AAIB
Air Accidents Investigation Branch

AAIB Bulletin 6/2014

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(ALL TIMES IN THIS BULLETIN ARE UTC)

AAIB Field Investigation reports

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-140 Cherokee, G-ATRR
No & Type of Engines:	1 Lycoming O-320-E3D piston engine
Year of Manufacture:	1966 (Serial no: 28-21892)
Date & Time (UTC):	19 May 2013 at 1018 hrs
Location:	Caernarfon Airport, Gwynedd
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - 1 (Serious) Passengers - 1 (Fatal) 1 (Serious)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	90 hours (of which 72 were on type) Last 90 days - 9 hours Last 28 days - 2 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was making an approach to Runway 26 at Caernarfon Airport when it struck a tree. The pilot reported that he had suffered a loss of power at a late stage of the approach and had been unable to reach the airfield. The investigation did not find any evidence of a failure within the engine but the atmospheric conditions were conducive to carburettor icing.

History of the flight

The pilot pre-booked the aircraft through an online booking system several weeks before the flight. He planned to make a cross-country flight from Blackpool to Caernarfon and then possibly on to Welshpool before returning to Blackpool. On the morning of the accident he arrived at the airfield with his passengers and found the aircraft he had booked was parked on the ramp. He checked the fuel contents, which were less than he required, so he decided to put in some additional fuel. He taxied to the pumps, filled each tank to the tab and then taxied back to the parking area and shut down the engine before boarding his passengers.

The passengers boarded the aircraft; the front right seat was occupied by the pilot's adult son and the pilot's five-year-old grandson was seated in the rear left seat. The pilot later recalled checking that the passenger seat belts were fastened before he commenced taxiing. The pre-departure power checks were carried out at the holding area prior to takeoff; the aircraft took off from Runway 28 and turned left on to a southerly course. The pilot followed a coastal route, maintaining an altitude of between 1,000 ft and 2,500 feet amsl. A GPS-derived track plot of the route is shown as Figure 1.

Figure 1
GPS track - Blackpool to Caernarfon

The pilot made several radio calls to RAF Valley as he approached the Caernarfon area but did not establish contact. He then contacted the Caernarfon Airport Air-Ground radio operator in the tower and was advised that Runway 26 was in use and that the circuit was clear of other traffic. The pilot requested, and positioned for, a straight-in approach. The radio operator saw the aircraft on a wide right base-leg position and estimated that it had joined the final approach course at about 4 nm. The approach path appeared normal to him and the pilot made a 'finals' radio call at what the radio operator estimated to be about 1.5 nm from the airfield. The radio operator acknowledged the call and gave the pilot the surface wind from 270º at 5 kt.

The aircraft was seen by several witnesses to get very low on the final approach and to be flying slowly. The aircraft struck a tree and dropped to the ground in a steep nose-down attitude, just inside the airfield boundary. The radio operator sounded the crash alarm and made an emergency call on the radio to advise all parties of an aircraft accident.

The airport fire service attended the scene and the local fire service were notified and attended subsequently. An air ambulance helicopter was already airborne in the local area and its pilot was listening out on the Caernarfon Airport radio frequency. He offered assistance and diverted to the airport; thus medical help arrived quickly at the scene. The adult passenger was fatally injured in the accident. The pilot and the child were freed from the aircraft and transferred to local hospitals, where they were treated for serious injuries.

Meteorological information

On the day of the accident there was a weak pressure pattern across the United Kingdom with a very light north to north-easterly airflow. The visible satellite image at 1000 hrs shows some stratocumulus-type cloud lying along the coast of north Wales; there was no precipitation indicated. Surface observations in the area showed a large amount of low-level stratocumulus-type cloud in the area, with bases between 2,500 ft and 3,500 ft in general. The 0950 hrs METAR from RAF Valley, 16 nm to the north-west of Caernarfon, showed a surface wind from 330º at 4 kt, visibility 10 km or greater, few cloud at 1,900 ft, scattered cloud at 2,400 ft, overcast cloud at 3,200 ft, temperature 13ºC and dewpoint 8ºC. The 0950 hrs METAR from Hawarden, 20 nm south east of the en-route track of the aircraft, showed a surface wind from 360ºat 2 kt, visibility 10 km or greater, broken cloud at 2,500 ft, temperature 13ºC and dewpoint 7ºC.

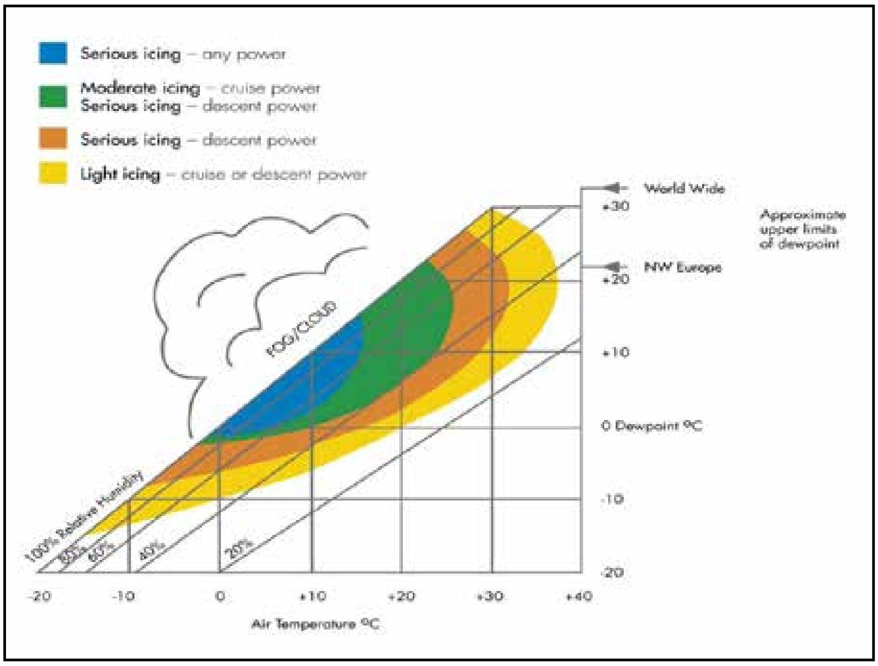

Figure 2

Carburettor icing probability chart

Figure 2 illustrates the probability of carburettor icing for values of air temperature and dewpoint. Assuming a reducing temperature and similar dewpoint above the surface, this would indicate that the latter part of the flight was operating in the blue sector: 'serious icing at any power'.

CAA Safety Sense Leaflet 14, '*Piston Engine Icing*', contains useful information and guidance concerning induction system icing. It includes the following information:

> *'Engines at reduced power settings are more prone to icing because engine induction temperatures are lower. Also, the partially closed butterfly can more easily be restricted by the ice build-up.'*

Pages 6 and 7 of this Safety Sense Leaflet give recommended procedures for the use of carburettor heating ('hot air') in different phases of flight, including Descent and Approach, Downwind and Base Leg and Final Approach:

> *'j) Descent and Approach*
>
> *Carb icing is much more likely at reduced power, so select carb heat **before, rather than after**, power is reduced for the descent, and especially for a practice forced landing or a helicopter autorotation, i.e. before the exhaust starts to cool. (A full carb heat check just before selecting hot air for the descent is advisable.) Maintain FULL heat during long periods of flight with reduced power settings. At intervals of about 500 ft (or more frequently if conditions require), increase power to cruise setting to warm the engine and to provide sufficient heat to melt any ice.*
>
> *k) Downwind*
>
> *Ensure that the downwind check includes the cruise carburettor heat check at paragraph 6(i) above. If you select and leave the heat on, however, speed or altitude will reduce on the downwind leg unless you have added some power beforehand.*
>
> *l) Base Leg and Final Approach*
>
> *Unless otherwise stated in the Pilot's Operating Handbook or Flight Manual, the HOT position should be selected well before power is reduced and retained to touchdown. On some engine installations, to ensure better engine response and to permit a go-around to be initiated without delay, it may be recommended that the carb hot air be returned to COLD at about 200/300 ft on finals.'*

Recorded information

Recorded information was available from a portable device[1] recovered from the aircraft. The device contained a track log of the accident flight, with aircraft GPS-derived position, track, altitude and groundspeed recorded. The record commenced at 0930 hrs as the aircraft departed Blackpool Airport and ended at 1018 hrs, shortly after the aircraft struck the ground. Information from the device is shown in Figures 3, 4 and 5; Figure 3 shows the approach commencing from overhead the town of Caernarfon, Figure 4 the time-history plot and Figure 5 the flight track of the final seconds of the approach. Times are UTC and altitudes are referenced to aal.

Having followed the coastline to the town of Llandudno, the aircraft altered track towards the town of Bangor, en-route to Caernarfon Airport. As it flew over the Menai Bridge, the aircraft climbed from 1,100 ft and at Caernarfon, about 3 nm from the airport, it was at 1,570 ft (Point A) and its groundspeed was 80 kt. The time was 1015 hrs. It then descended

Footnote

[1] Apple-manufactured iPad mini (version 1), operating a SkyDemon-manufactured flight navigation software application.

towards the final approach track for Runway 26, initially at about 300 ft/min, then at about 960 ft/min (Point B, groundspeed 103 kt, 2.2 nm from the runway threshold).

Figure 3

GPS track of approach to Caernarfon

At 1.25 nm from the runway threshold and 710 ft aal, the aircraft was on the final approach track, and the rate of descent increased to about 1,400 ft/min (Point C). As the aircraft approached 350 ft aal the rate of descent reduced; the aircraft was 0.87 nm from the threshold with its groundspeed 85 kt and reducing. As the approach continued, the groundspeed continued to reduce.

At about 500 m from the start of the paved surface of the runway, the aircraft was at 130 ft aal (Point D), its groundspeed was about 60 kt and the rate of descent 250 ft/min. Based on a wind from 270º at 5 kt, the airspeed would have been near 65 kt (75 mph). The descent rate then momentarily increased, whilst the groundspeed continued to reduce gradually. Shortly after, at about 80 m to the east of the paved surface of the runway, the aircraft struck the top of a tree at a groundspeed of about 49 kt (Point E - estimated airspeed 54 kt) before impacting the ground.

Airport information

Caernarfon Airport is located on the coast and has an elevation of 14 ft amsl. Inbound aircraft were advised to make a radio call to RAF Valley and to transit the Menai Strait at '*not above 1,500 ft amsl*'. At the time of the accident the airport had a licensed asphalt Runway 08/26, 935 m in length and 23 m wide. There was also an unlicensed Runway, 02/20, alongside of which there were two wind turbines at 140 ft aal.

To the east of Runway 26 (Figure 5), adjacent to the airfield boundary, there was a leisure park, with a number of mobile homes and caravans. At the time of the accident the park extended for 300 metres to the east of the airfield boundary.

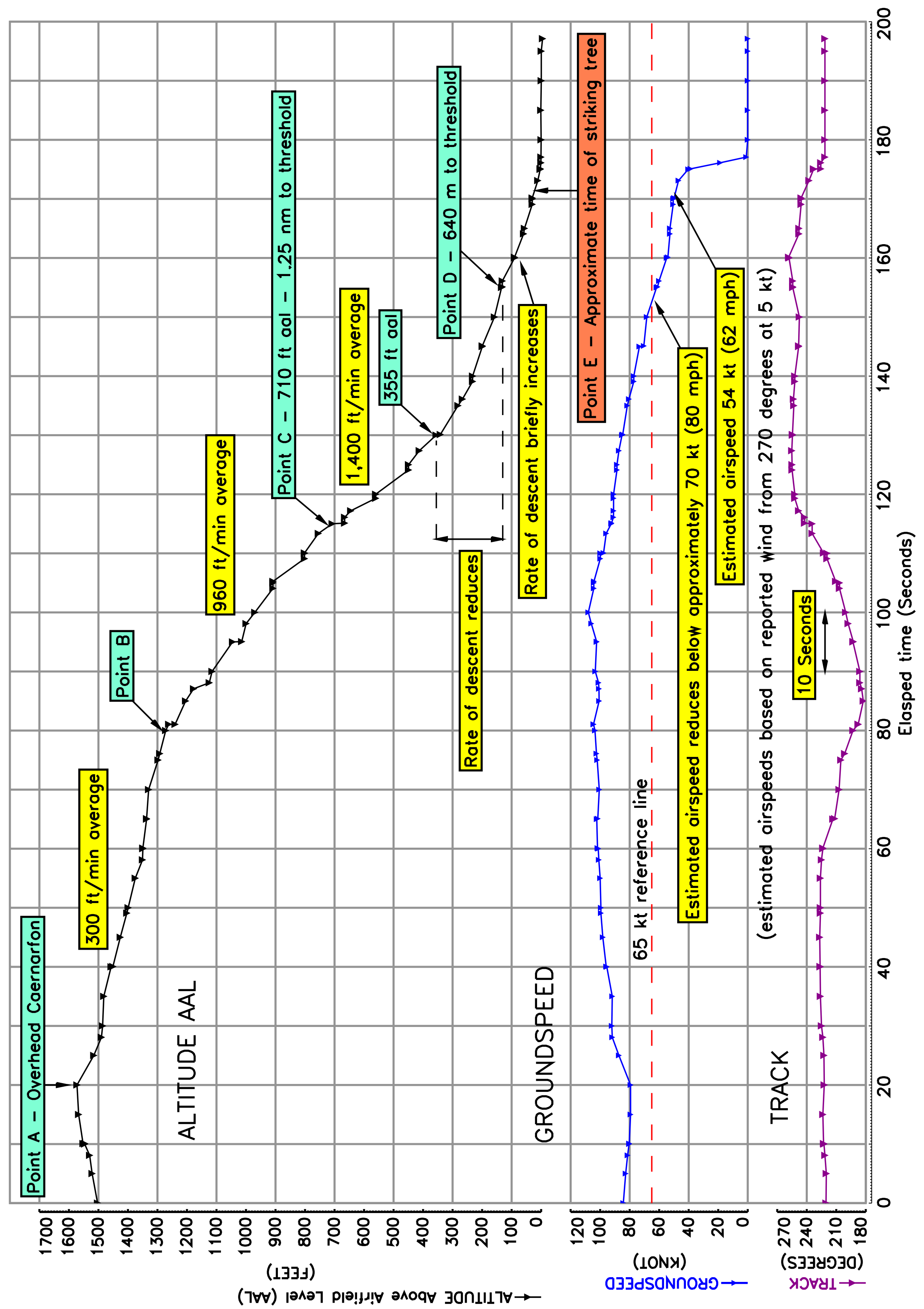

Figure 4

Time history plot of approach

Figure 5
GPS track of final approach

Witness information

There were a number of witnesses, both aural and visual, to the later stages of the approach of the aircraft. They all reported that the aircraft was lower than usual, some noted that the nose attitude was high and several commented that the flight path appeared flat and the aircraft very slow.

One witness's attention was drawn to the aircraft by an unusual noise. He reported that the engine was "trying to pick up and popping" and he had the impression that the pilot may have pumped the throttle three or four times. Another reported hearing the engine "spluttering and seemed to backfire", while others reported the engine was running, but at low power.

Pilot information

The pilot started training for his Private Pilot's Licence (PPL) at Blackpool Airport in January 2005. His training was completed successfully and his licence issued in October 2006. A proficiency check was carried out on 14 April 2010 to revalidate his SEP (land) rating, this remained valid until 14 April 2012. At the time of the accident the pilot's logbook and licence did not show evidence of a more recent revalidation or renewal.

The pilot had visited Caernarfon Airport several times before, most recently in October 2012. On some occasions when he flew he would ask an instructor to accompany him, particularly when visiting new airfields. The most recent flight with an instructor was on 5 April 2013, a cross-country flight with landings away, a total duration of 3 hrs 45 min. The AAIB later received from the pilot a photocopy of his logbook and licence indicating that the flight on 5 April 2013 had been conducted for the purposes of his rating renewal.

The pilot reported that his normal technique for an approach was to reduce power on base leg to around 1,900 rpm, select the first stage of flap and descend, maintaining a speed of "80" mph[2]. He would then turn onto final approach, deploy the next stage of flap and adjust power to maintain "80" into the landing.

The pilot was able to remember some of the events leading up to the accident and had a good recollection of the flight up to the point of joining the circuit at Caernarfon. He was not clear about the precise checks he had carried out while joining the circuit, but noted that it was his normal practice to use the checklist on his kneeboard.

A checklist was found attached to the pilot's kneeboard which contained the following checks relating to carburettor heat;

Downwind checks CARB HEAT ----- HOT/COLD

Base/Final checks CARB HEAT ----- HOT

The instructor who most regularly flew with the pilot reported that the method for carburettor heat he taught was to select it to HOT during the downwind checks, for up to 30 seconds, and then to return it to COLD for the approach. The pilot confirmed that this was the technique he used.

The pilot remembered that he had tried to increase power when on the approach but there was no response from the engine. He believes he tried unsuccessfully to pump the throttle in an attempt to gain power. Realising he was not going to reach the airfield he deployed first one stage, then a second stage, of flap in an attempt to clear the obstacles before the boundary.

Aircraft description

The Piper PA-28-140 is a four-seat light aircraft of conventional aluminium construction powered by a Lycoming O-320 piston engine and a fixed-pitch propeller. It has a maximum takeoff weight of 977 kg. The fuel tanks have a usable fuel capacity of 48 USG when full and 34 USG when filled to the tabs. The aircraft has mechanically-operated flaps, deployed by a control handle between the two front seats. To extend the flaps the handle is pulled up to one of three positions, corresponding to 10º, 25º and 40º of flap.

The stall speed of the aircraft at the maximum takeoff weight in clean configuration is 61 mph (53 kt) IAS and with Flap 40º is 55 mph (48 kt) IAS. The Flight Manual does not provide a recommended final approach speed but a typical final approach speed for the type would be 80 mph.

The carburetted engine has a carburettor heat control system which, when selected, feeds hot air from a shroud around the exhaust into the carburettor to prevent ice formation. Carburettor heat is controlled by pushing or pulling a knob marked *'CARB HEAT PULL HOT'* on the instrument panel to the left of the throttle.

Footnote

[2] On this aircraft the main ASI numbers were marked mph. There was an inner ring with lower numbers, indicating kt.

Accident site and initial wreckage examination

The aircraft had struck the ground 40 m short of the start of the paved surface of Runway 26 and displaced 15 m left of the extended runway centreline (Figure 6). The ground impact attitude was about 50º nose-down with a slight left bank. Following initial impact the aircraft flipped onto its back and came to rest 2 m further forward (Figure 7). Prior to ground impact the aircraft had struck a tree located slightly south of the extended runway centreline, 80 m from the start of the paved surface of Runway 26. Only the crown of the tree had been damaged with a level cut, indicating that the aircraft had struck the tree in a near-level attitude. The tree was later surveyed to have a height above runway threshold of 9.21 m – this was after the airport had arranged for about 0.4 m to be trimmed from the top. Therefore, immediately following the accident the tree height was about 9.6 m above the runway threshold.

Figure 6

Accident site overview

The aircraft suffered significant structural damage to its forward fuselage and wing leading edges and the right wing spar had failed. The propeller blades were slightly bent rearward but did not have any leading edge or tip damage. There were two clear propeller strike marks in the ground at the initial impact point, spaced about 70 cm apart. Based on an estimated impact groundspeed of 40 kt the propeller would have been rotating at about 900 rpm. If the groundspeed had been 50 kt the propeller rpm would have been about 1,100 rpm.

The left flap was measured at 38º deflection while the flap selector handle was found in the detent for ‘Flaps 25’. The fuel selector was set to the right tank and although the right tank was punctured there was sufficient fuel remaining to recover a 2.5 litre sample. This fuel sample was tested and was free from contamination apart from a few small globules of water. The left fuel tank had ruptured and was empty. The throttle was at a near-idle position, the mixture was set to full rich and the carburettor heat selector was set to cold, although these could have moved in the impact due to the disruption to the engine and instrument panel. The magneto key was found in the OFF position but it was bent so may have moved in the impact. The electric fuel pump switch was found ON and the master switch OFF. The master switch and magneto switches may have been turned off by emergency services. The altimeter was set to 1013 hPa.

The rear spar bolts from both wings were found to be missing and there was no damage to the attachment fittings.

Figure 7
Accident site

Powerplant examination

The throttle, mixture and carburettor heat control runs were examined and there were no disconnections apart from overload failures caused by impact. The carburettor heat valve was found crushed and it was not possible to determine its pre-impact position. The engine was removed for a complete strip examination. It had not suffered any mechanical failures and all four cylinders, pistons, and piston rings were in good condition. There was some light corrosion inside the casing but no excessive wear. There was some corrosion pitting on the cam lobes and on the fuel pump lobe and gear, but this would not have affected operation. The magnetos were both tested and passed specification. The eight spark plugs were tested and operated satisfactorily except for the No 4 lower plug and the No 1 upper plug which both failed to produce a spark at high pressure (simulating high power conditions) even after cleaning, and only produced weak sparks at low pressure. The spark plug gaps were within specification except for the No 1 upper plug, at 0.024 inches (maximum allowable 0.022 inches).

The carburettor was destroyed in the impact so could not be tested, but an examination of its parts did not reveal any defects and its fuel filter was clear. The floats were of the 'old brass' type, which the engine manufacturer had recommended be changed to foam floats (Lycoming Mandatory Service Bulletin 582A and EASA Safety Information Bulletin 2009-04), but they were not defective. The engine-driven fuel pump was stripped and all parts were in good working condition.

The fuel selector was removed and tested, which confirmed that the right tank was selected. The right fuel tank was free of debris and its fuel tank filter was clear. There were no disconnections in the fuel lines apart from overload failures at the engine-driven pump connector and either side of the electric fuel pump.

Airframe examination

The right wing had failed in overload at the main spar attachment and its rear spar attachment bolt was missing (Figure 8). The bolt could not be found at the accident site and there was no damage to the holes of the attachment fittings, indicating that the bolt had probably not been present at impact. The left wing had remained attached to the fuselage but its rear spar bolt was also missing. There was no damage to the attachment fitting holes and, if the bolt had failed at impact, the forward section of bolt would probably have been trapped in the area between the wing and the lower gap strip, but it was not found there.

In the PA-28 design the primary loads on the wing are in bending and these are primarily reacted by the main spar. The forward and aft spars primarily react the torsional loads on the wing and the front and rear spar bolts work together, both carrying a shear load, to react this torsion. With the rear spar bolt missing, the shear loads would still be taken up by the main spar attachment bolts and the front spar bolt, preventing the wing from significant twisting, nose-up or nose-down. The possibility remained that, with the rear spar bolts missing, the wing structure aft of the main spar could still twist up or down to a minor degree. The aircraft manufacturer stated that they could not quantify that effect from analysis and had not tested that configuration. However, the pilot did not report any handling issues during the flight.

Figure 8

Missing rear spar bolts from left wing (left image) and right wing (right image)

Airport survey information

At the time of the accident Runway 26 had a threshold that was displaced 139 m from the edge of the paved surface. This was to accommodate obstructions along the approach and takeoff surfaces. CAP 168 '*Licensing of Aerodromes*' defines the approach and takeoff surfaces which should be free of obstructions. For a Code 1 airport, like Caernarfon, the approach surface is projected at an angle of 2.86º from a point 30 m before the start of the Landing Distance Available (LDA) which for Runway 26 is 30 m before the displaced threshold. The takeoff surface is projected at an angle of 2.86º from a point 30 m beyond the Takeoff Run Available (TORA) which, for the case of Runway 08, is 48 m before the end of the paved surface. Based on a height above the threshold of 9.6 m the tree that was hit by the aircraft infringed the approach surface to Runway 26 by 0.27 m and infringed the takeoff surface from Runway 08 by 3.2 m.

Following the accident the airport operator had about 0.4 m trimmed from the top of the tree and later moved the Runway 26 threshold in by 34 m and reduced the TORA of Runway 08 from 799 m to 727 m[3]. These changes resulted in the approach and takeoff surfaces being free of obstructions. The airport operator had not been aware that the tree had infringed the obstacle surfaces and had relied on hand-held laser distance measuring equipment to monitor the height of the trees, which resulted in lower-than-actual height readings. Following the accident the operator decided to commission a survey company to perform an annual survey of obstacle heights in the vicinity of the airport.

Aircraft maintenance history

The airframe had accumulated 17,124 flying hours and the engine had accumulated 828 engine hours. The aircraft had not been flown for over 3 years between 15 March 2009 and 18 July 2012 when it was sold to its owner at the time of the accident. The aircraft's last annual check was completed on 27 July 2012 (at 16,894.6 hours) and its last 50-hour check on 10 May 2013 (at 17,121.5 hours).

The maintenance of the aircraft was the responsibility of the aircraft's owner, who also owned and ran the flying training organisation. He employed unlicensed engineers to carry out the maintenance work on his aircraft, under the supervision of a self-employed licensed aircraft engineer. The licensed engineer certified for the 50-hour, 150-hour and annual checks. A separate Part-M maintenance organisation had carried out the aircraft's airworthiness review following its last annual check and recommended that the aircraft be granted an Airworthiness Review Certificate. This Part-M organisation did not have any ongoing maintenance responsibilities for the aircraft.

The engine was last overhauled on 4 November 1998 (14.5 years before the accident) and was first used on 20 August 1999 (13.7 years before the accident). The manufacturer-recommended overhaul period for the engine was 2,000 hours or 12 years, whichever came first. The Civil Aviation Authority (CAA) required that this time period was complied with on aircraft used for 'Aerial Work', such as flying training, but a 20% operating time or calendar time extension was permitted if the requirements of GR No 24 '*Light Aircraft Piston Engine Overhaul Periods*' in CAP 747 '*Mandatory Requirements for Airworthiness*' were met. A 20% extension would have allowed the engine to be operated up to 14.4 years after overhaul. The CAA stated that the calendar time period could be based on the time since the engine's first use (13.7 years), providing the engine had been stored since overhaul in accordance with the manufacturer's instructions, therefore the 14.4 year limit was not exceeded. The engine logbook for G-ATRR contained an entry which stated that GR No 24 had been complied with, but there were no records detailing what work had been carried out

Footnote

3 The new survey also resulted in the runway designations changing from 26 to 25 and 08 to 07.

beyond normal 50-hour and 150-hour checks to comply with GR No 24. GR No 24 requires that the engine be inspected at 100-hour or yearly intervals, whichever occurs first, and it details a list of additional checks that may be necessary to assess the condition of the engine. These include oil consumption monitoring and cylinder compression checks. The licensed engineer overseeing the maintenance of G-ATRR could not provide any documentation to show that oil consumption was being monitored or that a cylinder compression check had been carried out in the 229 hours since the last annual inspection.

On 11 December 20012 the aircraft was due a 150-hour check which would have included a cylinder compression check, but the maintenance work sheet for this check was of the type used for a 50-hour check and a number '1' had been written by hand in front of the printed '50-hour' title at the top of the worksheet (Figure 9), but all the additional check items that were part of a 150-hour check were missing. The aircraft and engine logbooks had been signed to indicate that a 150-hour check had been completed.

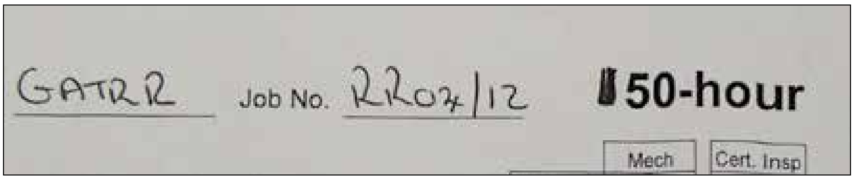

Figure 9

Header of the 50-hour maintenance worksheet used when the 150-hour check was due

The maintenance worksheets from the last annual check onwards did not detail work that would have required removal of the rear spar bolts and the licensed engineer overseeing the maintenance of G-ATRR stated that he was not aware of the rear spar bolts having been removed for any reason. He also stated that he could not envisage circumstances in which the rear spar bolts could be overlooked. The unlicensed engineer who carried out the last 50-hour check before the accident was also not aware of the rear spar bolts having been removed and stated that he would have noticed if they had been missing during the 50-hour check. The previous owner was contacted to find out if the wings had been removed while it had been in storage for three years, and he reported that the wings had not been removed and that he had always intended to fly the aircraft – the long storage period had not been planned. The maintenance records from the company that previously maintained the aircraft were examined for the period March 2007 to September 2008 and there were no entries related to removal of the rear spar bolts.

Audit of the operator's aircraft by the Civil Aviation Authority

The owner of G-ATRR operated a Registered Training Facility (RTF) for PPL training[4] which was not subject to CAA audit and, as the aircraft's maintenance was being certified by a licensed engineer and not by a Part-M organisation, the maintenance of the training

Footnote

[4] The owner of G-ATRR also operated an Approved Training Organisation (ATO) under the same name which was subject to CAA audit. This audit covered the training for helicopter type ratings, multi-engine piston ratings and flight instructor ratings.

organisation's aircraft was also not subject to audit. However, individual aircraft could be subject to audit by the CAA under the Aircraft Continuing Airworthiness Monitoring (ACAM) programme. Following the accident to G-ATRR the CAA carried out ACAM audits of two Piper PA-28 aircraft belonging to the owner of G-ATRR. The audits revealed a number of discrepancies and non-conformances with both aircraft, both from the physical survey and from an examination of the paperwork. This included findings of 150-hour checks being carried out as 50-hour checks. The owner of the aircraft was advised to rectify all the discrepancies found and then the aircraft would be re-audited a month later. During the subsequent audits of the two aircraft the CAA was not satisfied that all concerns had been addressed and therefore they could not be satisfied that the owner was adequately complying with his airworthiness obligations. As a consequence the CAA provisionally suspended the Certificates of Airworthiness of eight aircraft that were registered to the owner.

Changes to the approvals of flying training organisations

As a result of changes to the regulations each Registered Training Facility (RTF) that wishes to continue providing flight training must become an Approved Training Organisation (ATO) no later than 8 April 2015 (CAA Information Notice IN-2013-131). Following conversion each ATO will be subject to an audit programme by the CAA.

Survivability

Lap and shoulder straps were available in the front seat, the rear seats were equipped with lap straps only. The pilot could not recollect having used his shoulder strap and reported that in the past he had found it inconvenient to do so. However, evidence of post-impact bruising on his left shoulder area after the accident suggests that it was being worn. The rear seat child passenger was restrained by a lap strap.

A post-mortem examination was carried out on the deceased passenger. There was evidence to suggest that the passenger had not been restrained by either a lap or shoulder harness at the time of the accident.

Analysis

Engineering

The examination of the accident site revealed that the aircraft had struck the tree in a near wings-level attitude and then pitched nose-down and hit the ground in a nose-down attitude of about -50º. The limited damage to the propeller and the spacing of the propeller ground marks indicated that the engine was producing low or no power at impact. The examination of the engine did not reveal any faults that would have caused a loss of power; the remaining fuel was tested and found to be satisfactory, with no faults in the fuel system. The position of the carburettor heat valve could not be determined due to impact damage, but the carburettor heat selector was found in the cold position indicating that the selector may have been in the cold position at impact.

The rear spar bolts were found to be missing and the lack of damage to the holes indicated that they had probably not fractured at impact and, at some point, had probably been removed and not replaced. However, according to the pilot, the flight had proceeded uneventfully and he had not had any concerns about the aircraft's handling. The aircraft struck the tree following a loss of power and there was no evidence that missing rear spar bolts would have been a factor in this.

A review of the aircraft's maintenance revealed that the engine had exceeded its overhaul period by 1.7 years and there was no evidence to indicate that the actions required to extend this period by 20% had been carried out. There was also no evidence that a cylinder compression check had been carried out in the 229 hours since the last annual. The worksheets indicated that only a 50-hour check had been carried out when a 150-hour check was due, and investigations by the CAA revealed that this had occurred on two other aircraft owned by the operator. Further concerns about the maintenance of the operator's aircraft resulted in the CAA suspending the Certificates of Airworthiness of eight of the operator's aircraft.

The tree that was struck by the aircraft infringed the approach surface by about 0.27 m after the accident, and would have infringed it by slightly more prior to being hit. It is possible that, due to the aircraft's downwards trajectory, it would have still struck the tree if the tree's height had been at the upper limit of the approach surface. The same tree infringed the takeoff surface for the opposite runway by 3.2 m after the accident. The airport operator had been unaware of this due to the insufficiently accurate measuring equipment that had been used. As a result of these findings the airport operator plans to use a surveying company to carry out annual checks of obstacle heights.

The impact forces within the aircraft when it struck the ground were severe but two of the three occupants survived. The accident highlights the survival advantage which a correctly-worn harness can provide.

Flying technique

The pilot was familiar with the route and the weather conditions were suitable for the flight. The flight proceeded without incident until the latter stages of the approach when he attempted to add power, but the engine did not respond.

There were differences in the techniques for use of carburettor heat between the actions contained on the pilot's kneeboard checklist, and the method taught by the instructor. Following the accident the pilot could not remember exactly when or for how long he had applied the carburettor heat, but the selector was found in the COLD position after the accident. It was not possible to determine for how long the aircraft had been flying since carburettor heat had been applied. It is a possibility that, in carrying out a straight-in approach, the 'downwind' checks were overlooked or were conducted, with other 'downwind' checks, before the long straight-in final approach. The use of carburettor heat for 20 to 30 seconds at this stage would be unlikely to provide adequate protection against possible carburettor ice over the remainder of the approach.

The surface temperature/dewpoint split indicated by the meteorological reports in the area suggested that carburettor icing could be expected at any power setting. The time it would take for a significant amount of ice to form within the carburettor is unknown but in suitable conditions it can happen rapidly. Typical symptoms of carburettor icing include a gradual reduction of power followed, if not corrected by use of carburettor heat, by a complete loss of power. Although the pilot reported experiencing a sudden loss of power, a gradual loss of available power could have been masked by a reduced power setting during the descent and approach.

ACCIDENT

Aircraft Type and Registration:	Rans S6-ES Coyote II, G-BYMV
No & Type of Engines:	1 Rotax 582-48 piston engine
Year of Manufacture:	2000 (Serial no: PFA 204-13444)
Date & Time (UTC):	14 July 2013 at 1744 hrs
Location:	Near Stoke Golding Airfield, Leicestershire
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:	National Private Pilot's Licence
Commander's Age:	76 years
Commander's Flying Experience:	365 hours (of which 305 were on type) Last 90 days - 7 hours Last 28 days - 4 hours
Information Source:	AAIB Field Investigation

Synopsis

The accident occurred at the end of a routine private flight in benign conditions near Stoke Golding Airfield. Witness evidence suggests that the aircraft entered a stall followed by an incipient spin after entering the circuit. The pilot may have mistaken a mown grass strip to the north of the airfield for the runway and on realising this attempted to correct his approach path or go-around, during which the aircraft entered a stall. The pilot and passenger suffered fatal injuries.

History of the flight

On the day of the accident, weather conditions were good, with clear skies, good visibility, and a light northerly wind, estimated by other pilots as being approximately 6 or 7 kt. Following normal pre-flight preparations, the pilot, accompanied by his wife, took off in G-BYMV from a private grass strip for Stoke Golding. They were flying a few minutes behind two other aircraft, which were making the same journey.

Observers at Stoke Golding saw G-BYMV join the circuit, positioning right-hand downwind for Runway 26. Towards the end of the downwind leg, the aircraft made a descending right turn onto a final approach heading, but not lined up with the runway's extended centreline. One observer commented at the time that he believed the pilot might be lining up with Fenn Lanes, a road which runs parallel to the runway immediately north of the airfield. Witnesses at the airfield, who were listening to an air-band radio, heard the pilot of G-BYMV make a radio call which they recalled as "lining up two six". This transmission struck the witnesses as unusual because the phrase 'lining up' is usually used on the ground to indicate that an aircraft is entering a runway to take off.

The aircraft continued descending, and made some slight turns, before entering an incipient spin to the right. It struck the ground in a steep nose-down attitude and at relatively low speed. A number of people saw the last moments of flight; they believed that they had heard the aircraft's engine running until they heard a loud noise consistent with impact. They made their way rapidly to the accident site, telephoning the emergency services as they did so. An air ambulance arrived promptly, but the pilot and passenger had suffered fatal injuries.

Stoke Golding Airfield and its surroundings

Figure 1 shows Stoke Golding Airfield, Fenn Lanes, and the fields to the north. The grass Runway 08/26 at Stoke Golding is approximately 500 m in length and about 21 m wide. It also shows an area of mown grass in a field about 270 m to the north of the airfield.

The mown strip was approximately 260 m in length and 18 m wide, aligned on a westerly direction of approximately 240º and bordered by an area of crop and long grass.

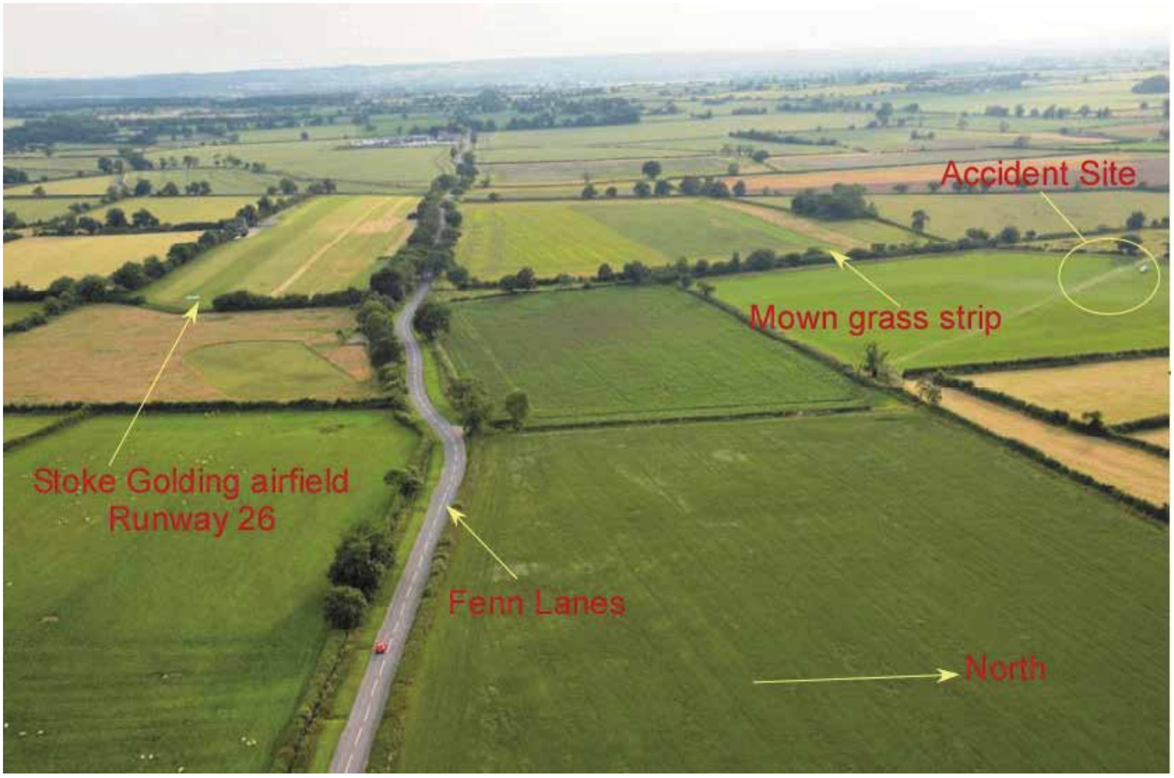

Figure 1

Stoke Golding Airfield and surrounding area

Meteorology and angle of the sun

An aftercast provided by the Met Office reported that:

> *'The UK was under the influence of high pressure at this time which was giving settled weather conditions. The situation in the area of the incident was relatively benign, with good visibility, little or no cloud below 5,000FT and surface winds no higher than 10KT.*
>
> *Although some convective cloud is apparent in the visible imagery under the high cirrus cloud, from observations the base of this cloud was above 5,000FT and the radar shows no precipitation associated with it. This means that any convective cloud was not deep enough to produce showers.'*

The closest airport to the accident site was Coventry, 13 nm to the south-south-west. The METAR timed at 1750 hrs (six minutes after the accident) stated that the wind was northerly at 7 kt, conditions were CAVOK, the temperature was 27ºC, the dewpoint 10ºC, and the QNH was 1022 hPa.

At the time of the accident, the sun was 21º above the horizon at Stoke Golding, on a bearing of approximately 280º from the airfield.

Recorded information

Recorded information was available from a portable device[1] recovered from the aircraft. Although severely damaged, a track log of the accident flight was successfully recovered, with aircraft GPS-derived position, track, altitude and groundspeed recorded, on average, once every 2.5 seconds. The record commenced at 1726 hrs as the aircraft took off and ended at 1735:18 hrs. Records of four previous flights were also recovered. These were a local flight from the aircraft's base on 10 June 2013 and three previous flights on 6 July 2013. Information from the device is shown in Figures 2 and 3. Figure 2 shows the approach to Stoke Golding Airfield in slant view, and Figure 3 shows the recovered data.

After departure, the aircraft followed an approximately straight track to Stoke Golding Airfield, climbing to an altitude of approximately 900 ft at an average rate of about 420 ft/min, after which the climb rate reduced to about 65 ft/min.

Approximately 0.7 nm to the north-west of Stoke Golding Airfield, and at an altitude of approximately 1,380 ft, the aircraft made a right turn (Point A). As the turn continued, the aircraft climbed to its maximum altitude of approximately 1,400 ft, before starting a gradual descent. Having positioned 0.9 nm from the airfield, the aircraft made a left turn as though positioning onto a downwind track for Runway 26 and the descent rate was stabilised at about 510 ft/min (Point B). However, instead of remaining parallel to the runway, the aircraft maintained a near parallel track relative to a strip of mown grass (Figure 1).

Footnote

[1] Lenovo manufactured IdeaTab model A2107, operating a SkyDemon-manufactured flight navigation software application.

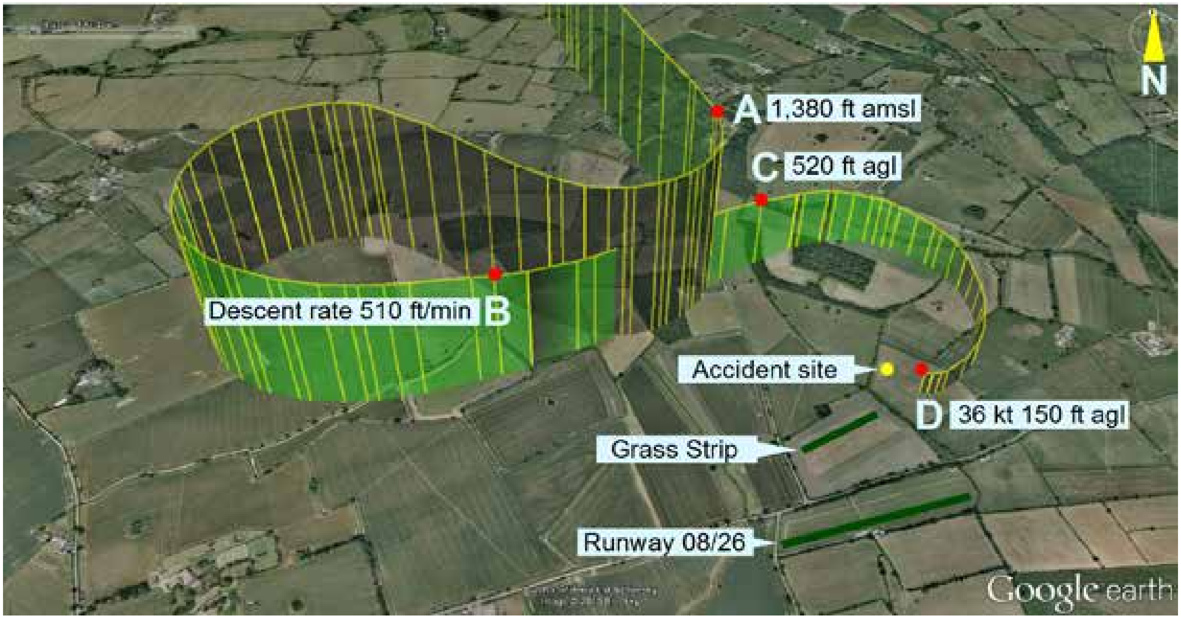

Figure 2

GPS track of approach to Stoke Golding Airfield[2]

When the aircraft was almost abeam the threshold of Runway 26 (which coincided with the easterly boundary of the adjacent mown strip), it started a gradual 180º right turn from an altitude of approximately 800 ft (520 ft agl) (Point C). The aircraft's groundspeed was then about 51 kt. The turn rate remained constant at about 4.5º per second and the descent rate remained at about 510 ft/min. However, rather than positioning onto the final approach for Runway 26, the aircraft turned onto an inbound track consistent with lining up to land on the mown grass strip in the field north of the road. The final seconds of the data indicate that when the aircraft was about 150 m from the field boundary and at a height of about 170 ft agl, the aircraft turned to the right (Point D). At the final data point, recorded approximately 110 m to the south-east of the wreckage position, the groundspeed was about 36 kt, and the aircraft was at a height of about 150 ft agl.

No further data points were recorded. Possible explanations for this were considered. The nominal logging rate of each data point is once every 5 seconds, although some points were recorded more frequently, resulting in the average logging rate of 2.5 seconds. It is possible that the next data point was to be logged 5 seconds later, and the aircraft struck the ground prior to this. Further possibilities are that the device buffered the data for several seconds prior to writing to memory, or satellite signals to the GPS device were lost, perhaps with the aircraft in an attitude that resulted in the signal becoming obscured.

Footnote

[2] The grass strip and runway at Stoke Golding have been highlighted in green to give an indication of their location, the actual appearance of these are shown in Figure 1.

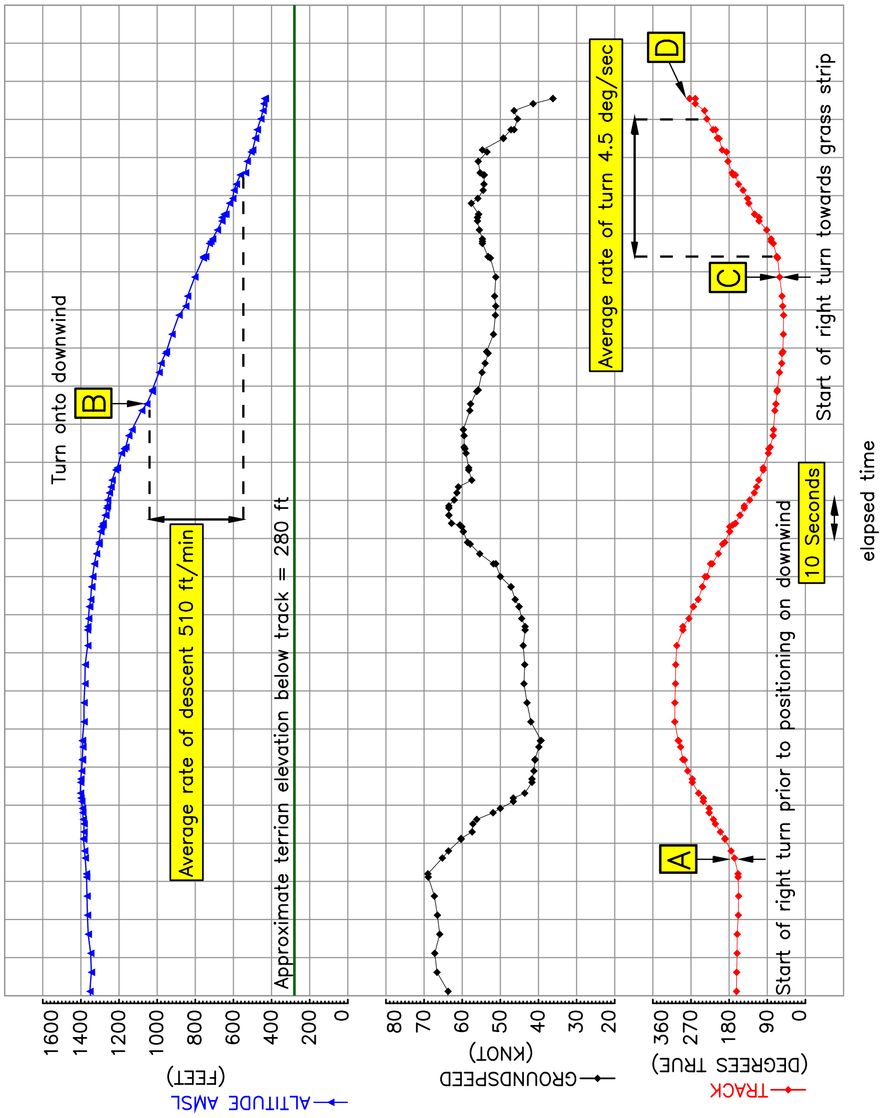

Figure 3
Time history plot of approach

Previous approaches to land

On 6 July 2013, the pilot landed G-BYMV at Wellesbourne Mountford Airport. The turn from downwind to base and then onto the final approach was recorded on the device and was similar to the final 180º turn during the accident flight, with an almost identical turn rate of about 4.5 degrees per second. The turn radius was also similar at about 370 m compared to approximately 340 m during the accident flight. Both final turns also commenced from altitudes of about 750 ft (600 ft agl) and 810 ft (520 ft agl) respectively and the average descent rates from having positioned onto the downwind leg were 450 ft/min compared to 510 ft/min.

Engineering

Description of the aircraft

The Rans S6-ES is a high wing microlight aircraft with two side-by-side-seats. The airframe is constructed mainly from aluminium tube, with the forward fuselage structure consisting of a welded tubular steel cage. The entire airframe is covered with pre-sewn polyester fabric envelopes.

A number of power plants are available for this type of aircraft; G-BYMV was fitted with a Rotax 582 two-stroke engine driving a two-bladed propeller. Whilst many two-stroke engines use fuel that has been pre-mixed with the two-stroke oil, this example was equipped with a direct injection system in which oil was supplied from a 2-litre cylindrical reservoir in the engine compartment via a metering pump on the engine to a jet in the mixture manifold of each carburettor.

G-BYMV had completed approximately 241 flight hours since it was built in 2000. The Light Aircraft Association (LAA) Permit to Fly was valid until 18 April 2014. The engine was also constructed in 2000 and had achieved a similar number of operating hours. The records indicated that the engine had suffered a seizure in June 2010 after coolant fluid had entered the oil system via a shared collection bottle. The engine was subsequently rebuilt, with both cylinders honed and one piston and ring set being replaced. The coolant overflow pipe was subsequently routed out of the engine bay in order to avoid a recurrence of the problem.

On-site examination

The aircraft had crashed in a level grass field approximately 400 m north of the Runway 26 threshold at Stoke Golding, coming to rest in an inverted attitude. The disposition of the wreckage indicated that the impact heading was due south, ie towards the airfield. It was clear that the impact had been steeply nose-down, estimated at around 70-80º, with a lack of damage to the tail fin indicating that little momentum was involved in the process of the aircraft nosing over onto its back.

The engine and nosewheel had made indentations in the ground, although the main landing gear had not made contact, thus confirming the steep nature of the impact. The only other mark on the ground was a light impression from the leading edge of the left wing; this was parallel to, and only a few centimetres from where the wing itself had come to rest and suggested that the aircraft was not spinning at impact. Some relatively minor damage was noted to the outboard sections of both wings, the symmetrical nature of which suggested that little roll or yaw had been present.

The aircraft was recovered to an upright attitude to facilitate additional examination. It was observed that the front of the aircraft, including the engine compartment, windscreen and cabin roof area, had sustained severe damage in the impact. However the fuselage aft of the seats, together with the empennage, had remained relatively intact. The overall pattern of damage was indicative of a low speed but steep impact, consistent with a stall from a low height.

The aircraft was equipped with two polythene fuel tanks, each of approximately 30 litres capacity, located in the inboard sections of the wings. Both tanks fed the engine jointly, as opposed to a left or right selection. It was noted that the fuel selector was in the ON position. Approximately 25 and 23.5 litres of motor gasoline were drained from the left and right tanks respectively. An odour of fuel had earlier been observed around the accident site, which suggested a small leakage of fuel, perhaps from the carburettors, which had broken off the engine during the impact.

It was noted that the fabric on the underside of the fuselage to the rear of the engine compartment was covered in an oily deposit that had the appearance of two-stroke oil. A small amount of oil was observed in the indentation in the ground made by the engine and propeller.

One propeller blade had broken off in the impact following a bending failure in the hub. The bend direction was aft, as opposed to against the plane of rotation, which suggested little or no propeller rotation at the point of impact. Neither blade displayed any evidence of leading edge damage nor chord-wise scuffing, which again was indicative of lack of propeller rotation. It was apparent that the propeller shaft had become slightly bent in the impact; this had allowed the tails of two of the propeller attachment bolts to contact the front of the reduction gearbox casing, resulting in impressions in the surface of the metal. The absence of any circumferential aspect to these marks provided further evidence of a lack of propeller rotation at impact.

Several pairs of spectacles including one on a neck lanyard, and sunglasses, were found in the cockpit area.

Following an on-site inspection the wreckage was recovered to the AAIB's facility at Farnborough for a detailed examination.

Detailed examination of the wreckage

Airframe

The examination confirmed that the primary flying control operating system was intact prior to the accident. The flaps were operated by means of a lever located between the seats and which was connected to a series of Teleflex cables. The lever had four detented positions and was found in the lowermost detent, indicating that the flaps had been retracted at the time of the accident.

Elsewhere in the cockpit it was noted that the throttle lever was in its fully retarded position.

The airspeed indicator appeared intact and was subsequently tested. It was found that the instrument consistently under-read by approximately 10% throughout its range. Whilst it is possible that the mechanism was damaged at impact, it was noted that the indicating needle displayed no off-set from zero before being connected to the test set.

Engine

The engine was subjected to a strip-inspection at a Rotax overhaul facility. Whilst extracting it from the airframe, it was observed that the gascolator contained fuel and the associated fuel screen was clear of debris. It was also noted that the two-stroke oil reservoir for the direct injection system was full.

Disassembly of the engine revealed that all the components were in good condition, with no evidence of a defect, failure or malfunction that could have had a bearing on the cause of the accident. The examination also included the ancillary components such as the water, fuel and oil injection pumps, the carburettors and the reduction gearbox. It was found that the rotary disc valve (which admits the fuel/oil mixture to the engine) was correctly timed, and the oil injection tubes were primed with oil.

Propeller

One propeller blade was found at a near neutral pitch angle, with the other in a markedly negative pitch position. The blades had been manufactured with cylindrical root sections which were then clamped between two halves of an alloy hub. While it seemed probable that the as-found blade angles were a consequence of impact with the ground, the advice of the propeller manufacturer was sought. They commented that, in their experience, any tendency for the blade to migrate in pitch would be in a coarsening direction. Moreover, the action of centrifugal force on a tapered knuckle on the end of the root section would tend to lock the blade in position, even if one or more of the hub bolts were insufficiently tight. It was therefore concluded that the blades became displaced in pitch as a result of reacting the forces exerted by the ground on the blade faces during the impact.

Fuel

A sample of the fuel from the aircraft was subjected to a laboratory analysis. This indicated that the fuel was consistent with motor gasoline (mogas) with no evidence of contamination. The laboratory report additionally stated that there was a '*small amount*' of ethanol, although this was significantly below the 5% limit stipulated by the engine manufacturer. Finally, the report commented that the vapour pressure was slightly higher than would be expected for UK summer grade fuel; it was however, within the range for spring and winter grade mogas. This in turn suggested that either the fuel was marginally out of specification, or 'old' fuel was being used.

Additional information: the use of mogas

The LAA provides advice on the use of mogas and refers to the CAA publication CAP 747, Section 2, Part 4, General Concession 4. (This information is also contained in the CAA Safety Sense Leaflet No 4, '*Use of Mogas*'). The Operating Limitations section requires that a placard be attached to the instrument panel, displaying the following:

USE OF UNLEADED MOGAS

(see CAP 747)
- only legal in aircraft specifically approved for the purpose
- fuel to be fresh, clean, water and alcohol free
- verify take-off power prior to committing to take-off
- tank temperature not above 20ºC
- fly below 6000 ft

CARB ICING AND VAPOUR-LOCK MORE LIKELY

(Note: a placard to this effect was found in G-BYMV.)

The reason for these restrictions is the higher vapour pressure of mogas in comparison to AVGAS, with an associated higher risk of vapour lock. However, gravity-fed fuel systems such as in the high-wing configuration of G-BYMV are generally less susceptible.

The pilot

The pilot began learning to fly in 2003, obtaining a National Private Pilot's Licence (NPPL) on AX3 and AX2000 aircraft. He owned and flew two tail-wheel-equipped Rans S6 aircraft, one between 2004 and 2008, and the other between 2008 and 2012. He then bought G-BYMV, which was equipped with tricycle landing gear. He flew G-BYMV regularly, usually with his wife as a passenger.

In December 2012, during training prior to a General Skills Test (GST), the instructor at the time assessed that the pilot had shown weakness in navigation, circuit flying, speed control and use of rudder. However, after subsequent training he passed his GST and his licence was renewed.

The pilot's medical declaration

The holder of an NPPL demonstrates his fitness to fly by making a medical declaration, in consultation with, and countersigned by, his General Practitioner. The declaration may be made in either Group One or Two. The Group One standard is closely equivalent to the Driver and Vehicle Licensing Authority (DVLA)'s standard for private driving; the Group Two standard is aligned with the DVLA standard for professional driving. The pilot of G-BYMV held a medical declaration in Group One.

The pilot's medical history and pathology

A specialist aviation pathologist carried out post-mortem examinations of the pilot and passenger. His report mentioned transverse bruising on the pilot's right foot, which:

> *'suggests that the pilot's foot was resting on something at the time of ground impact; the most likely structure would be the right rudder pedal, and this injury provides some limited evidence to suggest that the pilot was conscious at the time of the crash.'*

The pilot's last eye test, before the accident, was in May 2012. His corrected acuity allowed him to meet the DVLA Group One standards, but not those for Group Two. He was advised of some early cataract and macular degenerative changes. The pathologist's report noted the low angle of the sun and that the angle between the sun and the runway heading was only 20º and stated:

> *'It is not known whether [the pilot's] vision had changed in any way between the time of this eye examination and the accident, although both of these conditions can be progressive.'*

Toxicological tests revealed nothing remarkable.

Discussion

The accident occurred at the conclusion of a routine private flight in benign conditions. The engineering investigation did not identify any technical cause for the accident. The witness evidence suggests that the aircraft entered a stall followed by an incipient spin whilst approaching to land. There was also a consensus that the engine was running whilst the aircraft was visible to them. Nobody witnessed the impact with the ground, but examination of the accident site indicated that the aircraft had struck the ground in a steep nose-down attitude at a relatively slow speed. The marks on the ground did not indicate any airframe rotation at impact that could be associated with a spin, although it is possible that the pilot may have arrested any such rotation during the descent.

The on-site and subsequent examination of the wreckage revealed no evidence of engine power at impact. However, the fact that the engine was heard to be running until the aircraft disappeared from the view of the witnesses leaves a limited window for engine failure. Also, the engine was found to be in good condition internally, with the fuel and lubrication systems still primed with fuel. An oily deposit on the fuselage underside was probably the result of spillage after completely filling the oil reservoir.

The use of mogas increases the possibility of vapour lock, especially as the analysis of the fuel sample indicated a vapour pressure slightly higher than that normally found in summer-grade mogas. In addition, the accident occurred late in the afternoon on a day in which the temperatures had been in the mid to high 20's; it is thus probable that the fuel in the tanks was above the 20ºC figure stated in CAP 747. However, the engine fuel system was gravity-fed and the aircraft had apparently experienced no earlier problems on its short flight; it is thus considered unlikely that vapour-lock was a factor in the accident.

A two-stroke engine such as the Rotax 582 produces comparatively low torque at idle power setting. The throttle lever in G-BYMV was found on its idle stop. It is therefore possible that the steep impact angle allowed a large proportion of the propeller disc to contact the ground, which overcame the engine torque such that the engine stopped immediately.

Comparison of the recorded data recovered from the pilot's tablet computer of the circuit flown at Stoke Golding with a previous circuit at Wellesbourne, showed similar initial flight profiles and validated the eyewitnesses' accounts of events. The data indicates that the pilot possibly mistook the distinctive mown grass strip in the field north of Fenn Lanes and flew his approach towards it. Factors influencing this may have been his eyesight, and, once on final approach, the setting sun and any glare it caused on the windscreen. It is also possible that some other unidentified factor that degraded his performance accounted not only for this but also the unusual terminology in his final radio transmission.

The training which the pilot undertook, beginning in December 2012, prior to satisfactorily passing a General Skills test to renew his licence, highlighted weaknesses in navigation, circuit flying, speed control and use of rudder. Departure from controlled flight into a spin typically occurs as a result of yaw, which itself may arise from a lack of co-ordinated rudder input, at low speed[3] (usually below the normal approach speed). The accident also occurred at the conclusion of a visual circuit which did not follow the normal path.

A realisation, close to the ground, that he was not approaching the runway, may have prompted the pilot to rapidly consider his options and significantly increase his workload. He may have considered the possibility of continuing the approach and manoeuvring towards the correct final approach, or going around. Any nose-up pitch input, necessary in either case, without an accompanying increase in power, would have caused the angle of attack to increase and speed to reduce toward a stall; no witnesses recalled the engine power increasing prior to impact. Inattention to appropriate rudder pedal inputs to control yaw could then have led to an incipient spin following the stall.

Footnote

3 high angle of attack

ACCIDENT

Aircraft Type and Registration:	Rans S6-ESD (Modified), Coyote II, G-MYSP
No & Type of Engines:	1 Rotax 582-48 piston engine
Year of Manufacture:	1992 (Serial no: PFA 204-12265)
Date & Time (UTC):	28 August 2013 at 1118 hrs
Location:	Redhill Aerodrome, Surrey
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	National Private Pilot's Licence (Aeroplanes)
Commander's Age:	57 years
Commander's Flying Experience:	63 hours (of which 4 were on type) Last 90 days - 9 hours Last 28 days - 3 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilot was practising visual circuits and was climbing away after a touch-and-go landing when the aircraft's engine was heard to falter. The aircraft was seen to slow in a climbing attitude before stalling and entering a vertical dive from which it did not recover. The pilot was fatally injured.

History of the flight

The pilot was planning to practise some visual circuits at Redhill Aerodrome. Runway 26L was in use at the time and the weather was CAVOK with the wind variable at 4 kt.

The aircraft was stored in a hangar at Redhill. The pilot was assisted in taking the aircraft out of the hangar by another pilot who had not previously met him; the assisting pilot described the pilot of G-MYSP as being in good spirits and having a polite demeanour. Closed-circuit television on the outside of the hangar recorded the pilot moving the aircraft and it captured him carrying out the aircraft's pre-flight inspection, engine start and initial taxi.

The first takeoff and circuit progressed uneventfully but, as the aircraft approached the runway for its first touch-and-go, it was observed to be high on the final approach. It touched down firmly, about 500 m from the threshold, and bounced before settling onto the runway. The pilot converted the touch-and-go into a full-stop landing, coming to a halt about 720 m from the threshold of Runway 26L. The pilot then taxied back to Holding Point A1 for

Runway 26L for takeoff. One witness who observed the aircraft's first touch-and-go thought that, as a result of the firm landing, the propeller may have struck the runway.

The pilot completed another uneventful circuit for a further touch-and-go. The final approach appeared lower than the first but was still slightly higher than normal. The aircraft was seen to touch down smoothly about 180-240 m from the threshold before taking off. At approximately 500 ft aal witnesses heard its engine falter, one describing the engine's noise as "quickly revving in and out". Several witnesses later stated that the aircraft then decelerated as it remained in a climbing attitude until it appeared to roll slightly left, followed by the right wing dropping. The aircraft then rolled right into a near-vertical dive from which it did not recover. No transmissions were heard by ATC from the pilot.

The aircraft impacted the ground about 280 m from the end of Runway 26L, 350 m inside the airfield boundary. The aerodrome RFFS and local emergency services were quick to arrive on the scene but the pilot had been fatally injured in the impact.

Pilot's experience

The pilot commenced his training for his National Private Pilot's Licence (Aeroplanes) (NPPL(A)) in September 2011 on an Ikarus C42. His instructor commented that the pilot had progressed rather slowly through the syllabus but that his approach was methodical. His handling of slow-speed flying was described as satisfactory and he had practised numerous forced landings and emergencies, including engine failures after takeoff (EFATOs), completing these to a satisfactory standard. He flew solo in September 2012 having completed 29 hours of instruction and subsequently completed his Microlight General Skills Test on 28 April 2013 having completed 53 flying hours. He was issued with his NPPL(A) on 4 July 2013.

After the pilot obtained his licence he flew G-MYSP on four occasions, three of which were with a mentor pilot, for a total of 4 hrs 40 mins. The mentor pilot stated that during the three flights the pilot did not practise any slow-speed flying or stalling. Having learned to fly on an Ikarus C42 no difference training was required to fly the Rans S6.

Medical examination

The post-mortem examination was carried out by a consultant aviation pathologist. It concluded that the pilot died as a result of head and chest injuries sustained in the impact and toxicological examination revealed no evidence of alcohol, drugs or carbon monoxide.

Meteorology

At 1115 hrs the weather was CAVOK with the wind variable at 4 kt, temperature 20ºC, dew point 12ºC and QNH of 1023 hPa. '*Safety Sense Leaflet 14 - Piston Engine Icing*', published by the Civil Aviation Authority, indicates that these conditions can, in some circumstances, produce a risk of moderate carburettor icing with cruise power or serious carburettor icing with descent power.

Airport information

Redhill Aerodrome is located 4 nm north-north-east of Gatwick Airport. It has six grass runways, the longest (08R/26L) being 897 m in length (Figure 1).

Figure 1
Redhill Aerodrome

Aircraft information

The aircraft was operated by a syndicate, of which the pilot was secretary. The syndicate's procedures for operation of the aircraft included an instruction for it to be refuelled at the end of each flight to FULL. The pilot was known to be fastidious about refuelling the aircraft after flight and had sent a number of emails to syndicate members reminding them to do the same.

A syndicate member commented that when flying G-MYSP he would typically aim to take off at 35 mph, climb at 50 to 55 mph, approach at 55 to 60 mph and land at 50 mph. The aircraft's last annual check flight carried out on 22 April 2013, recorded that the onset of stall buffet was at 35 mph with the flaps UP and 28 mph with the flaps DOWN.

Engineering

Accident site

The aircraft had come to rest, nose down, 280 m from the end of Runway 08L, close to the extended centreline, with the nose of the aircraft pointing south. There was no evidence to show that the aircraft had made contact with the ground prior to this point. Examination of the runway surface did not identify any evidence associated with a propeller strike; however, the ground was dry and hard which may have prevented the formation of propeller strike marks.

The nose of the aircraft had been severely compressed and pushed upwards and rearwards, causing disruption to the cockpit area. Compression of the outboard leading edge of the left wing indicated that the aircraft had probably been rotating to the right at impact and the fuel tank had ruptured, resulting in the loss of its contents. There was a strong smell of fuel on the accident site. A small quantity of fuel was recovered from the aircraft fuel filter and fuel lines. Two large containers, containing what appeared to be MOGAS, were recovered from the pilot's car. After the aircraft was recovered onto its main landing gear, examination of the propeller showed little evidence of rotational damage. Prior to recovery the continuity of the flying controls was confirmed.

Aircraft description

The Rans S6 Coyote II is a three-axis microlight aircraft. G-MYSP had been built in 1992 and accumulated approximately 681 flying hours at the time of the accident. The aircraft records indicated that there were no defects prior to the accident flight which would have had a bearing on the accident.

A Rotax 582 engine had been installed in the aircraft, driving a three-bladed propeller through a reduction gearbox. The engine was fitted with a carburettor heating system which used water from the engine cooling system to warm the body of both carburettors continuously, preventing ice build-up. The engine was fitted with a dual ignition system, comprising two capacitance discharge units operated by trigger coils located in the flywheel case. In the event of failure of a single ignition system the engine may run roughly at certain power settings, due to the uneven progression of the combustion flame front within the cylinder.

Records showed that the engine had been overhauled 54 flying hours prior to the accident. The engine had been modified in 2003 to incorporate an RK400 clutch in the reduction gearbox, before the purchase of the aircraft by its owners at the time of the accident.

This type of clutch (Figure 2) consists of a drive body secured to the engine output shaft, four friction pads (held together by two circular springs) which locate in the drive body, a locating plate and the clutch rim, which is secured to the gearbox coupling flange. The clutch is designed to remain disengaged until the engine speed reaches approximately 2,400 rpm, at which point the friction pads move outwards, contacting the clutch rim and causing the gearbox to rotate. The installation of this clutch reduces engine vibration during engine start and at idle speed, and allows the installation of a larger propeller than would normally be fitted to a 'direct drive' engine. In flight, however, the engine speed must be maintained above 2,400 rpm to prevent the clutch from disengaging and allowing the propeller to windmill. If this were to occur it would affect the gliding performance of the aircraft.

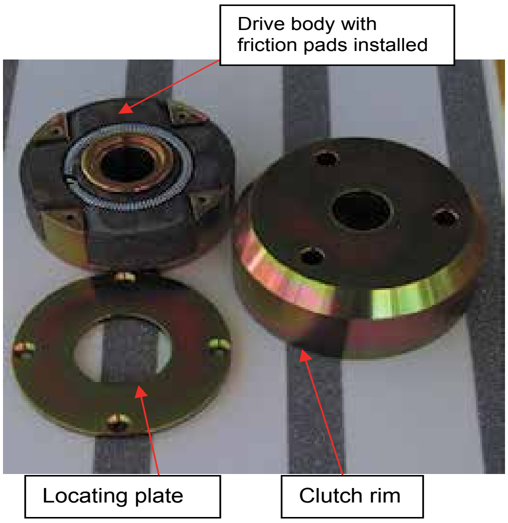

Figure 2

RK400 clutch assembly

Investigation

Based on the witness reports of rapidly changing engine noise, the investigation focused on the engine, engine controls, gearbox and aircraft fuel system.

Several small areas of damage were found on the tips and leading edges of the propeller blades, which could be attributed to propeller rotation at impact or a propeller strike during the previous landing. Examination of the engine identified scoring, made by the starter gear, on the inner face of the starter gear housing, which confirmed that the engine had been rotating at impact. Examination of the clutch assembly showed no evidence of overheating or damage associated with 'slipping'; this examination also showed further evidence of engine rotation at impact.

The engine controls functioned correctly and showed no evidence of pre-impact restriction. No evidence of a pre-impact defect was found in either carburettor.

Disassembly of the engine confirmed that it rotated freely and that there was no failure within the engine or the induction system. Damage to the engine's ignition system prevented any testing of the two capacitive discharge units, the ignition leads or the spark plugs. The two ignition trigger units functioned correctly.

No evidence of a restriction or blockage was found within the fuel supply pipes, fuel filter or fuel pump and tests carried out on the limited volume of fuel recovered from the aircraft confirmed that it met the general specification for MOGAS. Examination of the two containers recovered from the pilot's car confirmed that one container was full and that, assuming the other container had originally been full, seven litres of fuel had been used. Further testing confirmed that the fuel in both containers was MOGAS and that it did not contain levels of water, or any other contaminant, which would have affected the running of the engine.

Analysis

Operational aspects

The pilot's pre-flight preparation appears to have been normal, with all appropriate pre-flight checks carried out. The first landing was deep into the runway and the aircraft bounced. There is a possibility that during the bounce the propeller may have struck the runway. When the aircraft was at about 500 ft aal, climbing out from the second circuit, its engine faltered, appearing to result in a rapid and significant loss of power. The initial action of a pilot experiencing a power loss should be to lower the nose of the aircraft to prevent it stalling. On this occasion, the pilot appears not to have lowered the nose after the power loss; the aircraft continued in a climbing attitude and decelerated, until it stalled.

The abruptness of the loss of power meant that the pilot may not have been mentally prepared to carry out the actions required during an EFATO. The windmilling propeller would have created extra drag on the aircraft, reducing the aircraft's airspeed. Additionally, the lack of any radio transmission after the power loss may indicate that the pilot became overwhelmed by the situation. Nevertheless, if the pilot had been able to lower the aircraft's nose before it stalled, he may been in a position to maintain a safe airspeed and perform a forced landing.

Engineering

The damage observed on the starter gear casing and the clutch rim confirmed that the engine was rotating at impact, although no indication of engine speed could be made. It could not be determined whether the rotational damage to the propeller blades was the result of a propeller strike or caused during the impact sequence. It was not possible to confirm whether the clutch was engaged at the time of impact.

The investigation did not identify any defect within the engine, gearbox or fuel system which would have prevented normal operation of the engine. The installation of the carburettor heating system on the engine, with its continuous operation, would have minimised the possibility of carburettor ice occurring at any stage during the accident flight. This installation, and the aircraft appearing to develop full power from the touch-and-go landing to 500 feet, make it unlikely that carburettor ice was a factor in this accident.

While no defects were identified with the ignition triggering mechanism, the inability to test the capacitive discharge units, ignition leads or spark plugs meant that the investigation could not rule out the presence of a defect in these components. If the engine speed falls below 2,400 rpm the clutch will disengage, allowing the propeller to windmill and cause a significant reduction in aircraft performance.

Conclusion

The engine appears to have faltered at about 500 ft aal. The sudden power reduction, the pilot's relative inexperience and the limited time available to react appropriately are likely factors in the pilot not lowering the nose before the aircraft stalled. There was then insufficient height available for the pilot to effect a recovery from the stall before ground impact. No definitive cause of the engine power loss could be determined.

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.

INCIDENT

Aircraft Type and Registration:	Beech B200C Super King Air, G-SASD
No & Type of Engines:	2 Pratt & Whitney Canada PT6A-42 turboprop engines
Year of Manufacture:	2005 (Serial no: BL-151)
Date & Time (UTC):	10 October 2013 at 1050 hrs
Location:	Aberdeen Airport, Scotland
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - 3
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to both left main gear tyres
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	16,130 hours (of which 3,667 were on type) Last 90 days - 60 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was conducting an air ambulance flight from Lerwick to Aberdeen with five persons on board, including a stretcher patient. The touchdown at Aberdeen was normal and full reverse-thrust was selected initially. As the aircraft approached the E3 exit it started to veer to the right and the pilot became aware that it was not slowing down normally. The aircraft veered onto the grass and came to a halt after about 50 m.

When engine ground runs were performed later that day, the left engine immediately accelerated to maximum torque. The left engine Fuel Control Unit (FCU) was suspected to be faulty and was replaced.

The FCU was shipped to the manufacturer in Quebec and stripped in the presence of a representative from the Transportation Safety Board of Canada. Debris was obstructing the Py orifice which would have had the effect of increasing the fuel flow, which was consistent with the observed symptoms. The debris was identified as being organic and metallic, but the source of the debris could not be determined.

SERIOUS INCIDENT

Aircraft Type and Registration:	DHC-8-402 Dash 8, G-JECJ
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2005 (Serial no: 4110)
Date & Time (UTC):	23 October 2013 at 0540 hrs
Location:	Manchester Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 20
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	4,360 hours (of which 1,145 were on type) Last 90 days - 162 hours Last 28 days - 58 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional enquiries by the AAIB

Synopsis

Whilst enroute, 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.

History of the flight

During a flight from Edinburgh to Brussels at FL250, the crew received a PUSHER SYSTEM FAIL caution on the CWP. The commander and co-pilot reviewed the Quick Reference Handbook (QRH) and actioned the appropriate checklist. They disengaged the autopilot and agreed that they should continue to Brussels. A few minutes later, they received a call from the senior cabin crew member asking "Is everything all right in there?" since the cabin ceiling lights were going out progressively, starting from the front; eventually all these lights extinguished.

The commander replied that they had a technical problem but were continuing on route. The crew then received ELEVATOR FEEL and PITCH TRIM cautions on the CWP and decided to consult the electrical section of the QRH. They brought up the electrical page on the Engine Display (ED) to review the status but, before any meaningful analysis could take place, the Co-pilot's Multi Function Display (MFD) failed and they received two further cautions on the CWP. Before any action could be taken, the Co-pilot's Primary Flight Display also failed.

Positive control was handed to the commander as TCAS and Yaw Damper failure messages were displayed. The co-pilot reviewed the QRH and noticed that, on the ED, the No 2 generator showed zero load. The cockpit lights then failed as well as the No 2 Audio Radio Control Display Unit (ARCDU) and, later, the emergency torch the crew were using. They agreed to divert to Manchester, broadcast a PAN call and were advised by ATC that they were about 60 miles from Manchester. There were several more cautions as the co-pilot switched the VOR display to the commander's side. On passing FL200, the Flight Director failed.

The co-pilot had to make several attempts to conduct the NITS (Nature, Intention, Time, Special instructions) briefing with the cabin crew as more cautions were appearing. He then addressed the passengers and explained that they would be diverting to Manchester due to electrical problems. During the approach, the flight crew had sufficient time to discuss the normal approach procedures as well as preparing for possible system malfunctions such as braking and anti-skid. The aircraft was configured for landing early in the approach to ensure landing gear and flaps were operational, since hydraulic system 2 was indicating zero contents. However, these systems worked normally and an uneventful landing was performed on Runway 23R, during which braking action was normal. The crew were unable to change from Tower frequency to the Fire Service frequency as requested by ATC, due to the failure of ARCDU 2 and a 'Follow Me' vehicle was used to guide the aircraft onto a remote stand. Since the hydraulic system 2 contents indication had recovered to 75%, the crew considered it was safe to taxi however during the taxi, the sidewall cabin lights failed and, upon arrival at the stand, the Auxiliary Power Unit (APU) would not start.

The crew recalled some 25 cautions and failures during the event.

Investigation

The Dash-8 400 has three 28v DC starter/generators associated with the left (No 1) and right (No 2) engines and the APU. In addition, the AC generation system can supply the left and right DC busses through Transformer Rectifier units. The system is designed to reconfigure automatically to cater for individual power source and bus malfunctions, by the automatic closing and opening of bus tie contactors (Figure 1)

Initial analysis of the available data (flight recorder and crew accounts) by the aircraft manufacturer suggested that there had been a malfunction of either the No 2 starter/generator, which powers the right main DC bus, or its GCU. In this condition contactor K2, which connects the No 2 generator to the right main DC bus, should open. Auxiliary contacts within K2 send a signal that this has happened to the Electrical Power Control Unit (EPCU), which closes contactor K21 and ties the right DC bus to the left, thus maintaining services supplied by the right bus. The auxiliary contacts also send a signal to the CWP to display a NO 2 DC GEN caution. It was considered likely that the auxiliary contacts within K2 had remained open either through severe pitting or interference by a foreign object. In this case there would be no indications to the EPCU or the flight crew that there was a problem, the bus tie contactor would remain open and the right bus would draw its power from the main battery, progressively losing services as the battery discharged. The series of failures reported by the crew was consistent with such an event.

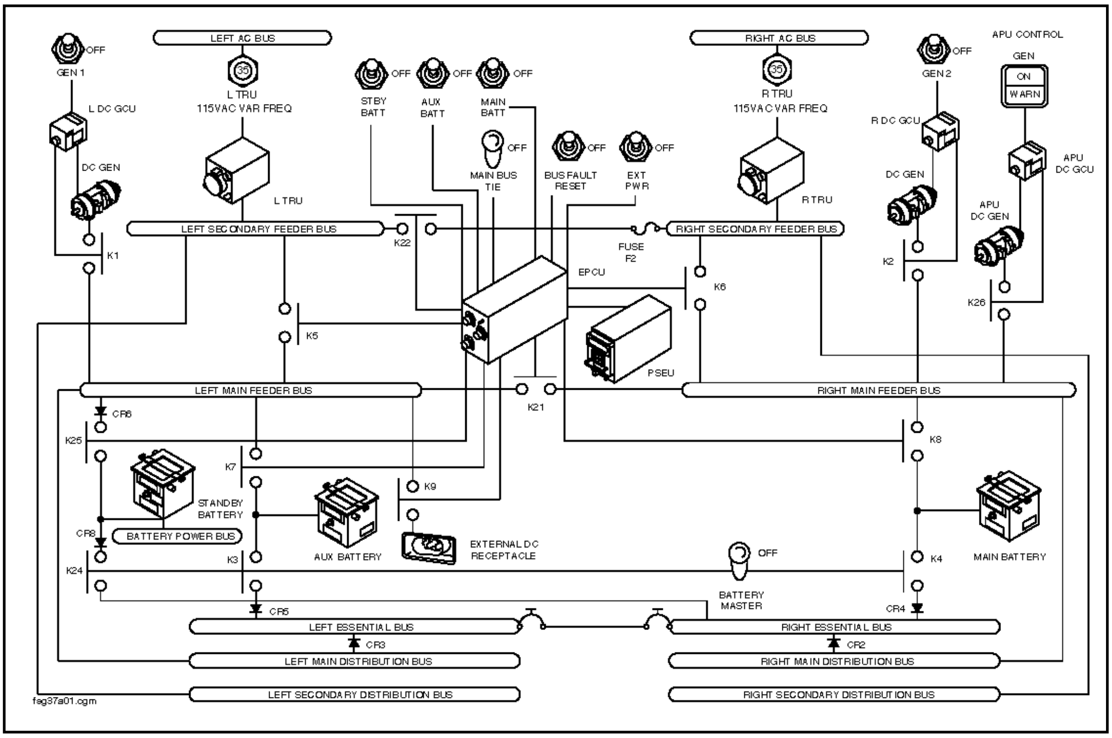

Figure 1

Dash-8 Q 400 DC generation schematic

The operator inspected the K2 contactor and found severe pitting on the auxiliary contacts and, as the manufacturer suggested, forwarded the unit, together with the starter/generator and GCU, to them for examination. At the time of preparation of this Bulletin, the manufacturer was continuing with their examination of the components and any significant findings will be reported in a later bulletin.

BULLETIN ADDENDUM

An addendum was published in the AAIB Bulletin 11/2014 concerning this report.

The addendum has been added to this report for completeness.

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 three mentioned:

- 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

ACCIDENT

Aircraft Type and Registration:	1) Pilatus PC-12/45, M-YBLS 2) Beech B200GT King Air, M-SYGB
No & Type of Engines:	1) 1 Pratt & Whitney PT6 67B turboprop engine 2) 2 Pratt & Whitney PT6A-52 turboprop engines
Year of Manufacture:	1) 1999 (Serial no: 176) 2) 2009 (Serial no: BY-68)
Date & Time (UTC):	10 January 2014 at 1500 hrs
Location:	Fairoaks Airport, Surrey
Type of Flight:	1) Private 2) N/A
Persons on Board:	1) Crew - 1 Passengers - None 2) Crew - None Passengers - None
Injuries:	1) Crew - None Passengers - N/A 2) Crew - N/A Passengers - N/A
Nature of Damage:	1) Paint cracked on left wing tip 2) Damage to the right aileron and wingtip
Commander's Licence:	1) Private Pilot's Licence 2) N/A
Commander's Age:	1) 80 years 2) N/A
Commander's Flying Experience:	1) 6,621 hours (of which 3,546 were on type) Last 90 days - 9 hours Last 28 days - 3 hours 2) N/A
Information Source:	Aircraft Accident Report Form submitted by the pilot

When the pilot of M-YBLS carried out his external inspection of the aircraft, he noted that there was a Beech King Air parked on its left. His aircraft was normally parked parallel to adjacent aircraft but, on this occasion, it was parked with the nose pointing 45º to the left of the parallel heading. Having completed his checks and started the engine, he was cleared to taxi for the runway. As normal, he taxied straight ahead and the left wingtip of his aircraft contacted the right wingtip and aileron of the King Air. The AFISO informed the pilot of the collision and he stopped the aircraft.

The pilot's assessment of the cause of the incident was that this was the first occasion in 16 years that his aircraft had been parked at a 45º angle to an adjacent aircraft. Having realised this during his external inspection, he should have instructed the ground crew to reposition his aircraft parallel to the other aircraft or asked them to marshal him out of the parking area. By following his normal routine and not monitoring the wingtip, the collision occurred.

INCIDENT

Aircraft Type and Registration:	Piper PA-31-350 Navajo Chieftan, G-STHA
No & Type of Engines:	2 Lycoming LTIO-540-J2BD piston engines
Year of Manufacture:	1980 (Serial no: 31-8052077)
Date & Time (UTC):	19 November 2013 at 0645 hrs
Location:	Vicinity of Luton Airport
Type of Flight:	Commercial Air Transport (Cargo)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Engine and cowling damaged extensively
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	4,950 hours (of which 600 were on type) Last 90 days - 30 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

During cruise at FL80, the left engine suffered a mechanical failure. The crew shut down the engine and feathered the propeller but were unable to maintain altitude. An emergency landing was completed at Luton Airport without further incident. Inspection found the No.2 cylinder assembly of the left engine had detached from the crankcase due to an internal failure. At the time of writing a detailed examination of the engine had not taken place, so it is not possible to draw any firm conclusions as to the cause of the failure.

History of the flight

The aircraft was routing from Southend Airport to Oxford Airport at FL80. Without warning, the crew felt a large 'thump' and the aircraft yawed to the left and began to lose altitude. The crew identified that the left engine had failed and could see its top cowling had been buckled upwards. After shutting down the engine and feathering the propeller, they declared a MAYDAY with London Radar. They were still unable to maintain altitude and reported that it was difficult to maintain directional control. The crew were transferred to Luton Radar and were given vectors for Runway 26 at Luton Airport, where they landed without further incident.

Aircraft examination

A preliminary examination of the aircraft revealed that the No.2 piston and cylinder assembly on the left engine had detached from the crankcase, but had remained attached to the aircraft by the spark plug ignition leads. The cowlings had been disrupted and pushed apart (Figure 1).

Figure 1

Disruption to left engine cowlings and No.2 cylinder detached from crankcase

Engine examination

The engine was removed by the operator and a limited inspection carried out. This indicated that the failure of the No. 2 piston and cylinder assembly had initiated internally and that the engine had continued to operate for a period of time prior to the cylinder detaching. There were indications that this cylinder had been operating at a higher than normal temperature. The No. 3 cylinder was removed and its piston showed distress marks consistent with an engine that had been unused for long periods, allowing oil to drain from the surface of the cylinder.

Engine history

Following an overhaul in February 2011, the left engine was refitted to the aircraft in March 2011. Between 12 October 2012 and 28 January 2013, the aircraft was stored at Lydd Airport and an annual inspection was completed at the end of this period. The aircraft was removed from service for a maintenance check between 31 July 2013 and 08 October 2013, where inspections included cylinder compression checks and checking the oil filters were free from debris. All engine flexible hoses were replaced at this time. The aircraft flew for a total of 80 hours in 2011, 52 in 2012 and 92 in 2013.

Discussion

The detachment of the No.2 cylinder from the crankcase disrupted the engine cowlings to a large extent. This would have caused considerably more drag and would account for the aircraft being unable to maintain altitude. The crew were able to maintain control and perform a safe landing at Luton Airport.

At the time of writing a detailed examination of the engine had not taken place, so it is not possible to draw any firm conclusions as to the cause of the failure. If any further information becomes available it will be reported as an addendum to this report.

Since the overhauled engine was refitted to the aircraft in February 2011, the aircraft history showed that the aircraft had a low utilisation and had been parked for extended periods of time. Some internal distress marks were visible in the engine that could be attributed to sporadic use.

Lycoming Service Letter L180B contains useful information on engine preservation for active and stored aircraft:

http://www.lycoming.com/Lycoming/SUPPORT/TechnicalPublications/ServiceLetters.aspx

ACCIDENT

Aircraft Type and Registration:	Diamond DA 42 Twin Star, G-CTCH
No & Type of Engines:	2 Thielert TAE 125-02-99 piston engines
Year of Manufacture:	2007 (Serial no: 42.238)
Date & Time (UTC):	7 January 2014 at 1611 hrs
Location:	Exeter Airport, Devon
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to right wing tip, right aileron, tail skid and propeller
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	8,347 hours (of which 2,200 were on type) Last 90 days - 41 hours Last 28 days - 19 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

After a "competent" landing by his student, the instructor intended for him to go around and reached for the flap switch to retract the flaps to TAKEOFF. Instead, he inadvertently moved the landing gear lever to UP and, although he quickly realised his mistake and returned the lever to DOWN, the right main gear had unlocked and collapsed at a speed of about 60 kt. The aircraft yawed to the right, leaving the runway and travelling onto the grass before coming to a halt, with damage to the right wing tip, right aileron, tail skid and the right propeller.

The aircraft is fitted with a 'weight-on-wheels' switch on the left oleo, which should prevent gear retraction on the ground. In this case it is likely that, at an airspeed of 60 kt, the combination of landing flap and a crosswind component from the left probably made the aircraft very light on that side and the 'weight-on-wheels' switch had not been made. The pilot, who stated that he had performed this procedure "hundreds of times", could only attribute the accident to a reduction of his alertness, possibly brought on by his confidence in his student's ability.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28RT-201T Turbo Cherokee Arrow IV, G-OPJD
No & Type of Engines:	1 Continental Motors Corp TSIO-360-FB piston engine
Year of Manufacture:	1982 (Serial no: 28R-8231028)
Date & Time (UTC):	14 January 2014 at 1405 hrs
Location:	Thruxton Airfield, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to right wingtip and flap, right entry step, right landing gear and underside aerial
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	1,565 hours (of which 1,435 were on type) Last 90 days - 20 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

On approach to Thruxton Airfield, the pilot was unable to obtain a green DOWN-AND-LOCKED indication for the right Main Landing Gear (MLG). Despite several attempts to recycle the gear, he was unable to obtain the correct indication and eventually landed, during which the right MLG collapsed. It was found that a broken seal in a valve which allows the gear to free-fall was preventing normal hydraulic extension and that a stiff downlock hook mechanism was hampering engagement of the downlock when extending under gravity.

History of the flight

The aircraft was on a flight from Alderney to Thruxton Aerodrome. The flight had proceeded entirely normally and the pilot was cleared for a straight-in approach to Runway 25 at Thruxton. At about 5 nm finals, he noticed that the green indication light for the right MLG was not illuminated, so he recycled the gear but the light remained extinguished. He declared a go-around to the control tower and tried recycling again whilst flying a circuit, this time asking the tower for visual confirmation of the right gear status as he flew along the runway. He was not given a definite answer so he flew more circuits whilst he tried to recycle the gear several more times, eventually pulling the manual free-fall release lever.

After about 45 minutes, with the right gear green indication still unlit and with the emergency services in position, the pilot performed an emergency landing, cutting the fuel before touchdown. The right main gear collapsed during the landing roll but the airframe damage was relatively light; it was noted that the Airfield Fire Service sprayed foam into the cabin interior, although there had been no fire.

Description of the landing gear extension/retraction system

This model of aircraft uses hydraulic power supplied by a single reversible electric pump/reservoir to raise and lower the landing gear. Normal gear selections are made using a handle on the instrument panel labelled UP and DOWN.

When UP is selected, fluid pressure on the retract side of the pistons acts in that sense and the down line returns fluid to the reservoir. When fully retracted, the gears remain in that position due to hydraulic pressure in the actuator jacks; there are no uplocks.

When a DOWN selection is made, the pump rotates in the opposite direction and the up line becomes the return line.

If hydraulic pressure is lost, all three gears should drop under their own weight, although some spring assistance is used on the nose gear. In addition to a loss of hydraulic pressure, the gears are designed to extend under two further circumstances, if:

- The emergency extension lever between the front seats is lowered, or
- A combination of low airspeed and low engine power is sensed via a pressure-sensing chamber (Auto Extension)

In either case the same valve, the Automatic Gear Down and Emergency Free Fall Gear Valve, opens to allow pressure to be dumped from the up side and the landing gears to extend.

The main gear downlock mechanism comprises a conventional over-centre sidestay, kept in lock by a hook engaging on a pin (Figure 1). Engagement of the hook also actuates a microswitch to illuminate the associated DOWN AND LOCKED green light in the cockpit. Under a normal, powered extension, the final movement of the actuator engages the hook, but in a free-fall extension, a spring is used to engage the downlock hook.

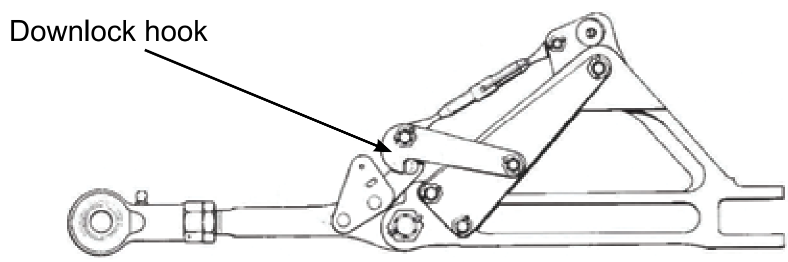

Figure 1

Downlock mechanism with hook correctly engaged on pin

Examination of the aircraft

The aircraft was examined during and after recovery. It was initially found that the downlock hook had not engaged on the pin and that the hook movement was stiff due to an apparent build-up of dirt and/or light corrosion; light finger assistance was, however, sufficient to get the hook to engage.

It was also found that the gear could not be raised either on a hand pump or using the aircraft's electric pump. Isolating the Automatic Gear Down valve allowed both these to operate the gear, so it was removed and strip-inspected. A seal was found to have broken up and pieces were blocking the normal gear down port. It was reasoned that, on the first and subsequent gear down selections, the gear had actually free-fallen rather than having been hydraulically powered down. The increase in friction of the right downlock hook mechanism had hampered its engagement during gravity extensions of the landing gear.

SERIOUS INCIDENT

Aircraft Type and Registration:	Robinson R44 Raven II, G-ODAZ	
No & Type of Engines:	1 Lycoming IO-540-AE1A5 piston engine	
Year of Manufacture:	2008 (Serial no:12167)	
Date & Time (UTC):	26 March 2014 at 1250 hrs	
Location:	Near RAF Wittering, Peterborough	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Damaged windscreen	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	32 years	
Commander's Flying Experience:	1,550 hours (of which 220 were on type) Last 90 days - 25 hours Last 28 days - 10 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

While flying at 1,000 ft in VMC conditions, the helicopter struck a bird which the pilot identified as a buzzard. The pilot carried out a precautionary landing to inspect the helicopter, which suffered a broken windscreen transparency. After the inspection, the pilot continued the flight to his destination at White Waltham. He reported that he did not see the bird before it struck the helicopter so had been unable to take avoiding action.

ACCIDENT

Aircraft Type and Registration:	Silence Twister, G-MRJP
No & Type of Engines:	1 Jabiru 2200A piston engine
Year of Manufacture:	2011 (Serial no: LAA 329-14972)
Date & Time (UTC):	14 January 2014 at 1455 hrs
Location:	Launton, Oxfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller, landing gear, wings and fuselage
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	20,000 hours (of which 4 were on type) Last 90 days - 160 hours Last 28 days - 48 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional inquiries by the AAIB

Synopsis

The aircraft was flying at about 1,500 ft, following minor maintenance, when the pilot heard a loud bang accompanied by vibration and a yaw and roll to the right. The aircraft was damaged in the subsequent forced landing but it was clear that the deriggable right tailplane had rotated through 90º in-flight. Wear in the guide tube of the tailplane locking pin was found to have led to improper routeing of the pin which had not engaged with the locking spigot.

History of the flight

Following minor maintenance, the aircraft was being flown near Bicester at 1,500 ft and at an airspeed of 100 kt when the pilot heard an "enormous bang" accompanied by severe vibration, and felt it yaw and roll to the right. Realising that the aircraft had experienced some sort of structural failure, he turned towards Bicester Airfield and carried out a handling check. He found that he had to maintain full left rudder and some left bank in order to maintain control but could not maintain altitude, so he selected a field for a forced landing.

The pilot was able to retain control by maintaining 80 kt airspeed and, as he judged that he would be able to make his chosen field, he selected full flap and rounded out. However, he was unable to maintain directional control as the aircraft landed and ground looped to the left, coming to rest in soft mud with the landing gear collapsed, incurring damage to the propeller and airframe underside.

As he evacuated the aircraft, the pilot saw that the right tailplane had rotated through 90º about its mainspar (Figure 1).

Figure 1

G-MRJP after landing showing right tailplane rotated through 90º

Examination of the aircraft

The Twister has fully demountable tailplanes. Each is slid onto the tubular mainspar and, when pushed fully home, the elevator torque tube engages in its hexagonal drive and a rigging spigot enters a hole in the fuselage (Figure 2). To lock the tailplane laterally, a wire locking pin is inserted into a plastic guide tube in the rear fuselage and pushed home. The final part of its travel inserts the pin through a hole in the rigging spigot, preventing lateral movement of the tailplane.

In the case of G-MRJP, the locking pin had missed the hole in the rigging spigot because it had exited the guide tube through a hole before reaching the end. The hole had been worn in the tube because it had been rubbing on the elevator torque tube. The unlocked tailplane had then migrated spanwise, disengaging the hexagonal elevator drive and allowing the tailplane to rotate about the main spar. The aircraft had previously been derigged to conduct minor maintenance and, when subsequently reassembled, had been independently inspected by two people without spotting that it not been properly locked.

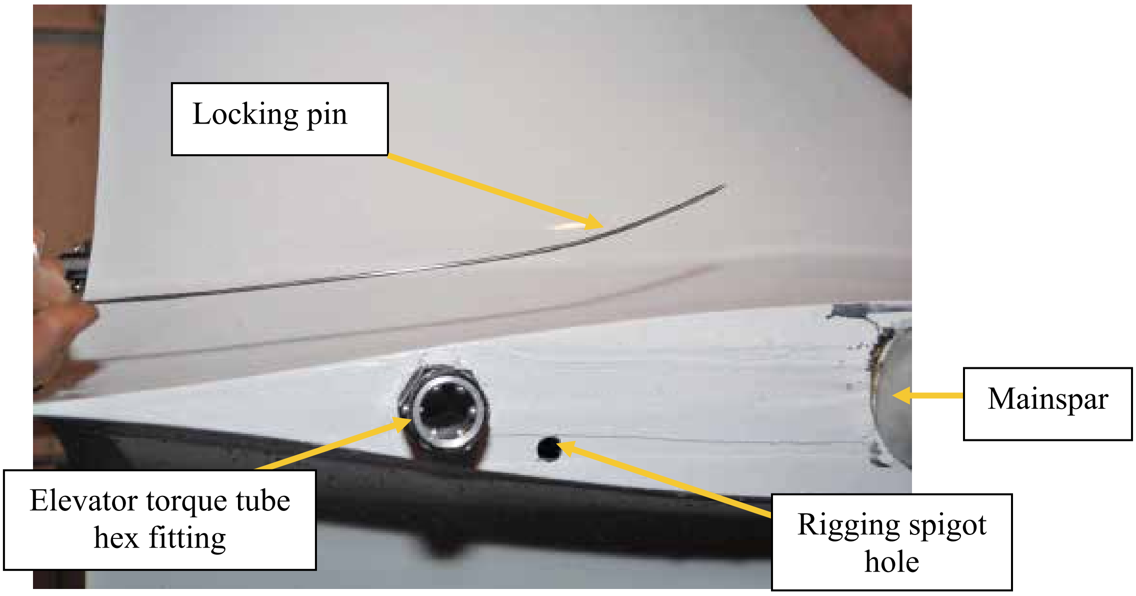

Figure 2

View of rear fuselage showing tailplane/elevator attachment features.
The locking pin has been withdrawn completely. Note that the pin is angled upwards as it and the guide tube have to pass under the elevator torque tube.
(Photo courtesy LAA)

Safety action

The Light Aircraft Association (LAA) acted quickly on learning of this accident and wrote to all Twister owners explaining the known circumstances and advocating a physical pull check on the tailplanes to ensure the locking pin has engaged in the spigot. They also published an item in their magazine *Light Aviation* (February 2014), repeating the letter and giving additional photographs and details as well as advising that their design team would be looking to see whether improvements needed to be made.

ACCIDENT

Aircraft Type and Registration:	Societe Aeronautique Normande Jodel DR1050, G-ARXT
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	1962 (Serial no: 355)
Date & Time (UTC):	7 March 2014 at 1428 hrs
Location:	Cranfield Airfield, Bedfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Distortion to left main landing gear leg
Commander's Licence:	Private Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	235 hours (of which 97 were on type) Last 90 days - 45 minutes Last 28 days - Nil
Information Source:	Aircraft Accident Report Form submitted by the pilot and ATS occurrence report submitted by Cranfield ATC

The aircraft was landing on Runway 21 at Cranfield when the accident occurred. The pilot described fine weather conditions and a wind from 260° at 11 kt, although he reported that the wind was gusty. During the landing roll, the pilot lost directional control and the aircraft performed a ground loop, sustaining slight damage to the left main landing gear leg. The pilot considered that his rudder inputs during the landing roll had been late and insufficient, considering the wind conditions he encountered.

The Tower controller initiated the crash procedure and the Aerodrome Fire Service attended the scene. However, neither the pilot nor his passenger was injured and the pilot was able to taxi the aircraft to the parking area.

ACCIDENT

Aircraft Type and Registration:	Mainair Blade, G-CDAG
No & Type of Engines:	1 Rotax 582-2V piston engine
Year of Manufacture:	2004 (Serial no: 1325-0502-7-W1120)
Date & Time (UTC):	4 March 2014 at 1600 hrs
Location:	Over Farm, Gloucester
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Serious)
Nature of Damage:	Damage to wing, monopole, front strut and propeller
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	105 hours (of which 87 were on type) Last 90 days - 3 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

During the takeoff run the aircraft did not accelerate normally due to soft ground. At a point about three-quarters along the runway the pilot decided to abort the takeoff, but the nosewheel dug in and the aircraft inverted.

History of the flight

The pilot was planning a solo flight to assess the runway suitability before taking a passenger flying later in the afternoon. He walked along the grass runway, which was later estimated as 410 m[1] long, and noted that it was soft everywhere with occasional patches of standing water. He had taken off in similar wet conditions before, so he chose a line and prepared for a takeoff at about 1330 hrs. There was a light crosswind, of about 5 kt. With a full tank and a 20 litre jerry can of fuel strapped to the passenger seat as ballast, the takeoff weight was 348 kg (42 kg below the maximum takeoff weight). The takeoff proceeded normally and the aircraft became airborne after using about a third of the runway. The flight lasted 1 hour and 15 minutes which was followed by an uneventful landing.

For the second flight, with his passenger, the pilot removed the jerry can and siphoned some fuel from the main tank so that 25 litres remained – this resulted in a takeoff weight of

Footnote

1 From Google Earth

370 kg (6% greater than the previous takeoff). The wind was calm and during the takeoff run the pilot chose a different line to avoid rutting the runway. At a point about three-quarters along the runway the aircraft had not become airborne so he decided to abort the takeoff. He estimated the airspeed at the time of abort at about 45 mph. On later reflection he believed that the nosewheel had probably just become airborne as he closed the throttle. He also believed that he probably pulled back on the bar when he closed the throttle and this caused the weight on the nosewheel to increase. Due to the soft ground the nosewheel dug in and "in the blink of an eye" the aircraft flipped inverted and came to rest. The passenger suffered broken ribs but was able to vacate quickly, while the pilot suffered a broken shoulder and sternum and took some time to get out.

Pilot's comments

The pilot considered that in taking a different line for the second takeoff, to avoid rutting the runway, he probably encountered softer ground which reduced the aircraft's acceleration. He stated that the engine was operating normally. He thought that he could stop the aircraft in the distance remaining when he aborted the takeoff, but the soft ground and slight down slope resulted in the aircraft inverting.

Civil Aviation Authority (CAA) advice

The CAA's Safety Sense Leaflet on '*Aeroplane Performance*'[2] provides the following advice about a takeoff decision point:

> ***'Decision point:*** *you should work out the runway point at which you can stop the aeroplane in the event of engine or other malfunctions, e.g. low engine rpm, loss of ASI, lack of acceleration or dragging brakes. Do NOT mentally programme yourself in a GO-mode to the exclusion of all else.*
>
> *If the ground is soft or the grass is long and the aeroplane is still on the ground and not accelerating, stick to your decision-point and abandon take-off. If the grass is wet or damp, particularly if it is very short, you will need a lot more space to stop.'*

The CAA's Safety Sense Leaflet '*Good Airmanship Guide*'[3] provides the following advice about a takeoff acceleration check point:

> *'Choose an acceleration check point from which you can stop if the aircraft hasn't achieved a safe speed. If you haven't reached for example 2/3 of your rotate speed by 1/3 of the way along the runway, abandon the take-off!'*

Footnote

[2] Safety Sense Leaflet 07, version C, January 2013
[3] Safety Sense Leaflet 01, Version E, January 2013, Section 20 on '*Take-Off*'

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).

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

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

Published May 2010.

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

Published May 2010.

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.

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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