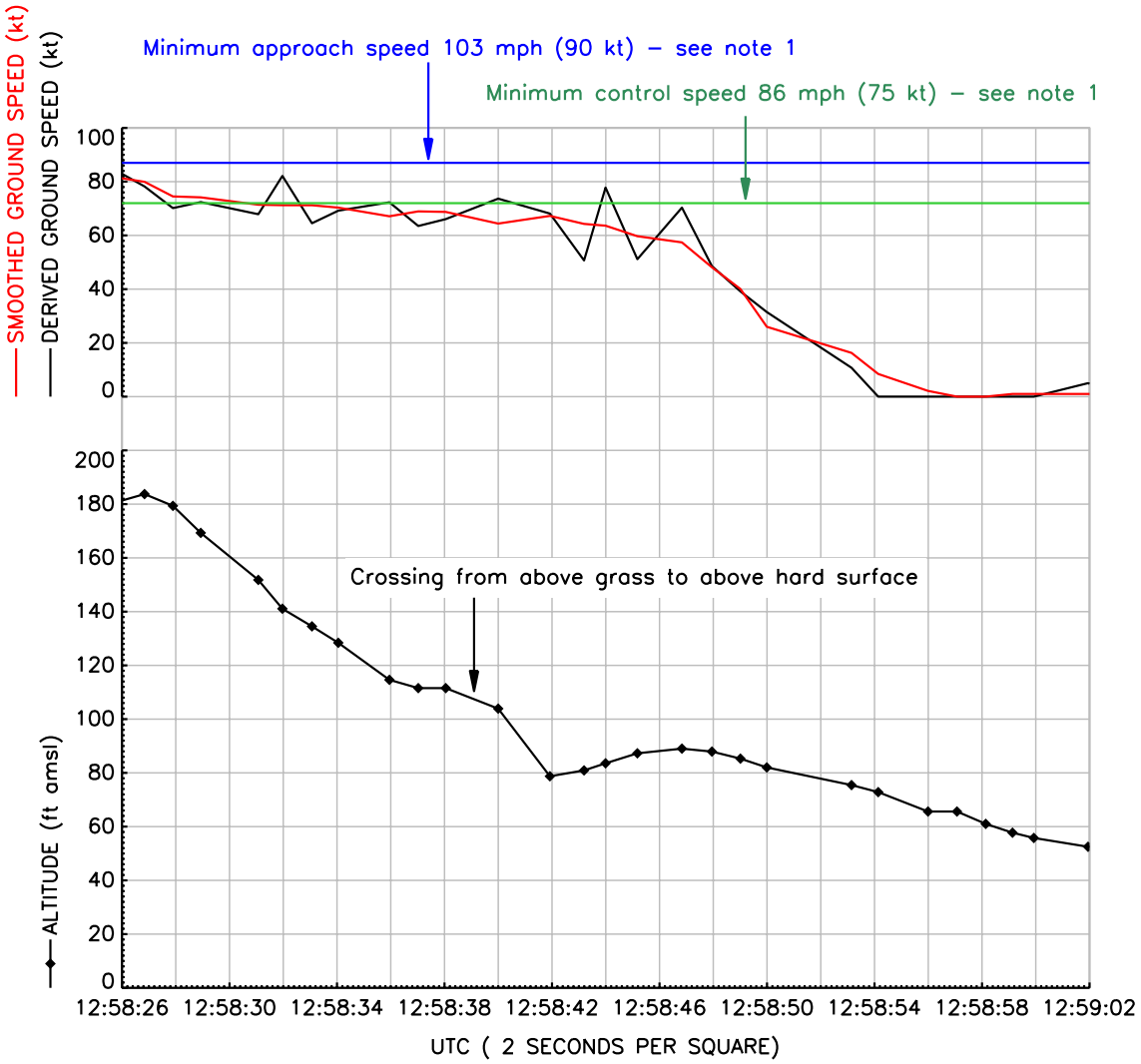


Figure 2

Recorded altitude data and derived speed

Note 1. A 3 kt headwind allowance is factored into the displayed minimum speed
Note 2. GPS accuracy is compromised during dynamic manoeuvres
Note 3. GPS altitude continued to drift down post-impact as altitude errors continued over time

governors supply metered high pressure engine oil to the propeller to control the propeller blade pitch. In the event of a loss of engine oil pressure the propellers fitted to G-BXUY would automatically move to the feathered position to minimise drag. When the engine is stopped on the ground, it is undesirable to feather the propeller, as the high blade angle will inhibit engine starting. To prevent this, the propellers incorporate a spring-operated pitch lock. If propeller speed falls below 800 rpm the spring force causes the latches to close and prevents the propeller blades from feathering during engine shutdown.

In the event that an engine begins to gradually lose power due to a fuel supply or mechanical problem, the propeller control system will automatically maintain engine speed by reducing the blade pitch until it reaches the FINE position. This may mask a problem with the engine until the propeller systems become unable to maintain the selected engine speed.

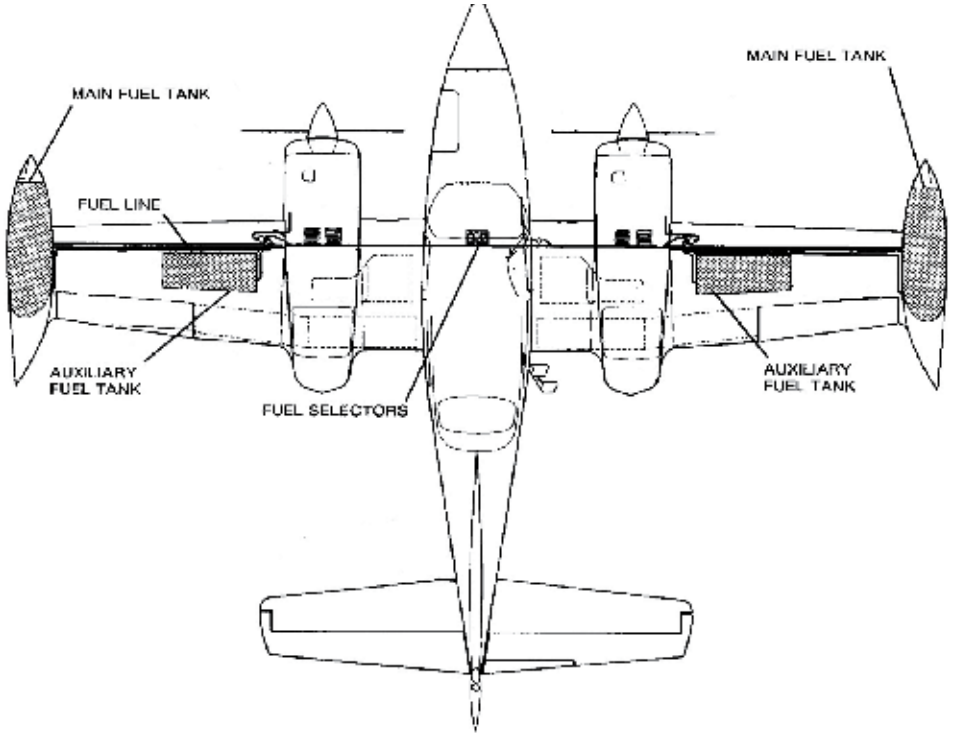


Figure 3

G-BXUY fuel system

Figure 4

G-BXUY fuel quantity gauge
(electrical power not applied)

Initial aircraft examination

Ground marks indicated that the aircraft first struck the ground inverted, in a steep nose-down attitude 115 m beyond the left edge of Runway 22 and 15 m before the threshold markings. After the initial impact the aircraft travelled backwards on its main landing gear for approximately 20 m before coming to rest (Figure 5). The fuselage of the aircraft had failed immediately aft of the main spar and the nose of the aircraft had been severely damaged. The right tip tank had ruptured and separated from the wing and the right wing exhibited compression damage to the outboard leading edge. The right propeller had dug into the ground during the initial impact which had resulted in a failure of the engine crankshaft and separation of the propeller. The left propeller remained attached to its associated engine.

Figure 5
Accident site

Inspection confirmed the continuity of all of the flying control circuits and that the flaps were deployed to a position of approximately 35°. The landing gear was down and locked. Both engine throttle levers were in the fully forward position, the propeller control levers were fully forward in the INC position and the fuel levers were in the FULL RICH position. These control positions corresponded to the positions of the engine throttle valves, the fuel mixture control and the propeller governor input levers on both engines. Both fuel tank selector switches were set to MAIN. The left main (tip) tank was undamaged but the quantity of fuel in the tank was too small to recover on site. The ruptured right main (tip) tank showed little evidence of the presence of fuel and there was no evidence of fuel spillage on the accident site. It was assessed that the tank was unlikely to have held more than about 10 litres of fuel, probably less. Fuel samples were taken from both engine fuel injection manifold valves. The right engine valve was found to be full of fuel, whereas the left engine valve was approximately 50% full. Approximately eight gallons (30 litres) of fuel was recovered from each auxiliary fuel tank.

Examination of the right propeller showed that rotation of the propeller during the initial impact had caused all three blades to dig into the ground; two of the blades exhibited significant rearwards bending of the blades at approximately half span as a result of rotation through the soil (Figure 6). The left propeller exhibited significantly different damage from the right; one blade had been bent backwards and the remaining two blades had been bent forward at mid-span. There was little evidence of rotational damage to any of these blades.

Figure 6
Left and right propellers

Maintenance history

Examination of the aircraft records showed that the aircraft was compliant with current UK airworthiness requirements. Between September 2008 and July 2013, the aircraft had undergone extensive maintenance as a result of scheduled structural inspections. This involved the replacement of a number of significant structural items including the wing spars. During this maintenance the aircraft fuel system was removed and inspected, the ignition systems, propellers and propeller governors were overhauled and the fuel quantity indication system recalibrated.

Detailed aircraft examination

The investigation focused on the aircraft's control systems, the fuel system, engines and propellers. No evidence of a pre-impact defect or restriction was identified within the aircraft's flight control circuits.

Testing of the aircraft fuel system confirmed that the cockpit fuel tank selectors and the respective fuel selector valves were correctly rigged and no evidence of a blockage or restriction was found in the aircraft fuel system. The left main fuel tank was disassembled and two litres of fuel were recovered. Both main fuel tank electric pumps were found to be operational. Tests carried out on the main fuel tank quantity sensors, the fuel quantity and fuel flow gauges confirmed that they operated normally and were correctly calibrated.

There was no evidence of a major mechanical failure in either engine and tests confirmed that both of the engines' ignition systems and propeller governors were operational. Examination of the failure surface of the right engine crankshaft showed that it had failed due to a combination of bending and torsional overload.

Two of the blades fitted to the right propeller showed chordwise witness marks and exhibited significant twisting and rearward bending along the span of the blade. One of these blades, the first to enter the ground, was found to be at a higher pitch setting when compared to the other two blades, which appeared to be at or close to the FINE pitch position.

The damage to the left propeller showed significant differences from that observed on the right. Damage to the propeller spinner was restricted to one third of the circumference, corresponding to the position of the propeller blade which had been bent backwards and little evidence of rotational damage was observed. All three of the blades on the left propeller appeared to be at or close to the FINE pitch position.

Both propellers were stripped and examined at an approved overhaul facility under AAIB supervision. Examination of the right propeller and its records confirmed that the No 3 blade was locked at a higher pitch angle than the remaining two blades and that it had been the first blade to strike the ground. Disassembly of the pitch change mechanism showed that the pitch locks had engaged and that the No 3 propeller blade pitch change knob, attached to the blade root, had failed in overload. This was consistent with having been caused during the impact sequence. A witness mark associated with the failure of the pitch change knob was found on the pitch change slot in the blade preload plate. Based on the position of the witness mark on the preload plate slot, it was estimated that the blade pitch when the pitch change knob failed was 27º. Additional witness marks on the faces of the preload plates, made by the pitch change fork, confirmed that at some point during the impact sequence all three blades had been at a pitch angle of 15º. Damage to the internal flanges of the propeller hub halves was consistent with all three blades being subject to a large rearward force. No evidence of a pre-impact failure or defect was found during the disassembly and inspection.

Discussion with the propeller manufacturer confirmed that the engine would have been capable of producing sufficient power at its maximum governed speed of 2,625 rpm to generate a propeller blade pitch angles of 15º during the early stages of a go-around. It was also determined that the engine would not be able to generate sufficient power to produce a blade angle of 27º in similar conditions.

Inspection of the left propeller confirmed that the No 3 propeller blade had been bent rearwards and the Nos 1 and 2 blades had been bent forward. Disassembly of the left propeller confirmed that there were no witness marks on the propeller pitch change mechanism which could give an indication of blade pitch at impact and the propeller blades had been prevented from feathering by closure of the pitch locks. Damage to the internal flange of the propeller hub halves was consistent with the No 3 propeller blade having been subject to a rearward force and the Nos 1 and 2 blades being subject to a forward force. No evidence of a pre impact defect or failure was identified within the propeller.

Pilot information

The pilot's flying licence, Class One medical certificate and aircraft class rating were all valid. He gained a PPL (Aeroplanes) in 1996 and subsequently took ownership of a Socata TB9 Tampico aircraft. In 2000, he also gained a PPL (Helicopters) and flew a mixture of fixed wing and rotary wing after that time. He gained a CPL (Aeroplanes) in November 2002

and a CPL (Helicopters) in June 2003. Although he held professional pilot qualifications, the pilot did not fly as a commercial pilot and only exercised the private pilot privileges of his licences.

The pilot first gained a multi-engine rating in October 1997 which he renewed in 2002, prior to taking ownership of G-BXUY. The pilot's MEP rating lapsed after G-BXUY began its refurbishment programme in 2008, but he renewed the rating at Hawarden on 6 August 2013, flying G-BXUY on its return to service. At the time of the accident, the pilot had flown 329 hours multi-engine, of which 261 hours were in G-BXUY. Between the pilot first flying G-BXUY post-refurbishment on 5 August 2013 and the day of the accident, he flew 20 flights in the aircraft, totalling 28 flying hours.

The examiner who flew with the pilot in August 2013 described the pilot's flying as competent, including his single engine handling. The examiner had needed to make only minor comments on the pilot's overall performance. The pilot's father, also an experienced private pilot, described his son as being competent and meticulous. With regard to fuel planning, the pilot was known for always using a dipstick to measure fuel quantities before flight rather than relying on fuel gauges, and would have been aware of the exact quantity of fuel required for a flight. The pilot was also described as being very sensitive to fuel economy and aware of fuel prices at different airfields. These comments were supported by an airline pilot who flew with the pilot in 2006. He reported that the pilot seemed very competent and spent considerable time in flight achieving the most economical running conditions for the engines.

It was established that the pilot telephoned Hawarden before the accident flight to enquire whether he could purchase fuel at a favourable rate, as he had flown at Hawarden for many years and was well known there. He established that he could, which would make the fuel available at Hawarden 9p / litre cheaper than that at Lognes-Emerainville.

Medical and pathological

The pilot was examined for his Class One medical certificate on 13 May 2013, which was valid for one year. He was described as being in good health and living an active lifestyle.

Post-mortem examinations of the pilot and his passenger revealed that each had died from injuries consistent with having been sustained during the accident sequence. There was no underlying natural pathology in the pilot which could have contributed to the accident. Toxicological investigations indicated that the pilot was not under the influence of alcohol, therapeutic or prescribed drugs nor illicit and abused drugs. His blood carbon monoxide level was low, indicating that he had not been exposed to the effects of carbon monoxide.

Navigation and route planning

Aeronautical charts covering the route from Longes-Emerainville to Hawarden were recovered from the aircraft. The charts were unmarked and there was no physical evidence of a prepared navigation log.

Tablet computer data

When the flight planning and navigation application on the pilot's tablet computer was accessed, an active route from Longes-Emerainville to Hawarden was present. It was a total of 410.9 nm long, and was predicted to take 2 hours 34 minutes and consume 206 litres of fuel. The predictions were based on a speed of 160 kt and a fuel consumption of 80 litres/hour, figures entered by the pilot and stored in memory (the cruise speed is consistent with that nominated by the pilot on his ATC flight plan). For individual flights, an optional average wind entry could be made. As found, there was no average wind entry, which thus defaulted to zero. It was established empirically that an average wind component, once entered, remained the default value, even if the tablet was switched off and on again. To illustrate the effect of wind entry, an average wind component of 020°/15 kt (based on the forecast winds taken from meteorological information issued on the morning of the accident) produced a revised flight time of 2 hours 41 minutes and a revised fuel burn of 215 litres.

The recorded route commenced 22 minutes after the reported takeoff time, when the aircraft was to the south of Paris. It was not established why the first part of the route was not recorded, but it may be that the tablet was switched off until that point.

A single planned flight existed in the tablet's memory for a flight from Seo de Urgel to Lognes-Emerainville, the route the pilot flew on 7 November 2013. The recorded actual flight time was 3 hours 5 minutes, which would have consumed about 247 litres at 80 litres/hour.

Flight planning calculations

The investigation reconstructed a flight planning sequence using the pilot's own performance data, the route data from the tablet computer and forecast wind information which would have been available to the pilot. This wind information, taken from Met Office Form 214 for the day of the accident, showed forecast winds at 1200 hrs of 040°/25 at 1,500 ft over northern France and the Channel, increasing to 050°/30 kt at 5,000 ft. Further north, over England, the wind at 5,000 ft gradually backed and reduced to 010°/10 kt. Using this data, the planned flight time increased to 2 hours 41 minutes, consistent with the tablet prediction with an average wind entered, but still considerably shorter than the actual time of 2 hours 57 minutes.

The time the route recording started was consistent with the expected time at that position. However, analysis showed the aircraft made slower than expected progress from that point during its flight over France and the Channel such that it was about 15 minutes later than expected crossing the south coast. For about the last 50 minutes of flight, the aircraft made progress approximately according to the calculation. Revised calculations for most adverse likely winds over France and the Channel failed to account fully for the extra time, so it was concluded that the aircraft probably flew more slowly than planned for some reason, before resuming planned cruise speed for the latter part of the flight.

The flight plan submitted by the pilot included his elapsed time estimates for entering the London Flight Information Region (FIR) and for arrival at Hawarden. These were 25 minutes

and 2 hours 15 minutes respectively. These figures were inaccurate: the total time given was more consistent with a direct line routing in still air conditions, while the estimated elapsed time to the FIR boundary should have been about 1 hour 13 minutes.

Fuel planning

Fuel calculations during the investigation used the pilot's average planning figure of 80 litres/hour. Calculations assumed a serviceable fuel system with no leakage; the possibility of this not being the case is discussed in the analysis section of this report.

Assumed fuel quantities and distribution at the time of the accident are shown at Table 1. The figures are based on measured fuel quantities except for the right main tank, which was an estimated figure, based on the evidence from the accident site and assuming approximately equal fuel use from both sides during the flight.

Fuel tank quantities (litres)				
Left Main	Left Auxiliary		Right Auxiliary	Right Main
2	30		30	6
Total fuel 68 litres				

Table 1

Estimated fuel quantities at the time of the accident

Based on the actual flight time, the flight would have consumed about 236 litres. Thus, the aircraft would have taken off with about 304 litres of fuel (68 litres remaining, plus 236 litres trip fuel).

It was established that the aircraft was refuelled with 103 litres at Lognes-Emerainville on the morning of the accident, so the aircraft would have landed there with about 201 litres on board. The inbound flight from Spain, which took 3 hours 5 minutes, would have used about 247 litres. The aircraft therefore probably left Seo de Urgel with about 448 litres of fuel. This would be consistent with the last refuel before departure from Seo de Urgel, when 422 litres were uplifted.

The expected fuel consumption figure used by the pilot for deciding the fuel load for departure is unknown, but is likely to have been based on the tablet prediction for either still air (206 litres) or average wind (215 litres). The pilot would have added a suitable reserve fuel to his minimum requirement. Again, the figure used is unknown but a typical reserve fuel, sufficient for 30 minutes holding time at the destination, would be about 40 litres (including unusable fuel of about 7 litres). Using this information, three possible planning scenarios are presented at Table 2.

No	Option	Flight time (hr:min)	Trip fuel litres	Reserve fuel litres	Total fuel litres
1	Flight Plan estimate	2:15	180	40	220
2	Using still air conditions	2:34	206	40	246
3	Using forecast winds	2:41	215	40	255

Table 2

Possible fuel planning scenarios

Aircraft mass and balance

An aircraft mass and centre of gravity schedule was recovered from the pilot's documents. This was based on a weighing report dated 19 November 2004, which was the most recent available.

Calculations were performed to establish the aircraft's mass and balance condition at the time of the accident, using actual weights for the two occupants and actual weights for luggage and items of equipment not included in the weighing report. The estimated fuel load was as shown at Table 1 (small variations in quantity of fuel in the main tanks would not significantly affect the balance calculations due to the position of the tanks). Luggage and miscellaneous items in the cabin accounted for 105 kg. Although there was evidence that some of the luggage had been restrained, significant movement of luggage and equipment had taken place during the accident sequence. Therefore, two calculations were made, one based on an evenly spread load and a second based on the most adverse (aft) loading possible.

The aircraft weight at the time of the accident was calculated as 2,038 kg (4,494 lb). The maximum landing mass was 2,404 kg (5,300 lb). The centre of gravity for the evenly distributed case was 74% aft of the forward limit. The theoretical worst case loading scenario placed the centre of gravity at 81% aft of the forward limit. Thus, the aircraft was found to be within the mass and balance limitations, with a relatively aft centre of gravity.

Aircraft performance

Conventional twin engine light aircraft such as G-BXUY are subject to the same principles of aerodynamics as single engine aircraft but there are differences which arise from the location of the engines on each wing. One advantage of wing mounted engines is that significant extra lift is derived from propeller slipstream over the wings. Like single-engine aircraft, twin-engine aircraft generally have left turning tendencies due to asymmetric propeller loading and torque, but this effect is greater in twin-engine aircraft, particularly during high angle of attack manoeuvres.

When a twin-engined aircraft loses power on one engine, the asymmetric thrust that results requires positive and prompt pilot control inputs to counter the yawing and rolling tendencies, particularly if the operating engine is at a high power setting. The loss of power, combined with a significant increase in drag and loss of lift due to the reduced slipstream effect, may make sustained level flight impossible to achieve in some cases.

Aircraft manufacturers generally produce minimum and recommended speeds to fly with one engine inoperative. A minimum control speed (V_{MC}) represents the lowest airspeed that the aircraft can be controlled with one engine inoperative and the other at full power. It normally assumes a clean configuration, with the critical engine[2] failed (and its propeller feathered if an automatic feathering device is installed).

For G-BXUY, the critical engine was the left engine, and the Vmc speed stated in the aircraft owners' manual was 86 mph (75 kt). The manufacturer's recommended safe single engine speed was 105 mph (91 kt), with a best single engine rate of climb speed of 116 mph (101 kt). The owners' manual stated:

> *'Although the aircraft is controllable at the minimum control speed, the aircraft performance is so far below optimum that continued flight near the ground is improbable. A more suitable recommended safe single-engine speed is 105 MPH IAS since at this speed, altitude can be maintained more easily while the landing gear is being retracted and the propeller is being feathered.'*

The manufacturer's minimum approach speed with 35° flaps was 103 mph (90 kt), with power being reduced only just before touchdown. In case of a single-engine go-around, the target speed was 116 mph (101 kt).

Analysis

Technical investigation

No pre-impact defects were identified within the aircraft flight control or fuel systems and there was no evidence of a pre-impact mechanical failure within either engine or propeller or their associated control systems.

The witness marks observed on the faces of the right propeller preload plates indicted that all three propeller blades were at the same pitch angle of 15° at the start of the impact sequence. The damage observed to the right propeller blades and the failure of the right engine crankshaft was consistent with the engine operating at high rpm at impact. Analysis of the blade pitch angle data by the propeller manufacturer confirmed that a blade pitch angle of 15° was consistent with a Continental IO-470-VO engine operating at its maximum governed speed of 2,625 rpm, as may be expected during the early stages of a go-around. Given that the No 3 blade of the right propeller was the first blade to enter the ground, it is thought that the forces acting on the blade were sufficient to twist the blade in the hub, resulting in the failure of the pitch change knob and an increase in blade pitch when compared to the remaining two blades.

The lack of rotational damage to the left propeller, and the deformation of its blades, was consistent with the left engine operating at low power at impact despite all of the engine controls being in the 'full power' position. The closure of the left propeller blade pitch locks

Footnote

[2] The critical engine is the one whose failure most adversely affects the performance or handling characteristics of the aircraft.

indicated that the engine was operating and that the engine speed was at or above idle rpm at impact but no further estimation of the engine speed could be made.

The absence of fuel within the left main fuel tank and the limited quantity of fuel recovered from the left engine fuel injection manifold valve indicated that the probable reason for the difference in engine power was fuel starvation. Given the lack of evidence of fuel spillage from the right main fuel tank, it is considered that the right hand fuel system was also at a low level and that the right engine would also have begun to experience fuel starvation problems had the flight continued for any length of time.

The possibility of a fuel leak occurring during the flight was considered, but discounted for the following reasons: there was no physical evidence for a leak (other than the low fuel state); the pilot did not declare an emergency or change his course of action; and a leak would have had to affect both sides simultaneously, which was considered unlikely.

Final approach flight path

It is probable that G-BXUY's deviation to the left on final approach was a result of the left engine losing power, a situation which the properties of the constant speed propeller system may initially have masked from the pilot and which would have given rise to the apparent control difficulties described by all eyewitnesses. The aircraft drifted to the side of the runway, with very little height or time available to the pilot to correct. Faced with the alternative of landing on the grass, the pilot appears to have attempted to fly a go-around.

Given that the situation developed quickly, it is not certain that the pilot would have been fully aware of the exact nature of the problem, although he was probably aware (as discussed later) of the low fuel state in the main tanks. The speed had apparently been allowed to drop below the minimum approach speed, which may be due in part to the loss of power as the left engine became starved of fuel.

All the available evidence is consistent with a go-around attempt, during which the pilot would have selected full power. It is possible (and there is some witness evidence to support the possibility), that the left engine responded to the pilot's selection, but only for a very short time. A fluctuating power delivery from the left engine would also account for the control difficulties seen at this time. However, the aircraft was by now at or below the minimum control speed, and would have slowed further as it pitched up. The reason for the exaggerated pitch attitude was not positively identified, but thought to be most likely due to a combination of increased engine power (which naturally produces a pitch-up on this aircraft type) and applied nose-up trim associated with the low speed. The increase of power on the right engine would have created an asymmetrical power condition, and the pilot would have been unable to control the resultant left yaw and roll.

With no indication from the pilot that he was experiencing a technical malfunction, the investigation sought to establish why the aircraft's main fuel tanks ran critically low on fuel on final approach, when there was sufficient fuel on board the aircraft for about another 45 minutes flying time.

Fuel load and distribution

An attempt was made to predict the likely fuel load and distribution at various stages of the two final flights. The results are shown at Table 3 and discussed in subsequent paragraphs.

Calculation

Event	Total fuel litres	Fuel distribution			
		Left main	Left aux	Right aux	Right main
Refuelled with 422 litres					
Depart Seo de Urgel	448	193	31	31	193
Trip fuel 247 litres					
Arrive Lognes-Emerainville	201	70	30	30	71
Refuelled with 103 litres					
Depart Lognes-Emerainville	304	121	30	30	123
Trip fuel 236 litres					
Arrive Hawarden (accident)	68	2	30	30	6

Sequence

Table 3

Estimated fuel quantities and distribution since departure from Seo de Urgel

The aircraft did not depart Spain with all tanks full, as it could then have reached Hawarden without refuelling. With an estimated 448 litres of fuel on board on leaving Seo de Urgel, 31 litres would have been in each auxiliary tank (normal practice would be to fill main tanks first). This correlates closely to the fuel quantity recovered from the auxiliary tanks (60 litres) during the investigation.

Refuelling with 422 litres at Seo de Urgel was only possible if fuel was put in the auxiliary tanks. This required a deliberate action, as the tanks were refuelled via separate filler caps, and indicates that the pilot regarded the auxiliary fuel tanks as usable at that stage. As a refuelling in Lognes-Emerainville was apparently planned, and each of the flights could comfortably be made with main tank fuel only (total capacity 386 litres), there would have been no need to load or use auxiliary tank fuel. The investigation therefore considered it likely that, at the planning stage, the pilot would have regarded the auxiliary fuel as a contingency fuel for unforeseen circumstances. In this case, it is more likely that he would originally have intended to use the fuel during the return journey to Spain rather than during the accident flight.

At Lognes-Emerainville there would have been ample capacity in the main tanks so the pilot would have had no reason to put any fuel in the auxiliary tanks. Therefore, it was concluded that the aircraft departed with 304 litres, consisting of 244 litres approximately evenly distributed in the main tanks, and the existing auxiliary tank fuel of about 60 litres.

Fuel plan for the accident flight

It was not possible to establish what fuel load the pilot would have regarded as a minimum for takeoff but, as he refuelled the aircraft on the morning of the accident flight, all necessary weather and wind information would have been available to him in order to decide on a suitable amount. Considering the pilot's known attitude to fuel prices, and the fact that he established cheaper fuel was available at Hawarden, it is unlikely that he would have loaded more fuel than he considered necessary, particularly as the auxiliary tank fuel was also available if needed.

The tablet computer, in its 'as found' state, did not included an average wind component, suggesting that the pilot may have used a still-air fuel prediction, a possibility supported by the close correlation between the estimated main tank fuel (244 litres) and planned fuel from Table 2 (246 litres). The only firm evidence regarding the pilot's expected flight is his estimate of a 2 hours 15 minutes flight time to Hawarden. Although this was a very inaccurate figure, and unlikely to be the basis for his fuel decision, it may indicate that the pilot expected a significantly quicker flight time than that achieved, possibly because the prevailing wind had not been taken into account.

If, as already discussed, the pilot's original intention was to regard auxiliary tank fuel as contingency fuel, he would have aimed to load sufficient fuel into the main tanks for the flight. The still-air fuel required was 206 litres and the fuel required when taking prevailing winds into account was 215 litres. Thus, with 244 litres in the main tanks, the investigation concluded that the pilot originally intended to complete the flight using fuel from the main tanks only, in the knowledge that auxiliary tank fuel was available if necessary.

Conduct of the accident flight

Had the pilot planned on using auxiliary tank fuel during the accident flight, it would have been normal practice to use it relatively soon after takeoff. Whether originally intended or not, had he tried to use the auxiliary fuel but been unable to for any reason, it may be expected that he would have made arrangements to refuel en-route, for which there were adequate alternative airfields.

The extra flight time, which was presumably unexpected, was incurred in the first half of the flight. Once the aircraft was over southern England, a comparison between expected and actual fuel load would have revealed that the aircraft would land with a low main tank fuel state unless the auxiliary tanks were used. However, without a prepared navigation log, the pilot would not have had a ready fuel reference during the flight that would allow such a comparison to be made, relying instead on mental calculations. Consequently, when the flight started to take longer than originally planned, it may not have been immediately apparent that the fuel in the main tanks might not be sufficient to complete the flight safely.

There was no reason to suspect that the pilot was not presented with accurate fuel quantity information in the cockpit. Even if this were not the case, he routinely used a dipstick to measure the fuel quantity before flight and (considering it was an aircraft he knew well and

in which he had flown several long flights) he would have had an independent awareness that fuel in the main tanks would be very low on arrival.

Thus, as the aircraft neared Hawarden, it is most probable that the pilot was aware, either from the fuel gauges or by mental calculation, that fuel in the main tanks was running low. Even at that stage, he could have declared a low fuel state to ATC and possibly requested Runway 04 (a shorter routing), which may have altered the final outcome. It is possible he attempted to use some auxiliary tank fuel in the latter stages of the flight, in which case it is unlikely that a significant amount was used before the selectors were returned to main tanks for landing in accordance with normal procedure.

Conclusions

The engineering examination showed that the right engine appeared to be operating normally at impact while the left engine appeared to be operating at a lower power. The investigation did not identify a mechanical defect within the engines, the propellers or their control systems which could account for this difference.

In view of the lack of fuel recovered from the left main tank and the left engine fuel injection manifold valve it is considered that the probable reason for the differing engine power was fuel starvation of the left engine. The lack of evidence of fuel spillage from the ruptured right main fuel tank suggests that fuel starvation of the right engine may have been imminent.

The majority of usable fuel at the time of the accident was in the auxiliary tanks, which were not selected for engine feed. From the available evidence, it is probable that the pilot originally intended to complete the flight using fuel from the main tanks only, and loaded them with what he considered to be a sufficient quantity. However, the main fuel tank quantity was insufficient for safe completion of the flight. Options to use auxiliary tank fuel or to land and refuel would have been available to the pilot.

With no evidence of a prepared fuel plan, and in the absence of any obvious concern on the part of the pilot, he appears to have continued to believe that the fuel in the main tanks alone was sufficient, albeit with a greatly reduced reserve. Although he would not have intended or expected to land with such a low fuel state in the main tanks, the fine weather conditions of the day and his familiarity with Hawarden may have been factors in his apparent acceptance of the situation.

The accident occurred when the pilot lost control during a single-engine go-around manoeuvre, after the speed had fallen below the minimum control speed. The investigation concluded that the loss of power on the left engine just before landing was due to fuel starvation which resulted from mismanagement of the aircraft's fuel system.

AAIB correspondence reports

These are reports on accidents and incidents which were not subject to a Field Investigation.

They are wholly, or largely, based on information provided by the aircraft commander in an Aircraft Accident Report Form (AARF) and in some cases additional information from other sources.

The accuracy of the information provided cannot be assured.

ACCIDENT

Aircraft Type and Registration:	CASA 1-131E Series 1000 Jungmann, G-BUCK	
No & Type of Engines:	1 ENMA Tigre G-IV-A2 piston engine	
Year of Manufacture:	1951 (Serial no: 1113)	
Date & Time (UTC):	10 July 2014 at 1030 hrs	
Location:	White Waltham Airfield, Berkshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Right landing gear	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	55 years	
Commander's Flying Experience:	210 hours (of which 110 were on type) Last 90 days - 4 hours Last 28 days - 2 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

The pilot described the approach and landing as normal, but as the speed reduced he noticed the left wing beginning to drop. The pilot held the wing up with the ailerons, until the speed reduced so much that the ailerons were no longer effective and the wing touched the ground causing the aircraft to yaw gently approximately 10º to the left before it came to a halt. The pilot shut the aircraft down and vacated normally.

A subsequent inspection revealed a fractured bracket at the rear of the right landing gear strut. This had allowed the landing gear to spread, and the left landing gear leg to move sideways. The pilot considers the initial failure may have occurred during the takeoff roll, as he recalled going over a larger than normal bump at a runway intersection.

ACCIDENT

Aircraft Type and Registration:	Czech Sport Aircraft SportCruiser, G-EMSA
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2010 (Serial no: 09SC323)
Date & Time (UTC):	30 August 2014 at 1245 hrs
Location:	Near Saffron Walden, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller, engine cowling and exhaust, noseleg and landing light
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	2,065 hours (of which 2,057 were on type) Last 90 days - 180 hours Last 28 days - 60 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and technical information published by the aircraft manufacturer

Synopsis

Following a normal approach and touchdown at a private grass airstrip, the nose landing gear failed. The nosewheel detached and the aircraft came to a rest within a short distance. Examination of the failed components showed what appeared to be a fatigue failure in the nose landing gear leg.

History of the flight

The aircraft was landing at a private airstrip when the accident occurred. The airstrip, where the aircraft was based, was of short grass and was dry. The weather was fine, with an 11 kt crosswind. The pilot flew a normal approach and touched down at about 35 kt. After touchdown, the aircraft pitched nose-down and came to an abrupt stop in a distance later measured at 8.5 m. One propeller blade broke and the engine stopped. The pilot, who was uninjured, turned off the switches and vacated the aircraft. It was found that the nosewheel had detached and was lying on the ground behind the aircraft.

The pilot explained that the nosewheel assembly had detached following a failure in the nose leg. The failure occurred in a vertical spindle at the forward, lower end of the leg, which entered an upper bushing on the nosewheel bracket. The pilot attributed the failure of the vertical spindle to fatigue, and noted that no corrosion was visible on the leg. A photograph of the failed component is shown at Figure 1.

Figure 1

Photograph of the failed vertical spindle, taken from above

Manufacturer's technical information

Figure 2 shows the general arrangement of the nose landing gear (NLG), being a simplified version of a diagram included in the manufacturer's illustrated parts catalogue. The vertical spindle and upper bushing, referred to by the pilot, are identified.

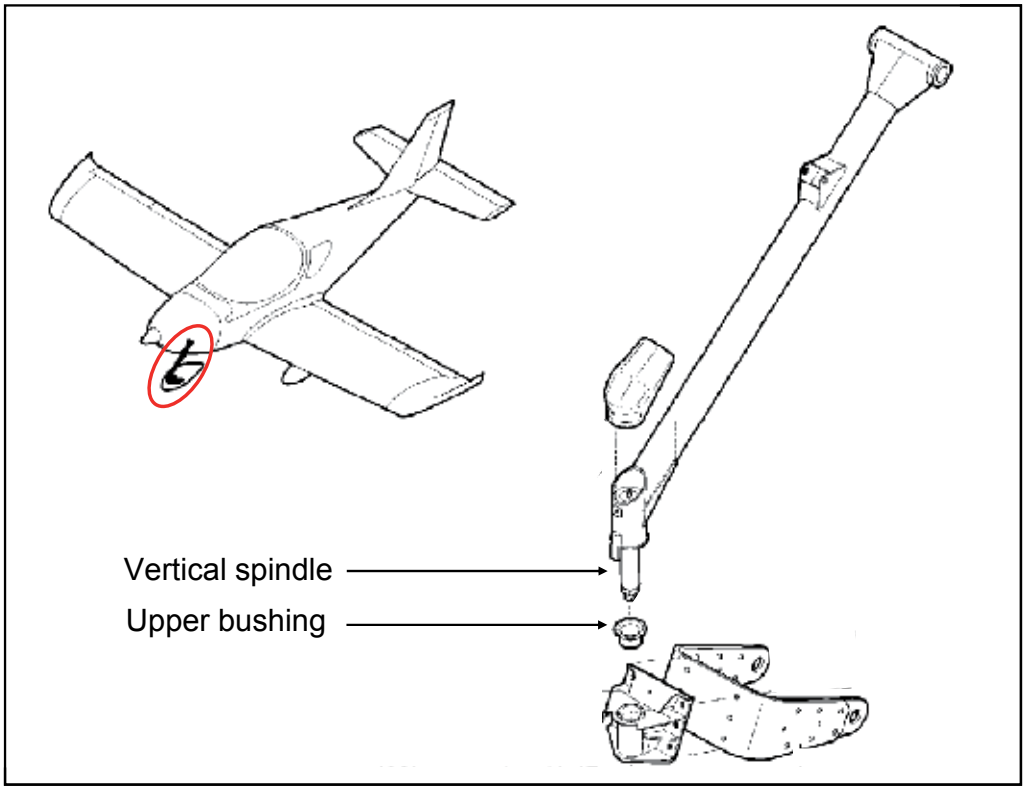


Figure 2

Nose landing gear assembly (simplified, nosewheel omitted)

On 9 October 2013, the aircraft manufacturer issued service bulletin (SB) SB-CR-016 (Revision 1 to the SB was issued 26 June 2014), which called for an inspection and replacement (if required) of the NLG. The SB included the following text:

> *'Some SportCruiser / PiperSport / PS-28 Cruiser aircraft have developed cracks in the bottom side of the lower section of the nose landing gear (NLG). The cracks develop on the NLG assembly along the weld of the tube and the bracket. Furthermore, on several aircraft it was found bending of the pivot connecting the fork with leg. To address this potential condition, an inspection of the bottom side of the lower section, in the place of the weld of the tube and the bracket and the pivot is required.'*

The SB went on to identify, with the aid of diagrams, the correct method of inspection. A further SB (SB-CR-021) was issued on 10 July 2014, containing instructions for replacement of the NLG. The SB included the following text:

> *'Some PS-28 Cruiser / SportCruiser / PiperSport aircraft have developed cracks in the bottom side of the lower section of the nose landing gear (NLG) SG0270N. To address this potential condition, CSA has issued service bulletin SB-CR-016 that prescribes an inspection of the nose landing gear SG0270N. Subsequently, CSA have developed an improved NLG SG0300N, which has better fatigue resistant properties. For the reasons described above, CSA recommends replacement of the NLGSG0270N with an improved NLG SG0300N especially on aircraft used in intensive flight training activity and operated from unpaved runways.'*

G-EMSA

The pilot confirmed that the inspection required by SB-CR-016 had been carried out and also that the modified NLG referred to in SB-CR-021 had not been fitted. Although the aircraft was routinely operated from a grass airstrip, its surface was smooth and in good condition. The NLG had not been subject to any hard landings or other abnormal loading. The Light Aircraft Association is currently reviewing the design of both the modified and unmodified versions of this type of NLG.

ACCIDENT

Aircraft Type and Registration:	Falco F8L, G-REEC	
No & Type of Engines:	1 Lycoming IO-320-B1A piston engine	
Year of Manufacture:	1991 (Serial no: 654)	
Date & Time (UTC):	24 August 2014 at 1350 hrs	
Location:	Near Lewes, East Sussex	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Substantial	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	71 years	
Commander's Flying Experience:	1,653 hours (of which 484 were on type) Last 90 days - 11 hours Last 28 days - 5 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

The aircraft was on a local flight from a grass airstrip. Runway 28 was being used, with fine weather conditions and a light surface wind varying between calm and 8 kt from 270°. The airstrip was 505 m long, with a ditch and medium sized trees crossing just beyond the upwind end. The pilot, who had flown from the airstrip on numerous occasions, described the grass as damp.

The pilot reported flying a normal approach, crossing the threshold at 68 kt. Following touchdown, he applied moderate brake pressure but the aircraft did not decelerate as expected. He decided to abort the landing; flaps were raised to the takeoff position, the propeller control was checked fully fine and full power was applied to fly a go-around. The aircraft lifted off but was unable to clear the trees at the end of the airstrip, coming to an abrupt stop as it flew into them.

The pilot remarked that the crumpling of the wooden structure and the breaking of the trees served to absorb most of the aircraft's energy, leaving him uninjured. He was able to make the switches safe and slide open the canopy before vacating in a normal manner.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna FA152 Aerobat, G-BGAF
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1978 (Serial no: 349)
Date & Time (UTC):	2 June 2014 at 1045 hrs
Location:	Southend Airport, Essex
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Damage to propeller, nose landing gear leg, fuselage and both wingtips
Commander's Licence:	Student
Commander's Age:	36 years
Commander's Flying Experience:	27 hours (of which 26 were on type) Last 90 days - 10 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

After successfully completing seven dual circuits immediately preceding the accident flight, the student pilot was flying his first solo circuit to Runway 24 at Southend Airport. The circuit appeared normal until the final stage of the approach where the aircraft was observed to flare too high. A high rate of descent developed that the student pilot did not arrest and the aircraft bounced, following which the student pilot initiated a go-around by applying full power and pulling back on the control yoke. A nose-high attitude developed and the left wing dropped, following which the aircraft struck the grass close to the southern edge of Runway 24 in a left-wing-low attitude. The aircraft's propeller, nose landing gear leg, fuselage and both wingtips were damaged in the accident, but the student pilot was not seriously injured and was able to vacate the aircraft by the right cabin door. The student pilot and his instructor assessed that the accident could have been avoided if the student pilot had conducted a go-around following the initial high flare, rather than allowing the bounced landing to develop.

ACCIDENT

Aircraft Type and Registration:	Pierre Robin HR200/120B, G-MFLC	
No & Type of Engines:	1 Lycoming O-235-L2A piston engine	
Year of Manufacture:	1997 (Serial no: 317)	
Date & Time (UTC):	20 June 2014 at 1516 hrs	
Location:	Leeds Bradford Airport	
Type of Flight:	Training	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Substantial damage to aircraft and aerodrome glideslope aerial	
Commander's Licence:	Student pilot	
Commander's Age:	20 years	
Commander's Flying Experience:	37 hours (of which all were on type) Last 90 days - 11 hours Last 28 days - 10 hours	
Information Source:	Aircraft Accident Report Form submitted by the student pilot, including comment from his flying instructor, and CCTV footage	

Synopsis

The accident occurred during the student pilot's first solo takeoff. The aircraft rotated rapidly to an exagerated nose-up attitude before landing and bouncing. The student detected a drift to the runway side and abandoned the takeoff. However, the aircraft ran off the edge of the runway and collided with a glidepath aerial. Both the aircraft and the aerial suffered substantial damage, although the pilot was uninjured.

History of the flight

On the day of the accident, the student pilot flew a circuit training detail with his instructor, during which he completed five circuits to a high standard. The instructor considered that his student was ready for his first solo flight, so briefed him accordingly. This briefing included changes in performance the student could expect without the weight of the instructor onboard.

The student pilot carried out normal pre-flight procedures and checks in preparation for a takeoff on Runway 32, entering the runway at Taxiway 'L'. The weather was fine, with a surface wind from 270° at 7 kt. The pilot reported that he initiated rotation at 60 kt but, as the aircraft became airborne, it immediately started to deviate to the left. He applied right rudder, and right aileron, but neither appeared to correct the deviation. The pilot decided to abandon the takeoff attempt and lowered the nose to land back on the runway while reducing power.

As the full runway came back into view, the pilot realised that the aircraft was close to the left hand edge. The aircraft landed hard and began a series of bounces, during which it ran onto the adjacent grass surface. The aircraft travelled across the grass and collided with the Runway 14 glidepath aerial. The pilot, who was uninjured, vacated the aircraft in the normal manner.

The student pilot's instructor, who had flown with him on eight occasions in the previous 14 days, watched the takeoff. He commented that the aircraft appeared to over-rotate on takeoff, before landing heavily and bouncing, landing again, and running off the runway edge.

Video analysis

CCTV Video footage provide to the AAIB confirmed a rapid rotation, to an attitude measured (within the limitations of the recording quality) at about 15° nose-up, followed immediately by a wing drop, which was corrected. The aircraft's pitch attitude reduced rapidly and it descended back to the runway, bounced and pitched up again a similar amount, before landing once more and running onto the grass.

The footage appeared to show that, after the initial rapid rotation, the aircraft was subject to a pilot induced oscillation in pitch. A significant nose-down input was followed by a further significant nose-up input as the aircraft descended and landed heavily, causing it to become airborne again with an exaggerated attitude.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-161 Cherokee Warrior II, G-BODB	
No & Type of Engines:	1 Lycoming O-320-D3G piston engine	
Year of Manufacture:	1988 (Serial no: 2816042)	
Date & Time (UTC):	26 May 2014 at 1600 hrs	
Location:	Sandtoft Airfield, Lincolnshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 2
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Engine, propeller, panels and landing gear damaged	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	65 years	
Commander's Flying Experience:	157 hours (of which 157 were on type) Last 90 days - 6 hours Last 28 days - 2 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

After landing the aircraft began to drift towards the left shoulder of the runway. The pilot attempted to correct the drift with braking and the use of opposite rudder but the drift increased and the aircraft departed the side of the runway and came to rest in a shallow ditch some distance from the runway. There were no injuries. The pilot attributed the accident to a combination of a damp runway surface and using excessive braking during the early stages of the drift.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-181 Cherokee Archer III, G-CGVC
No & Type of Engines:	1 Lycoming O-360-A4M piston engine
Year of Manufacture:	2008 (Serial no: 2843669)
Date & Time (UTC):	15 August 2014 at 1035 hrs
Location:	Perranporth Airfield, Cornwall
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - None
Nature of Damage:	Damage to left wingtip, propeller blades and spinner, left wing root and fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	368 hours (of which 200 were on type) Last 90 days - 5 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was taxiing the aircraft towards the fuel pumps and control tower. He first had to move to the right to avoid an aircraft parked with its right wing overhanging the taxiway and then left to avoid another aircraft parked on the right and also to comply with a KEEP LEFT sign (this was a roadsign and was meant to instruct vehicular traffic). The pilot misjudged the distance of his left wingtip from a wooden fence post which it struck, yawing the aircraft into the fence and striking a tree stump behind it. The pilot considers that the distraction of the two parked aircraft and the KEEP LEFT sign as well as his own misjudgement contributed to the collision.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28RT-201T Turbo Cherokee Arrow IV, G-BHFJ
No & Type of Engines:	1 Continental Motors Corp TSIO-360-FB piston engine
Year of Manufacture:	1979 (Serial no: 28R-7931298)
Date & Time (UTC):	14 July 2014 at 1519 hrs
Location:	Wycombe Air Park, Buckinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, lower nose cowling and nose landing gear doors
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	41 years
Commander's Flying Experience:	3,148 hours (of which 148 were on type) Last 90 days - 70 hours Last 28 days - 32 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft's nose landing gear leg failed to extend fully, following which a successful landing was made that damaged the aircraft's nose and propeller. A flexible fuel drain hose had become disconnected at its fitting at the lower engine cowl and the loose hose had restricted the nose landing gear leg sufficiently to prevent its full extension.

History of the flight

The aircraft was operating its third flight following a 50-hour maintenance check. Whilst flying on the downwind leg to Runway 24 at Wycombe Air Park, the pilot selected the landing gear DOWN. The pilot observed that whilst both main landing gear green position indicator lights were illuminated, the red WARNING GEAR UNSAFE light had also illuminated, indicating that the nose landing gear had not fully extended. After repositioning the aircraft to the north of the airfield, away from the active circuit, the pilot completed the actions on the emergency landing gear extension checklist without success and the nose landing gear remained partially extended. The aircraft completed a flypast of the ATC tower and the position of the nose landing gear was confirmed visually by ATC and the airfield fire service.

The pilot then discussed the division of crew tasks with his passenger, who was also a commercial pilot. They agreed that the pilot would fly the aircraft during the approach and

landing, whilst the passenger would, at the command of the pilot and once the landing was assured, shut the engine down by selecting the mixture to IDLE CUTOFF, the propeller to FEATHER and the magnetos to OFF. The pilot flew a normal approach to Runway 24 and when the aircraft was approximately 70 ft agl, he commanded the passenger to shut the engine down. The aircraft landed on its mainwheels and as the airspeed reduced it settled onto its nose, causing the propeller to strike the runway several times before the aircraft came to rest, slightly to the left of the runway centreline. The pilot and passenger were uninjured and were able to vacate the aircraft by the cabin door.

Aircraft examination

Subsequent examination of the aircraft revealed that a flexible fuel drain hose, running between the engine and the left side of the lower engine cowl, had become detached at its fitting with the lower cowl. The loose hose had restricted the movement of the nose landing gear leg sufficiently to prevent its full extension. The operator's maintenance facility determined that the probable cause of the hose detachment was that the hose end fitting had not been tightened fully once the lower cowl was refitted during the recent 50-hour check; this connection required disassembly in order to remove the lower cowl as part of this inspection. The maintenance facility has introduced an additional verification check for this task that is intended to prevent a recurrence.

ACCIDENT

Aircraft Type and Registration:	Piper PA-38-112 Tomahawk, G-BPIK	
No & Type of Engines:	1 Lycoming O-235-L2C piston engine	
Year of Manufacture:	1982 (Serial no: 38-82A0028)	
Date & Time (UTC):	15 July 2014 at 1508 hrs	
Location:	Runway 25, Carlisle Airport, Cumbria	
Type of Flight:	Training	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Nose leg, engine cowlings, lower fuselage, propeller, engine, windscreen and tail	
Commander's Licence:	Student	
Commander's Age:	29 years	
Commander's Flying Experience:	44 hours (of which 44 were on type) Last 90 days - 24 hours Last 28 days - 4 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

The student pilot had returned to Carlisle from Newcastle Airport. The flight was intended to be the qualifying cross-country navigation which he required for his Private Pilot's Licence. The weather conditions were good and the approach to the runway was described as normal but during the landing, the student left the flare too late and the aircraft bounced back up into the air. He tried to control the bounce, but on the second, firmer landing the nose landing gear collapsed. The aircraft then veered off the runway and came to rest on the grass. The student, who was uninjured, shut down the aircraft and vacated it normally.

The student and his instructor agreed that after the initial bounce, initiating a go-around would have been a safer course of action.

ACCIDENT

Aircraft Type and Registration:	Robin ATL, G-GGHZ
No & Type of Engines:	1 JPX 4T60/A piston engine
Year of Manufacture:	1986 (Serial no: 123)
Date & Time (UTC):	25 July 2014 at 1835 hrs
Location:	Beverley (Linley Hill) Airfield, East Yorkshire
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to the nose landing gear, fuselage, propeller, engine, main landing gear and wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	529 hours (of which 112 were on type) Last 90 days - 4 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot flew three solo circuits then landed to pick up an examiner for his biennial proficiency check. The weather conditions were good, with a light and variable northerly wind.

After completing general handling in the local area, the aircraft returned to the circuit for a practice forced landing to a go-around. The pilot then positioned the aircraft for his first landing, a touch-and-go, on grass Runway 12. The approach, at 60 kt with full flap, appeared normal. However, as the pilot flared the aircraft, in what he thought was the usual position, the rate of descent did not reduce and the aircraft landed heavily, bounced and pitched forward. It landed again on the nosewheel and the nose landing gear collapsed, allowing the propeller to make contact with the ground. The aircraft ran along the runway for about 50 yards before coming to a halt. The pilots, who were uninjured, made the aircraft safe and vacated it normally. There was no fire.

The pilot, who normally flies the aircraft solo, considered that he had not made sufficient allowance for the additional weight of the examiner. Also, fatigue at the end of a long day, may have been a factor.

ACCIDENT

Aircraft Type and Registration:	Vans RV-9A, G-CDRV
No & Type of Engines:	1 Lycoming O-320-D2J piston engine
Year of Manufacture:	2010 (Serial no: PFA 320-14186)
Date & Time (UTC):	27 July 2014 at 1140 hrs
Location:	Langham Airfield, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, nose landing gear leg, right wing and attachment points
Commander's Licence:	Private Pilot's Licence
Commander's Age:	65 years
Commander's Flying Experience:	647 hours (of which 300 were on type) Last 90 days - 47 hours Last 28 days - 9 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft made what the pilot considered was a normal approach and touchdown on Runway 02 at Langham Airfield. Whilst decelerating, the pilot positioned his aircraft close to the left edge of the available landing area to avoid molehills he could see near the centre of the grass strip. At a little above normal taxiing speed the aircraft yawed to the left and the pilot was unable to prevent the left mainwheel from leaving the strip and going down into a deep trough in the adjacent cornfield. The aircraft then veered further to the left and the nosewheel also went into the trough. This caused the aircraft to pitch forward and the propeller and right wing came into firm contact with the ground. The pilot and his passenger were uninjured and, after shutting down, they vacated the aircraft normally.

The pilot believed the accident occurred because he positioned himself too close to the edge of the runway and had insufficient room to correct the aircraft's initial swing to the left.

ACCIDENT

Aircraft Type and Registration:	EV-97 TeamEurostar UK, G-CGGM
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2009 (Serial no: 3401)
Date & Time (UTC):	6 August 2014 at 1130 hrs
Location:	Grass strip, Pitsford, Northamptonshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right wing including outer edge trailing edge, upper side buckled, right flap
Commander's Licence:	Private Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	1,084 hours (of which 600 were on type) Last 90 days - 19 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was on short finals when the pilot realised he was too slow and too low. He applied power but was unable to prevent the aircraft from landing heavily in what the pilot considered was a level attitude. The aircraft continued with the landing roll and stopped normally. A subsequent inspection revealed that the aircraft's right wing had damage consistent with it having touched the ground.

The pilot believes that, during the heavy landing, the compressed undercarriage must have allowed the wing to come into contact with the undulating ground around the threshold of the grass strip. He considered that the heavy landing was as a result of him becoming distracted and allowing the aircraft to become too low and slow.

ACCIDENT

Aircraft Type and Registration:	Gemini Flash II, G-MTGA	
No & Type of Engines:	1 Rotax 503 piston engine	
Year of Manufacture:	1987 (Serial no: 535-587-5-W293)	
Date & Time (UTC):	21 June 2014 at 1215 hrs	
Location:	Private strip, Northiam, East Sussex	
Type of Flight:	Training	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Bent tubing and damaged fairings	
Commander's Licence:	National Private Pilot's Licence	
Commander's Age:	60 years	
Commander's Flying Experience:	4,500 hours (of which 2 were on type) Last 90 days - 10 hours Last 28 days - 4 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

The aircraft drifted to the left shortly after takeoff from Runway 02. The left wheel struck a fence on the side of the runway, causing the aircraft to hit the ground. The aircraft was damaged but there were no injuries. The pilot stated that the location of the fence on the edge of the narrow 18 m strip, and the variable wind conditions, contributed to the accident.

ACCIDENT

Aircraft Type and Registration:	Gemini Flash IIA, G-MVJE
No & Type of Engines:	1 Rotax 503 piston engine
Year of Manufacture:	1988 (Serial no: 706-1188-6-W496)
Date & Time (UTC):	14 June 2014 at 1110 hrs
Location:	Otherton Airfield, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Wing severely damaged, damage to nose and nosewheel
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	51 hours (of which 46 were on type) Last 90 days - 2 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

While landing on grass Runway 07, with a reported wind of 10 mph from the south-east, the pilot reportedly hit a bump or dip and the aircraft drifted to the left. He attempted to correct this but reported that a gust of wind from the right then lifted the right wing causing the aircraft to roll left. He attempted to steer left but the aircraft tipped such that the left wing and nose contacted the ground.

The pilot, who was wearing a lap harness and protective helmet, was uninjured. He considered that the accident was caused by a combination of hitting the bump or dip and the gusting crosswind conditions.

ACCIDENT

Aircraft Type and Registration:	P&M Aviation QuikR, G-FRIK	
No & Type of Engines:	1 Rotax 912-UL piston engine	
Year of Manufacture:	2011 (Serial no: 8562)	
Date & Time (UTC):	22 July 2014 at 0830 hrs	
Location:	Sulby airstrip, near Husbands Bosworth, Leicestershire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damage to wing, propeller, nosewheel, pod, pylon and base tube	
Commander's Licence:	National Private Pilot's Licence	
Commander's Age:	65 years	
Commander's Flying Experience:	119 hours (of which 118 were on type) Last 90 days - 5 hours Last 28 days - 2 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

Following a late decision to go around the aircraft's right wingtip contacted the ground, causing the aircraft to swing round such that it came to rest in the crop at the side of the runway.

History of the flight

The pilot had departed Enstone in Oxfordshire with the intention of delivering the aircraft to a maintenance organisation at Sulby airstrip for some planned maintenance. Sulby is a grass strip, orientated 04/22, approximately 410 m in length and 16 m wide and, at the time of the accident, was bordered by a standing crop of barley. The wind was subsequently reported as from 030º at 5 kt.

The pilot made what he described as a "poor" approach to Runway 04 and decided to go around. However the right wingtip contacted the barley, which swung the aircraft round such that it came to rest on its side, in the crop to the right of the runway. The aircraft sustained considerable damage although the pilot was uninjured.

In his statement the pilot attributed the accident to his failure to make a timely decision to go around.

ACCIDENT

Aircraft Type and Registration:	Quad City Challenger II, G-MYIX	
No & Type of Engines:	1 Rotax 503 piston engine	
Year of Manufacture:	1993 (Serial no: PFA 177-12260)	
Date & Time (UTC):	2 May 2014 at 1517 hrs	
Location:	Louth, Lincolnshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Damage to nosewheel, left main wheel, nose cone and underside of floor pan	
Commander's Licence:	National Private Pilot's Licence	
Commander's Age:	69 years	
Commander's Flying Experience:	280 hours (of which 26 were on type) Last 90 days - 2 hours Last 28 days - 1 hour	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

During a check flight the pilot applied full power prior to conducting a timed climb. However, the engine rpm suddenly increased and it became apparent that the drive to the propeller had become disconnected. The aircraft was damaged in the subsequent forced landing, although the occupants were uninjured. It was found that the drive belt that connected the engine driveshaft to the propeller shaft, located immediately above the engine driveshaft, had migrated out of the groove in the lower pulley. This may have been the result of a degree of misalignment between the engine driveshaft and propeller shaft.

History of the flight

The aircraft had been inspected for revalidation of its Permit to Fly on 29 April 2014, three days prior to the accident; the intention on 2 May was to conduct a check flight. The aircraft took off from North Coates Airfield and, having reached 1,000 ft over an open area, the pilot prepared to conduct a timed climb to 2,000 ft. He increased the power to an indicated 6,700 rpm and raised the nose to allow the aircraft to achieve its maximum rate of climb at around 60-65 mph. However, at around 1,200 -1,300 ft the engine rpm suddenly "ran away". The pilot immediately throttled back and lowered the nose so that the aircraft settled into a glide at approximately 55 mph. He then checked with his passenger what he had heard and, as a check, opened the throttle once more. The engine rpm increased rapidly and thus suggested to the pilot that the drive to the propeller had been lost.

The pilot selected an arable field for a landing, which he approached from the southwest. The field was bisected by a meandering drainage ditch running approximately north-south and the pilot intended to land on the eastern side of the ditch, with the aiming point some 10 m beyond it. The approach proceeded smoothly until shortly before touchdown, when it suddenly became apparent that the ground on the far side of the ditch was 2-3 m higher than on the approach side. This prompted the pilot to pull back sharply on the stick, causing the aircraft to stall and land heavily on top of the embankment on the eastern side of the ditch. Neither of the occupants of the aircraft was injured, although considerable damage had occurred to the landing gear and fuselage underside.

Examination of the aircraft

The Quad City Challenger is a tandem two-seat, high-wing, 'pusher-configuration' aircraft in which the engine is located behind the pilot. A belt drive system connects the engine driveshaft to the propeller shaft, located immediately above it.

Examination of the aircraft immediately after the accident indicated that the propeller shaft drive belt had come off the engine pulley; this accounted for the loss of drive to the propeller and the rpm 'runaway' of the engine.

Subsequent detailed examination of the propeller drive components revealed that the lower pulley (on the engine driveshaft) was rotating in an elliptical orbit. On removing it from the shaft it was apparent that there had been excessive wear on the internal surface of the pulley, with a corresponding build-up of aluminium alloy material on the shaft. It was concluded that, although the bolt that secured the pulley to the shaft had been tight, there had been periodic slippage between the two components. The pilot later commented that he had been aware of occasional "blips" in the engine rpm, but had attributed these to carburettor icing. He now considers that this may have been a symptom of the drive successively slipping and locking.

The Light Aircraft Association (LAA), which provides airworthiness services to the operators of this class of aircraft under delegation from the United Kingdom Civil Aviation Authority, were consulted on this accident. They noted that the aircraft log book indicated that the lower pulley had been replaced in 2010, some 19 flying hours previously, although the work had not been signed off by means of a Permit Maintenance Release, as would normally be required. The LAA also noted that their experience with this type of aircraft indicated that premature failure of the propeller drive system was usually the result of the upper and lower drive pulleys not being properly aligned. Thus, although it was not positively established in this case, it is considered possible that a degree of misalignment occurred between the two driveshafts during the maintenance conducted 19 flight hours prior to the accident. The increasingly elliptical orbit of the lower pulley would eventually result in the drive belt migrating out of the pulley groove.

This type of propeller drive system has largely been superseded by the use of gearboxes, which have generally proved more reliable and avoid the potential problem of slippage between the pulley and driveshaft. It is important, in pulley-driveshaft designs, to ensure

contact over the entire mating surfaces of the components. In the event of incomplete contact, engine vibration and torque spikes can cause localised surface damage, rapidly progressing to severe damage.

ACCIDENT

Aircraft Type and Registration:	Skyranger 912(2), G-CCCK	
No & Type of Engines:	1 Rotax 912-UL piston engine	
Year of Manufacture:	2003 (Serial no: BMAA/HB/265)	
Date & Time (UTC):	6 July 2014 at 1500 hrs	
Location:	Newtownards Airfield, Northern Ireland	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Dents in leading edge of wing and ripped fabric	
Commander's Licence:	National Private Pilot's Licence	
Commander's Age:	45 years	
Commander's Flying Experience:	183 hours (of which 4 were on type) Last 90 days - 16 hours Last 28 days - 5 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

The pilot was converting from flexwing to fixed-wing aircraft and had just flown a 90-minute sortie in G-CCCK, in what he described as difficult crosswind conditions. The pilot dropped off his instructor and was taxiing to put the aircraft away; as he passed a parked aircraft he needed to turn his own aircraft to the right. In his previous flexwing aircraft, to turn to the right the pilot would move his left foot forward; in this fixed-wing aircraft, moving his left foot forward turned the aircraft left. The pilot mistakenly moved the wrong pedal forward and his aircraft turned rapidly the wrong way, to the left, clipping the propeller of a parked aircraft before coming to rest against a corrugated hangar. The pilot, who was uninjured, made his aircraft safe and vacated it normally. There was no damage to the parked aircraft and the damage to the pilot's aircraft was minor, denting the leading edge of the wing.

ACCIDENT

Aircraft Type and Registration:	Skyranger 912(2), G-CDIJ	
No & Type of Engines:	1 Rotax 912-UL piston engine	
Year of Manufacture:	2005 (Serial no: BMAA/HB/445)	
Date & Time (UTC):	24 August 2014 at 1030 hrs	
Location:	Battleflat Farm Airstrip, Leicestershire	
Type of Flight:	Private	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damage to nosewheel, propeller, rear fuselage, wings	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	60 years	
Commander's Flying Experience:	4,514 hours (of which 129 were on type) Last 90 days - 34 hours Last 28 days - 13 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

The pilot reported that the power checks carried out prior to the takeoff were satisfactory, but as the aircraft climbed through 350 ft the engine lost most of its power. As the winds were light, and there was no suitable location ahead of the aircraft in which to land, the pilot turned back towards the airfield. The aircraft was high as it crossed the threshold and touched down at a higher than normal landing speed. During the ground roll the nose landing gear collapsed and the aircraft tipped over onto its back. Both occupants were uninjured and vacated the aircraft through the normal exits.

Miscellaneous

This section contains Addenda, Corrections and a list of the ten most recent Aircraft Accident ('Formal') Reports published by the AAIB.

The complete reports can be downloaded from the AAIB website (www.aaib.gov.uk).

BULLETIN ADDENDUM

Aircraft Type and Registration:	DHC-8-402 Dash 8, G-JECJ
Date & Time (UTC):	23 October 2013 at 0540 hrs
Location:	Manchester Airport
Information Source:	Aircraft Accident Report Form and additional information supplied by the aircraft manufacturer

AAIB Bulletin No. 6/2014 refers

The above AAIB Bulletin contained the following synopsis:

> 'Whilst en-route, the crew experienced a number of cautions and warnings on the Central Warning Panel (CWP). The number of these increased, and cabin and cockpit lights also started to fail. The aircraft diverted to Manchester, where an uneventful landing was made. It is suspected that there had been a failure of the right starter/generator or its Generator Control Unit (GCU) and that a further latent failure of a contactor had prevented automatic connection of the right DC bus to the left DC bus. The services normally powered by the right DC bus would now be powered by the main aircraft battery, which would progressively discharge.'

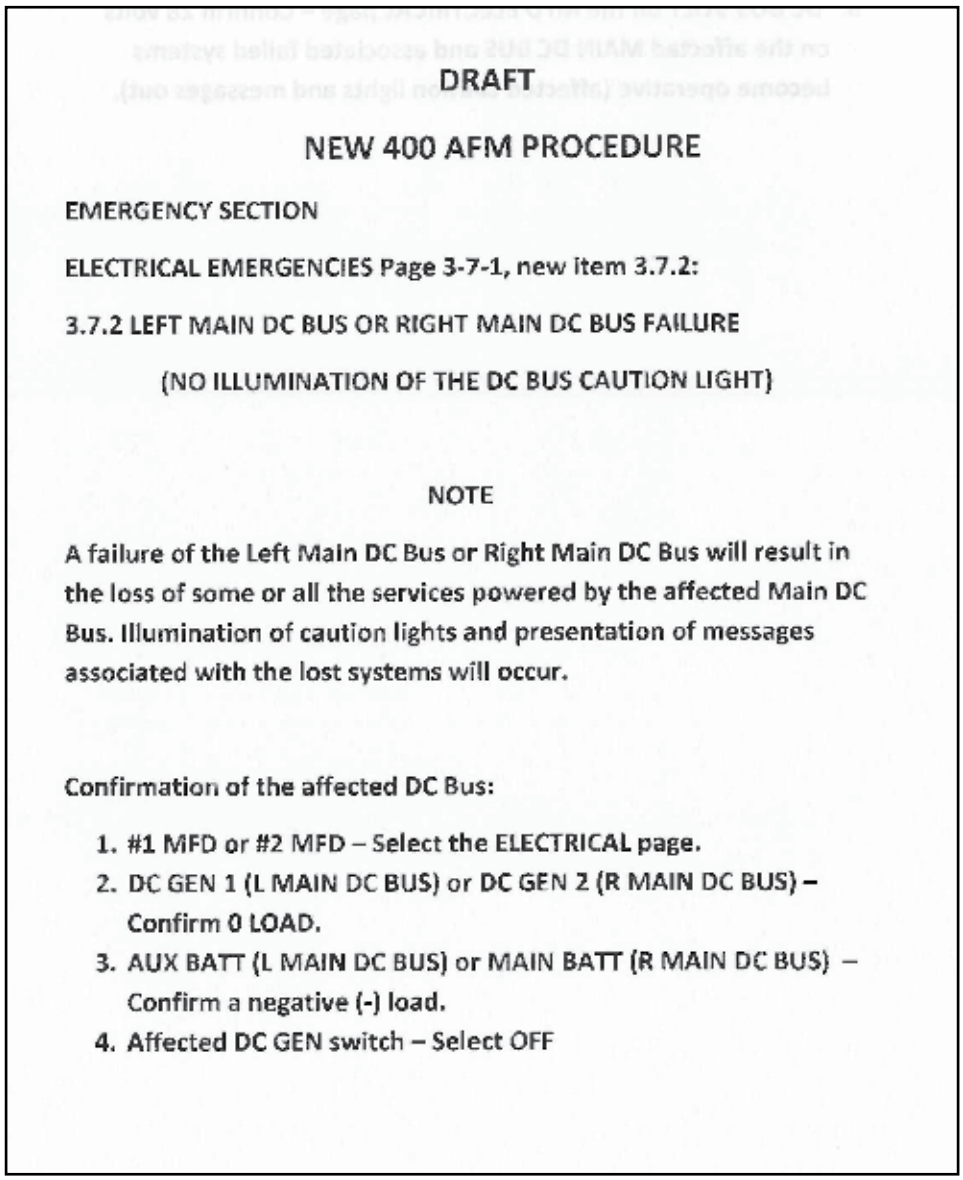
A report has subsequently been received from the manufacturer containing the following findings from their examination of the components:

- The brushes and collector of the DC generator were found severely worn and damaged
- *No fault found* with the Generator Line Contactor (GLC) K2 (AAIB italics)
- No fault found with DC GCU

The report also contained the conclusion that loss of contact between the brushes and armature:

> *'…while backed up by the battery allowed the condition to be undetected by normal generator power quality protection circuits.*
>
> *In the absence of detection, the GCU and EPCU do not reconfigure the system as would be the case for a power quality failure.*
>
> *This failure mode is detectable by the pilot through observation of zero generator output current on the electrical load meter page. Additionally, abnormal positive discharge current from [the] battery when the generator is believed to be on-line is an indication of impending … battery depletion…. resumption of DC power to the Right DC buses could be accomplished through…turning off the DC Generator switch to the faulty side which will enable cross tying of the opposite side to supply the load as well as charging the battery.'*

Bombardier advise that they propose the following amendment to the Aircraft Flight Manual (AFM):



DRAFT

NEW 400 AFM PROCEDURE

EMERGENCY SECTION

ELECTRICAL EMERGENCIES Page 3-7-1, new item 3.7.2:

3.7.2 LEFT MAIN DC BUS OR RIGHT MAIN DC BUS FAILURE

(NO ILLUMINATION OF THE DC BUS CAUTION LIGHT)

NOTE

A failure of the Left Main DC Bus or Right Main DC Bus will result in the loss of some or all the services powered by the affected Main DC Bus. Illumination of caution lights and presentation of messages associated with the lost systems will occur.

Confirmation of the affected DC Bus:

1. #1 MFD or #2 MFD – Select the ELECTRICAL page.
2. DC GEN 1 (L MAIN DC BUS) or DC GEN 2 (R MAIN DC BUS) – Confirm 0 LOAD.
3. AUX BATT (L MAIN DC BUS) or MAIN BATT (R MAIN DC BUS) – Confirm a negative (-) load.
4. Affected DC GEN switch – Select OFF

TEN MOST RECENTLY PUBLISHED FORMAL REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

4/2010 Boeing 777-236, G-VIIR
at Robert L Bradshaw Int Airport
St Kitts, West Indies
on 26 September 2009.

Published September 2010.

5/2010 Grob G115E (Tutor), G-BYXR
and Standard Cirrus Glider, G-CKHT
Drayton, Oxfordshire
on 14 June 2009.

Published September 2010.

6/2010 Grob G115E Tutor, G-BYUT
and Grob G115E Tutor, G-BYVN
near Porthcawl, South Wales
on 11 February 2009.

Published November 2010.

7/2010 Aerospatiale (Eurocopter) AS 332L
Super Puma, G-PUMI
at Aberdeen Airport, Scotland
on 13 October 2006.

Published November 2010.

8/2010 Cessna 402C, G-EYES and
Rand KR-2, G-BOLZ
near Coventry Airport
on 17 August 2008.

Published December 2010.

1/2011 Eurocopter EC225 LP Super
Puma, G-REDU
near the Eastern Trough Area
Project Central Production Facility
Platform in the North Sea
on 18 February 2009.

Published September 2011.

2/2011 Aerospatiale (Eurocopter) AS332 L2
Super Puma, G-REDL
11 nm NE of Peterhead, Scotland
on 1 April 2009.

Published November 2011.

1/2014 Airbus A330-343, G-VSXY
at London Gatwick Airport
on 16 April 2012.

Published February 2014.

2/2014 Eurocopter EC225 LP Super Puma
G-REDW, 34 nm east of Aberdeen,
Scotland on 10 May 2012
and
G-CHCN, 32 nm southwest of
Sumburgh, Shetland Islands
on 22 October 2012

Published June 2014.

3/2014 Agusta A109E, G-CRST
Near Vauxhall Bridge,
Central London
on 16 January 2013.

Published September 2014.

Unabridged versions of all AAIB Formal Reports, published back to and including 1971, are available in full on the AAIB Website

http://www.aaib.gov.uk

GLOSSARY OF ABBREVIATIONS

aal	above airfield level
ACAS	Airborne Collision Avoidance System
ACARS	Automatic Communications And Reporting System
ADF	Automatic Direction Finding equipment
AFIS(O)	Aerodrome Flight Information Service (Officer)
agl	above ground level
AIC	Aeronautical Information Circular
amsl	above mean sea level
AOM	Aerodrome Operating Minima
APU	Auxiliary Power Unit
ASI	airspeed indicator
ATC(C)(O)	Air Traffic Control (Centre)(Officer)
ATIS	Automatic Terminal Information System
ATPL	Airline Transport Pilot's Licence
BMAA	British Microlight Aircraft Association
BGA	British Gliding Association
BBAC	British Balloon and Airship Club
BHPA	British Hang Gliding & Paragliding Association
CAA	Civil Aviation Authority
CAVOK	Ceiling And Visibility OK (for VFR flight)
CAS	calibrated airspeed
cc	cubic centimetres
CG	Centre of Gravity
cm	centimetre(s)
CPL	Commercial Pilot's Licence
°C,F,M,T	Celsius, Fahrenheit, magnetic, true
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
DME	Distance Measuring Equipment
EAS	equivalent airspeed
EASA	European Aviation Safety Agency
ECAM	Electronic Centralised Aircraft Monitoring
EGPWS	Enhanced GPWS
EGT	Exhaust Gas Temperature
EICAS	Engine Indication and Crew Alerting System
EPR	Engine Pressure Ratio
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
FAA	Federal Aviation Administration (USA)
FIR	Flight Information Region
FL	Flight Level
ft	feet
ft/min	feet per minute
g	acceleration due to Earth's gravity
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
hrs	hours (clock time as in 1200 hrs)
HP	high pressure
hPa	hectopascal (equivalent unit to mb)
IAS	indicated airspeed
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IP	Intermediate Pressure
IR	Instrument Rating
ISA	International Standard Atmosphere
kg	kilogram(s)
KCAS	knots calibrated airspeed
KIAS	knots indicated airspeed
KTAS	knots true airspeed
km	kilometre(s)
kt	knot(s)
lb	pound(s)
LP	low pressure
LAA	Light Aircraft Association
LDA	Landing Distance Available
LPC	Licence Proficiency Check
m	metre(s)
mb	millibar(s)
MDA	Minimum Descent Altitude
METAR	a timed aerodrome meteorological report
min	minutes
mm	millimetre(s)
mph	miles per hour
MTWA	Maximum Total Weight Authorised
N	Newtons
N_R	Main rotor rotation speed (rotorcraft)
N_g	Gas generator rotation speed (rotorcraft)
N_1	engine fan or LP compressor speed
NDB	Non-Directional radio Beacon
nm	nautical mile(s)
NOTAM	Notice to Airmen
OAT	Outside Air Temperature
OPC	Operator Proficiency Check
PAPI	Precision Approach Path Indicator
PF	Pilot Flying
PIC	Pilot in Command
PNF	Pilot Not Flying
POH	Pilot's Operating Handbook
PPL	Private Pilot's Licence
psi	pounds per square inch
QFE	altimeter pressure setting to indicate height above aerodrome
QNH	altimeter pressure setting to indicate elevation amsl
RA	Resolution Advisory
RFFS	Rescue and Fire Fighting Service
rpm	revolutions per minute
RTF	radiotelephony
RVR	Runway Visual Range
SAR	Search and Rescue
SB	Service Bulletin
SSR	Secondary Surveillance Radar
TA	Traffic Advisory
TAF	Terminal Aerodrome Forecast
TAS	true airspeed
TAWS	Terrain Awareness and Warning System
TCAS	Traffic Collision Avoidance System
TGT	Turbine Gas Temperature
TODA	Takeoff Distance Available
UHF	Ultra High Frequency
USG	US gallons
UTC	Co-ordinated Universal Time (GMT)
V	Volt(s)
V_1	Takeoff decision speed
V_2	Takeoff safety speed
V_R	Rotation speed
V_{REF}	Reference airspeed (approach)
V_{NE}	Never Exceed airspeed
VASI	Visual Approach Slope Indicator
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional radio Range

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Air Accidents Investigation Branch