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AAIB Special Bulletins / Interim Reports

AAIB Special Bulletins and Interim Reports

This section contains Special Bulletins and Interim Reports that have been published since the last AAIB monthly bulletin.

ACCIDENT

Aircraft Type and Registration:	EC225 LP Super Puma, G-REDW
No & Type of Engines:	2 Turbomeca Makila 2A1 turboshaft engines
Year of Manufacture:	2009 (Serial no: 2734)
Date & Time (UTC):	10 May 2012 at 1114 hrs
Location:	20 nm east of Aberdeen
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - 12
Injuries:	Crew - None Passengers - 2 (Minor)
Nature of Damage:	Damage to be assessed following salt water immersion
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	To be advised
Commander's Flying Experience:	To be advised
Information Source:	AAIB Field Investigation

This Special Bulletin details the progress made in identifying the failure mechanism that caused the 360° circumferential crack, in the bevel gear vertical shaft in the helicopter's main gearbox, which was identified in the early stages of the investigation and published in AAIB Special Bulletin 2/2012 in May 2012. It also details progress on the investigation into the indicated failure of the main gearbox emergency lubrication system.

History of the flight

The helicopter was on a scheduled flight from Aberdeen Airport to the Maersk Resilient platform, in the North Sea, 150 nm east of Aberdeen. On board were two flight crew and twelve passengers. The helicopter was in the cruise at 3,000 ft with the autopilot engaged and at an approximate speed of 143 KIAS. Thirty-four nm east of Aberdeen Airport, the crew were presented

with indications of low pressure in both the main gearbox (MGB) main and standby oil lubrication systems. This was followed by a chip indication on the Vehicle Monitoring System (VMS), and the MGB oil temperature starting to increase.

The commander assumed control of the helicopter, reduced speed towards 80 KIAS, turned back towards the coast and initiated a descent. The crew activated the emergency lubrication system and during the descent the MGB EMLUB[1] caption illuminated on the Central Warning Panel (CWP), for which the associated procedure is to land immediately. The commander briefed the passengers and carried out a controlled ditching. The total flight time was 27 minutes.

The helicopter remained upright, supported by the emergency flotation gear. After the engines were shut down and the rotors were stopped, the crew and passengers evacuated the helicopter into one of the life rafts via the starboard cabin door. Six of the occupants were rescued from the life raft by a search and rescue helicopter, eight were transferred to a RNLI lifeboat.

Aircraft information

General information

The EC225 LP is a twin-engine, medium-sized helicopter developed from the Eurocopter AS332 L2 and L1 variants of the Super Puma. G-REDW was operated by two pilots and equipped with 19 passenger seats in the main cabin. It was also equipped with an emergency flotation system, a life raft fitted in each sponson and a deployable crash position indicator (CPI).

The MGB transmits power from the engines to the main rotor. The power from the engines is transmitted to the bevel gear through the combiner wheel and bevel gear pinion. The majority of this power is then transmitted upwards into the epicyclical reduction gear module. Two pinion gears, mounted at the bottom of the bevel gear vertical shaft, drive the main and standby oil pumps. The power train through the gearbox is illustrated at Figure 1.

The bevel gear vertical shaft consists of the bevel gear and a vertical shaft that are joined together by an electron beam weld: electron beam welding is also used to join the bevel pinion to the combiner wheel shaft. To ensure the integrity of these shafts, the disrupted material at the end of the weld is removed by drilling and reaming a 4.2 mm diameter hole; a countersink (chamfer) is also formed at each end of the hole. A PTFE plug is fitted in this hole to control the flow of oil within the vertical shaft.

MGB certification requirements

The EC225 LP was certified against the Joint Aviation Regulations (JAR) 29, which includes the requirement for the helicopter to continue safe flight, at prescribed torque and main rotor speeds, for at least 30 minutes following the loss of the MGB lubrication system. This is achieved on the EC225 LP by the use of a back-up lubrication system that uses a mixture of glycol and water (Hydrosafe 620) to cool and lubricate the MGB. This system is also known as the emergency lubrication system.

Main gearbox

The MGB fitted to the EC225 LP is of a similar design to the gearbox fitted to the AS332 L2, but has a greater torque capability. However, there are two significant differences to the MGB on the EC225 LP. The conical housing has been stiffened and the base material of the bevel gear vertical shaft has been changed from 16NCD13

Footnote

[1] The MGB EMLUB caption indicates loss of emergency MGB lubrication.

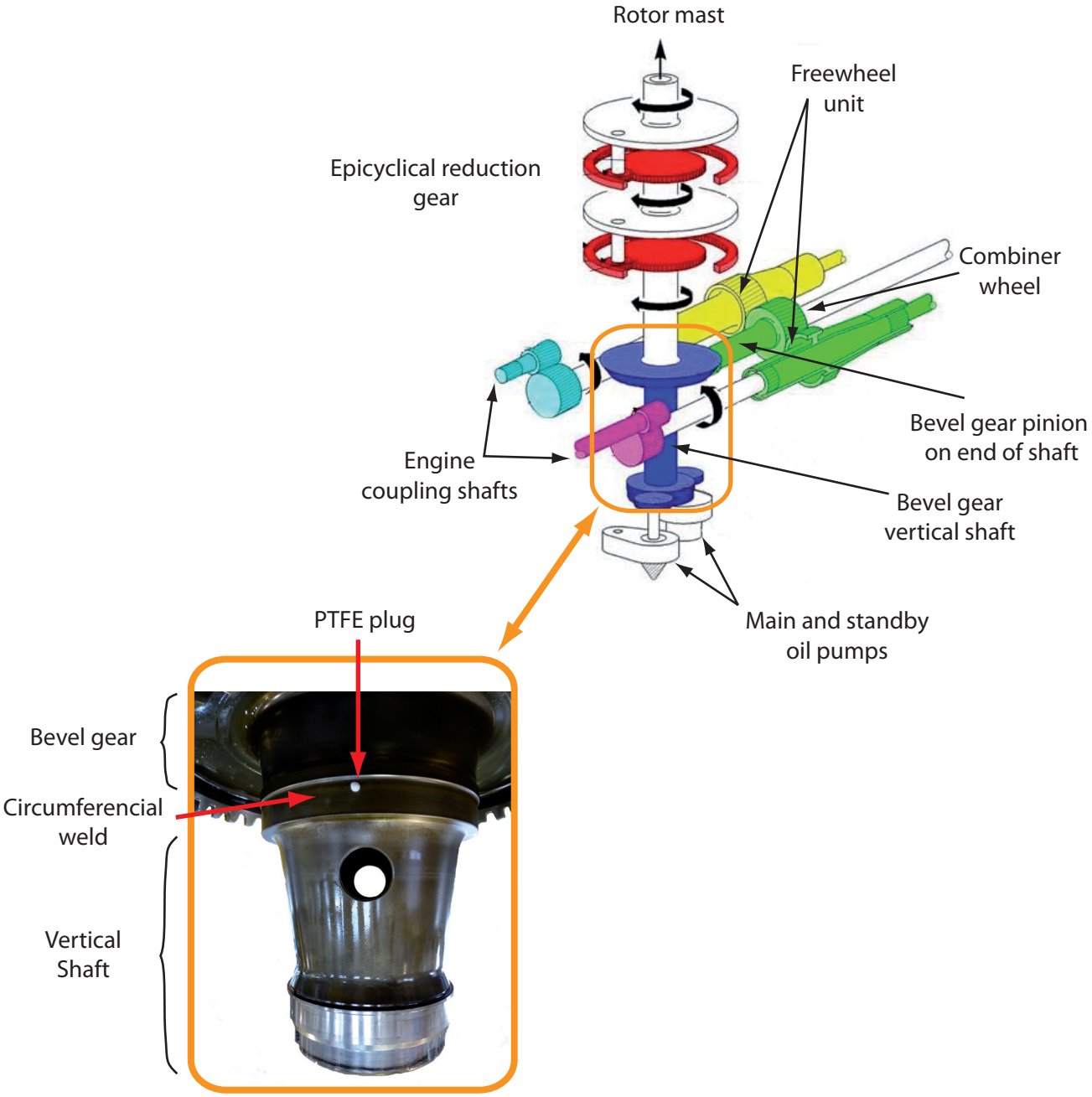


Figure 1

MGB power train

carburized steel alloy to 32CDV13 nitrided steel alloy. The 16NCD13 shaft (part number 331A323115) is no longer manufactured and the 32CDV13 shaft (part number 332A325101) is the replacement part for the MGB fitted to AS332 L1 and L2 helicopters. Approximately 732 of the 32CDV13 steel alloy shafts have been manufactured.

MGB lubrication

The MGB lubrication system includes two mechanically operated oil pumps and a crew-activated emergency lubrication system. The emergency lubrication system comprises: a bleed air supply from the left engine, a Hydrosafe 620 supply, a series of small pipes around

and inside the main gearbox to deliver the Hydrosafe 620 spray, and a control and monitoring system on a Printed Circuit Board (PCB).

When the system is activated, an electro-valve (P2.4 valve) opens and bleed air from the left engine enters the system. At the same time, Hydrosafe 620 is pumped from a reservoir into the system. There are two similar sensors that monitor the pressure in both the Hydrosafe 620 and bleed-air lines; these sensors are mounted on the MGB. The MGB EMLUB caption will illuminate if low pressure is detected in either the Hydrosafe 620 or the bleed air lines, or there is an erroneous signal. This warning is inhibited for approximately 30 seconds after the system is activated, to allow the system to reach a steady state.

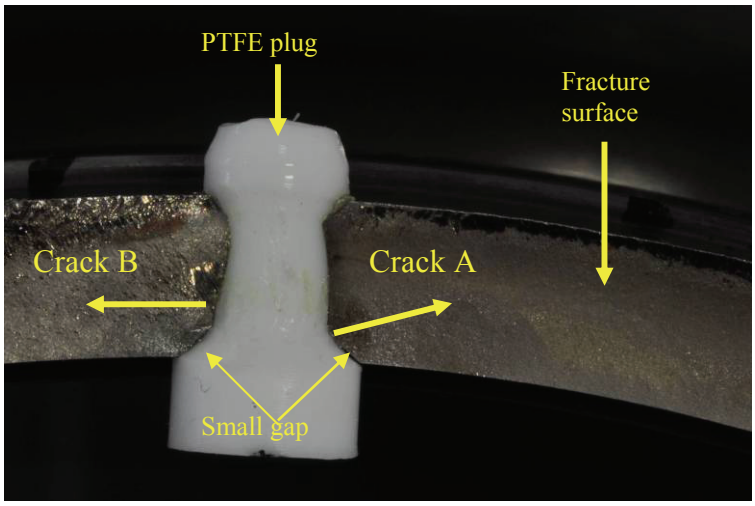


Figure 2

4.2 mm diameter hole in the weld

Engineering investigation

Overview

The MGB was fitted to G-REDW on 18 March 2012, following overhaul at the helicopter manufacturer's facility, where a new bevel gear vertical shaft (serial number M385) was fitted. This shaft failed in flight after approximately 167 flying hours.

A strip examination of the MGB established that the bevel gear vertical drive shaft had failed across the 4.2 mm diameter hole in the area where the two parts of the shaft are welded together. As a consequence of this failure, the lower part of the shaft moved downwards damaging the outer race retainer of the lower roller bearing and causing the pinion to disengage partially from the oil pump drive gears. This damaged the teeth on the oil pump drive gears and generated sufficient debris to activate the sump magnetic chip detector. At this stage, the lower part of the shaft was no longer being driven. During the examination, glycol was found throughout the gearbox casing and on all the gears and bearings. There was no visual evidence of heat distress or damage to any of the other components in the MGB.

Initial results of a dimensional survey of the MGB indicated that all the dimensions were within the design tolerances. Further work continues to establish the dimensions and concentricity of the bevel gear vertical drive shaft.

Examination of the shaft fracture surface

Examination of the fracture surface on both parts of the bevel gear vertical shaft revealed the presence of three cracks, identified as 'A', 'B' and 'C' (see Figure 2). Cracks 'A' and 'B' started from the 4.2 mm diameter hole in the weld and there was evidence of beachmarks and striations along both cracks, which are indicators of a fatigue failure. Crack 'A' was 336 mm long[2] and extended for approximately 250° around the circumference of the shaft. This crack appeared to have initiated from a small corrosion pit, approximately 60 µm

Footnote

[2] The length of the cracks was measured along the outer surface of the shaft.

deep, on the inner countersink. Crack 'B' was 106 mm long and extended for approximately 80° around the circumference. This crack appeared to have initiated at a small defect in the internal surface of the hole. Crack 'C' was 42 mm long and extended for approximately 30° around the circumference. One end of this crack joined Crack 'A' and the other end ran under Crack 'B'. While there were striations on the surface of Crack 'C', there was no evidence of any beachmarks.

In total, approximately 99% of the fracture surface on the bevel gear vertical shaft had failed in fatigue and 1% of the surface had failed in overload.

Examination of the 4.2 mm diameter hole

The diameter of the 4.2 mm hole was within the design specification. However, there was evidence of tooling marks and, what appeared to be, a spiral scratch that ran along the length of the hole. The geometry of the inner and outer countersinks was found to be outside the design specifications and there were a number of 'scoops' in the inner countersink (see Figure 3). There were patches of very small corrosion pits around the inner countersink, in the area where there is a gap (crevice) between the PTFE plug and the countersink. These corrosion pits were only initially detected using a scanning electron microscope.

The fracture surface was across the 4.2 mm diameter hole. The roughness of the surface of the hole on the lower section of the shaft, averaged over its length, was measured as 1.695 µm, using a Talysurf profile meter with an ISO-2CR filter. However, one end of the hole was much rougher than the other, with the average roughness measurements being 2.50 µm and 0.29 µm, respectively. The deepest feature was of the order of 60 to 70 µm. The roughness of the surface of the hole on the upper section of the shaft, averaged over its length, was measured as being between 0.92 µm and 1.48 µm.

Following the accident, 18 bevel gear vertical shafts, between serial numbers M308 and M559, were examined by the manufacturer. There was some variability in the geometry of the countersinks on the 4.2 mm diameter holes and a number were found to be outside the design tolerance. There was also evidence of tooling marks in the bore of a number of these holes.

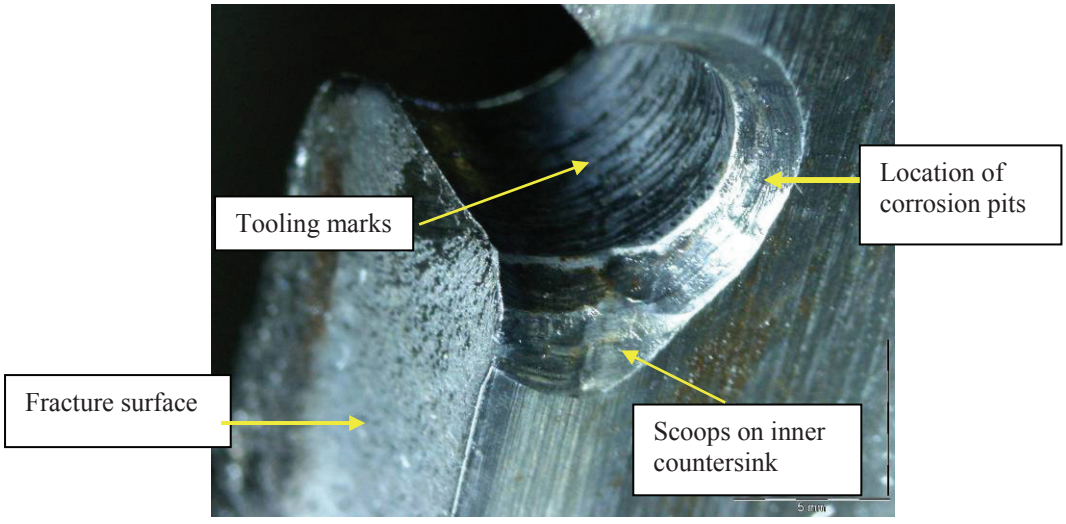


Figure 3

Condition of the 4.2 mm hole and countersink

Manufacturing change to the 4.2 mm diameter hole

The initial design was for a 100°±1° countersink (chamfer) at both ends of the 4.2 mm diameter hole. As a result of a production change in September 2009, to standardize production tooling, the angle of the countersink was changed to the same as that on the bevel pinion (90°±1°). The manufacturer assessed the effect on the stress in the region of the countersink as negligible. The first shaft manufactured following this change was serial number M330, on 14 June 2010. No change was made to the PTFE plug which is only used on the bevel gear vertical shaft.

It was established that when the PTFE plug is fitted in the hole, with a 90°±1° countersink, a small annular gap (approximately 0.37 mm x 0.05 mm in cross-section) can remain between the plug and the side of the countersink (see Figure 2).

Manufacturing dimensional inspection

A dimensional inspection is undertaken at the end of the manufacturing process to ensure that the component meets the design specification. The bevel gear vertical drive shaft is classed as 'Pièce Critique' (critical item) and an inspection document 332A32510100-DI926 lists the design features and specifies the percentage of components that need to be inspected accurately. This document calls for 10% of the countersinks in the 4.2 mm hole to be checked using a replicast[3] and shadow board. In addition, a visual inspection is carried out on all the holes and countersinks, using a torch and mirror.

The dimensional inspection also calls for the average roughness (Ra) of the hole to be measured, to ensure that it is less than 1.6 µm. However, when shaft serial number M385 was manufactured there was no acceptance criterion for surface scratches. Since the accident, the manufacturer has introduced acceptance criteria for scratches of a maximum depth of 5 µm.

Fatigue testing

As a result of this accident, 'single part' and dynamic fatigue tests have been undertaken on other bevel gear vertical shafts. In the 'single part' tests the shaft was subjected to a bending load in order to determine the fatigue properties across the weld. During one of these tests a crack initiated and propagated from the 4.2 mm diameter hole after it had been deliberately corroded under laboratory conditions prior to the test.

In the dynamic tests an instrumented shaft was run in an EC225 LP MGB in order to determine the in-service stress levels in the shaft and weld. The results of these tests are still being analysed.

Emergency lubrication system

This was the first occasion that the emergency lubrication system has been operated in-service.

Glycol was found throughout the main gearbox during the strip inspection, and there was no evidence of thermal damage. The amount of fluid remaining in the Hydrosafe 620 reservoir was also consistent with the pump operating normally. However, 32 seconds after the crew activated the emergency lubrication system, the MGB EMLUB caption illuminated.

The investigation of the emergency lubrication system has focused on the control and monitoring of this system. Nothing significant has been found during the test and inspection of the PCB (which controls and monitors this system), the two pressure sensors (air and glycol), the pipes and the relevant wiring. After the

Footnote

[3] A replicast is a replica of the feature made from a rubber compound.

accident, the P2.4 valve was found to be slightly open when it should have sprung closed; however, this does not readily explain why the MGB EMLUB caption came on. Further investigative work is planned.

The emergency lubrication system investigation has been broadened to include an assessment of component reliability and the certification process. There is some preliminary evidence that the in-service reliability of some of the components of this system is lower than that assumed in the System Safety Assessment for certification. The work in this area is ongoing.

Health and usage monitoring system (HUMS)

A review of the HUMS data showed no indication of any significant rising vibration trends until approximately six flying hours prior to the start of the accident flight. Prior to this period, the vibration levels on indicators associated with the bevel gear vertical shaft were below the mean level established from data collected from 23 other EC225 LP helicopters.

During the last six flying hours, which covered the two flights prior to the accident flight, the trend for indicator MOD 45, which monitors the meshing frequency of the bevel gear, and MOD 70 which monitors the meshing frequency of the oil pump wheels, increased. An amber[4] alert was generated for MOD 45 following the last flight on 9 May 2012, and for both indicators following the first flight on 10 May 2012. The operator's engineers followed the fault diagnosis chart in the Aircraft Maintenance Manual (AMM), Chapter 45.11.08.211. The washer on the accelerometer for these parameters was replaced following the first amber alert on 9 May 2012, and the MGB magnetic chip detectors were checked, and found to be free of debris, following the alerts on the 10 May 2012. Thirty six other indicators were checked and no significant trends were detected. In accordance with the guidance in the AMM, the aircraft was placed on 10 hourly close monitoring and released for flight.

Following the accident, the helicopter manufacturer analyzed the data for indicators MOD 45 and MOD 70 and reduced the vibration level required to generate an amber alert. Red alert thresholds have also been introduced for both these indicators[5].

Further work

The AAIB is continuing to work with the European Aviation Safety Agency (EASA), the Bureau d'Enquetes et d'Analyses pour la Securitie de l'Aviation Civile (BEA), representing the State of Manufacture of the helicopter, and Eurocopter, the helicopter manufacturer. The UK Civil Aviation Authority and the aircraft operator are also providing assistance to the AAIB.

The investigation will continue to review the results from the fatigue tests, with other data and evidence, to establish the mechanism that caused the initiation and propagation of the fatigue cracks in the bevel gear vertical shaft. It will also review the manufacturing process, dimensional inspections and quality system.

Further testing of components in the emergency lubrication system will be carried out, together with analysis of in-service data. The operational and survival aspects of the event will also continue to be investigated.

Published 13 July 2012

Footnote

[4] An amber alert requires the operator to determine if a maintenance action is required, whereas a red alert requires a maintenance action to be carried out before the helicopter is allowed to fly again.

Footnote

[5] Eurocopter Service Bulletin No 45-001.

AAIB Field Investigation reports

ACCIDENT

Aircraft Type and Registration:	Piper PA-31-325 Navajo C/R, G-BWHF
No & Type of Engines:	1 Lycoming TIO-540-F2BD piston engine 1 Lycoming LTIO-540-F2BD piston engine
Year of Manufacture:	1976
Date & Time (UTC):	18 January 2012 at 1117 hrs
Location:	Long Mountain near Welshpool Airport, Powys
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - 2 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	11,164 hours (of which 375 were on type) Last 90 days - 3.0 hours Last 28 days - 2.0 hours
Information Source:	AAIB Field Investigation

Synopsis

The commander was carrying out a flight to re-familiarise himself with the aircraft. After departing Welshpool and flying in the local area, he rejoined the circuit, was on the base leg and configured for landing when the aircraft struck cloud covered trees on the upper slope of Long Mountain. The aircraft then impacted a grass field where it caught fire. Both pilots were fatally injured.

History of the flight

The commander had retired from flying Commercial Air Transport operations with an airline in August 2011. He had recently renewed his single pilot Instrument Rating and Multi Engine Piston (Land) planes rating and his intention was to continue flying part-time. He had been invited to fly G-BWHF, which was privately operated for business purposes, but his last flight in this aircraft was on 10 November 1998. Accordingly, he planned to conduct a re-familiarisation flight.

The commander was accompanied by another pilot who was not a flight instructor but had recent experience of flying the aircraft and was familiar with the aerodrome. A webcam recorded the pilots towing the aircraft to the refuelling point, refuelling it and carrying out pre-flight preparations. There were no witnesses to any briefings which may have taken place.

The commander first started the right engine, which initially ran roughly and backfired before running smoothly. The left engine started normally. The second pilot took his place in the front right seat.

The aircraft taxied to the holding point of Runway 22, and was heard by witnesses to be running normally. A witness who lived adjacent to the airfield but could not see the aircraft heard the power and propeller checks being carried out, three or four times instead of once per engine as was usual. The engines were heard to increase power and the witness observed the aircraft accelerate along the runway and takeoff at 1105 hrs. It climbed straight ahead and through a small patch of thin stratus cloud, the base of which the witness estimated was approximately 1,000 ft aal. The aircraft remained visible as it passed through the cloud and continued climbing. The witness turned away from the aircraft to continue working but stated that apart from the unusual number of run-up checks, the aircraft appeared and sounded normal.

The pilot of a Robinson R22 helicopter which departed Welshpool at 1015 hrs described weather to the south of the aerodrome as drizzle with patches of broken stratus at 600-700 ft aal. He was able to climb the helicopter between the patches of stratus until, at 1,500 ft, he was above the tops of the cloud. Visibility below the cloud was approximately 5-6 km but, above the cloud, it was in excess of 10 km. He noted that the top of Long Mountain was in cloud and his passenger took a photograph of the Long Mountain area which is shown at Figure 1.

The R22 returned to the airfield and joined left hand downwind for Runway 22. As it did so, its pilot heard a transmission from the pilot of the PA-31 stating that he was rejoining for circuits. The R22 pilot transmitted his position in order to alert the PA-31, then continued around the circuit and called finas before making his approach to the runway, landing at about 1115 hrs.

The PA-31 track is shown at Figure 2. After passing overhead Welshpool, it made a descending left circuit, becoming established on a left hand, downwind leg for Runway 22.

Figure 1

Photograph taken by the R22 passenger showing the area of Long Mountain, covered in cloud in the upper part of the picture, approximately 30 minutes before the accident

A witness approximately 3.5 nm northeast of the accident site saw the aircraft coming towards him with both propellers turning. It made a turn to the left with the engines apparently at a high power setting and, as it passed over Long Mountain, commenced a descent. He could not recall whether he could still hear the engines as the aircraft descended. He then lost sight of it behind the rising ground of Long Mountain.

A search was initiated when the aircraft failed to return to Welshpool. Its wreckage was located in an open field on the west slope of Long Mountain.

There were no witnesses to the actual impact with the trees or surface of the field but the sound was heard by a witness in the wood who stated that the engines were audible immediately prior to impact. The accident, which was not survivable, occurred at 1117 hrs. Both pilots were fatally injured.

Meteorological information

The Met Office provided an aftercast for the Welshpool area covering the time of the accident. At 1200 hrs, a weak cold front was lying west to east over Welshpool Airport. The nearest observations showed a west south-westerly surface wind at about 10 kt. To the west of the front, visibility was 8 km, and cloud broken with a base at 400 ft and broken with a base at 1,500 ft. Surface temperature and dew point were both 9°C. To the east visibility was 50 km and the lowest cloud layer was broken with a base at 1,200 ft. The temperature was 12°C and the dew point 9°C.

A more detailed indication of the weather in the area of Welshpool Airport at the time of the accident was provided by the R22 pilot. He described two distinct layers of stratus cloud, the lower of which had a base between 600 and 800 ft aal and tops at about 1,500 ft aal when he departed, approximately one hour before the accident. This lower layer covered the tops of hills including Long Mountain but in the valleys there were small, well isolated patches of thin stratus with the same base as that covering the tops of the hills. The second, higher layer had a base between 3,000 and 4,000 ft aal. Visibility below the cloud was approximately 5 to 6 km and in excess of 10 km between the broken layers.

The R22 pilot reported that weather improved during his flight with the lower base rising to 1,000 ft aal as he joined the downwind leg. There were large gaps between the patches of cloud, which "easily" allowed him to remain VMC during his climb and descent above the lower layer of stratus.

Webcam images indicated a gradual improvement in the weather with patches of blue sky visible as the accident aircraft taxied. Two witnesses recalled being on the edge of the town in sunshine at about the time of the accident and seeing smoke from the accident site just below or at about the same level as the base of the cloud covering the top of Long Mountain.

Pilot background and experience

The aircraft commander started flying in 1989 and worked as a Flight Instructor before gaining a professional licence. His commercial flying commenced on a Cessna Citation business jet before moving to airline operations on the HS 748, followed by 10 years flying the Airbus A320 and Boeing 737. He retired from airline flying in August 2011 and, following a period of training, renewed his Flight Instructor (FI), Single Engine Piston (SEP) (land), Multi Engine Piston (MEP) (land) ratings and single pilot Instrument Rating (IR) in the last quarter of 2011 and January 2012. Prior to embarking on his commercial flying career, the commander had operated from Welshpool Airport.

The pilot occupying the front right seat was familiar with the local area and had operated from Welshpool for approximately 27 years. He flew several different types of aircraft and had amassed a total of 17,590 flying hours of which 2,177 hours were flying the PA-31 and 2,119 were flying G-BWHF. He had flown 348 hours in the last 90 days and 61 hours in the last 28 days. He was familiar with operating in and out of Welshpool Airport both by day and night. He had recently returned from multi-crew training in the USA where he attended a Rockwell Turbo Commander six monthly type recurrent training and revalidation course.

Aerodrome information

Welshpool Airport is known as Mid Wales Airport and is located 2 nm south of the town of Welshpool in the Severn valley. It has a single asphalt runway orientated 04/22, 1,020 m long and 18 m wide. It is equipped with a NDB and a DME, neither of which was in operation on the day of the accident. A commercially available flight guide for the aerodrome gave its elevation as 233 ft and included the following information:

> *'The aerodrome is located in the River Severn Valley with high ground on each side of the valley. Pilots are advised not to descend below safety height until on the final approach after having positively identified the runway.'*

It also carries a warning of high ground which states:

> *'**High Ground** – 400'aal, 633' amsl 1600 m to W, and 250' aal, 483' amsl 1500 m to E.'*

Long Mountain is located approximately 2 nm north-east of Welshpool Airport and rises to a height of 1,338 ft amsl, which includes a 28 ft mast 1,200 m south of the accident site. The highest adjacent terrain is to the east of the accident site and has an elevation of 1,280 ft.

Weight and Centre of Gravity

The following weight and centre of gravity calculations are based on estimated weights for the crew, fuel and items of aircraft and personal equipment onboard. The resulting weight and centre of gravity were approximations used in the flight trial described below.

The weight at takeoff was estimated as 5,724 lbs with 130 lbs of fuel used during the start, taxi and 12-minute flight. The estimated weight at the time of the accident was 5,594 lbs with the corresponding centre of gravity for both weights of 127.4 inches aft of the datum. The maximum permitted gross takeoff weight was 6,500 lbs and the fore and aft centre of gravity limits for both estimated weights were 126.4 inches and 138 inches aft of the datum respectively.

Based on these calculations, the aircraft was being operated within the maximum permitted all-up weight and within the centre of gravity range, close to the forward centre of gravity limit.

Medical and pathological information

Post-mortem examinations of both pilots revealed that they had died of severe multiple injuries caused when the aircraft struck the ground. The crash forces were outside the range of human tolerance and therefore the impact was not survivable. There was no evidence of any pre-existing condition that may have contributed to the accident and toxicology showed no evidence of drugs or alcohol in either occupant.

Recorded information

The Clee hill radar recorded the aircraft's position and Mode C altitude[1] approximately every eight seconds. The first radar return was recorded at 1106:37 hrs, just over 1 nm from the end of Runway 22, at an altitude of 1,433 ft amsl. The aircraft climbed to 3,223 ft amsl, tracking to the south of the aerodrome before turning in the opposite direction (Figure 2).

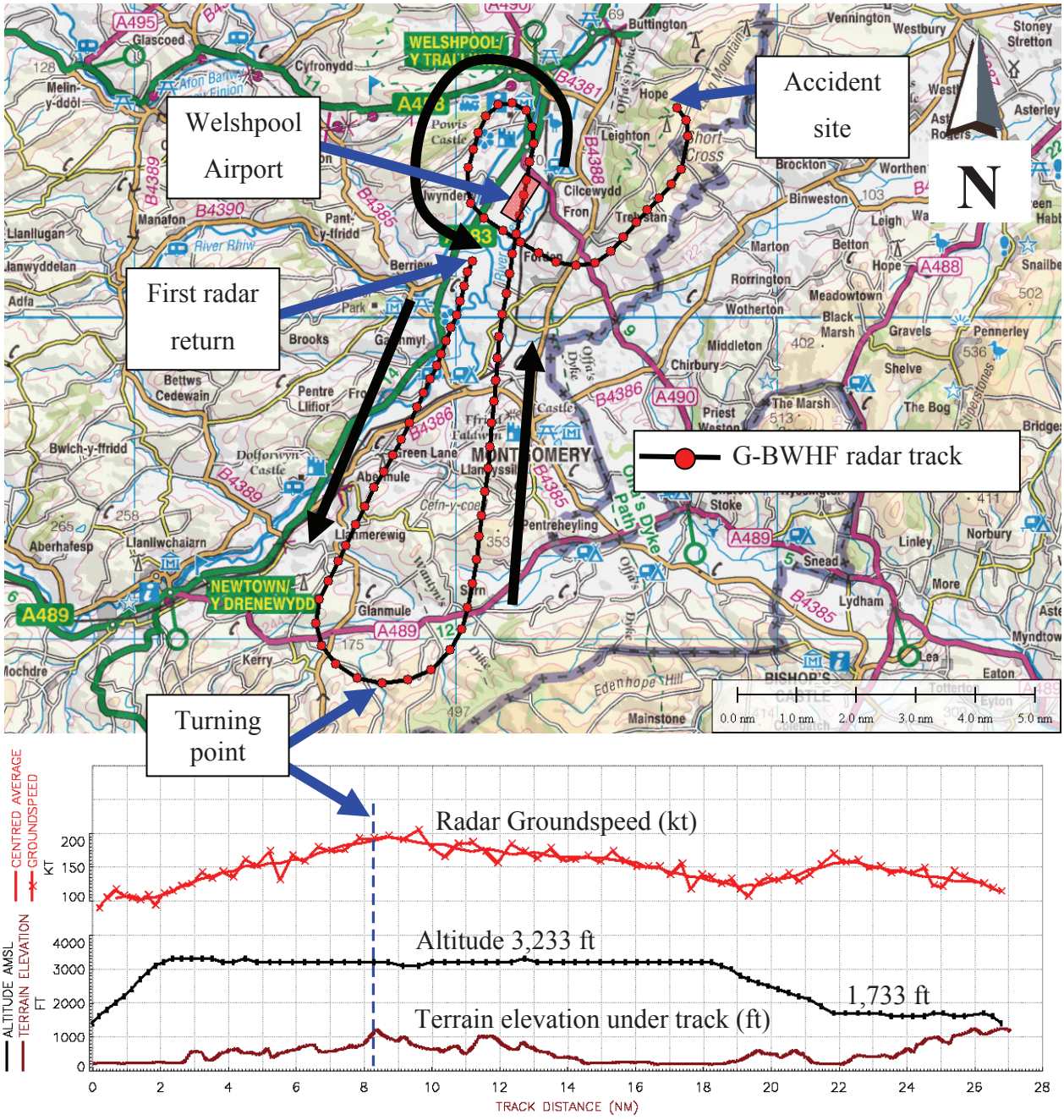


Figure 2

G-BWHF radar track (Map terrain elevations are shown in metres)

Footnote

[1] Mode C altitude assumes a QNH of 1013 hPa. This was corrected to the reported airport QFE of 1013 hPa by adding 233 ft to the radar altitude to produce an altitude amsl.

A GPS device fitted to the R22 helicopter, which was flying in the local area, recorded the time and position of the helicopter every 30 seconds. This was downloaded at the AAIB and plotted alongside the G-BWHF radar track. At 1112:53 hrs, the R22 was positioned on the downwind leg of its approach to Runway 22 at approximately 1,000 ft amsl. At the same time, G-BWHF was positioned 1.3 nm south of the aerodrome at 3,233 ft amsl (Figure 3). Ninety seconds later, the R22 turned onto the base leg, at which time G-BWHF

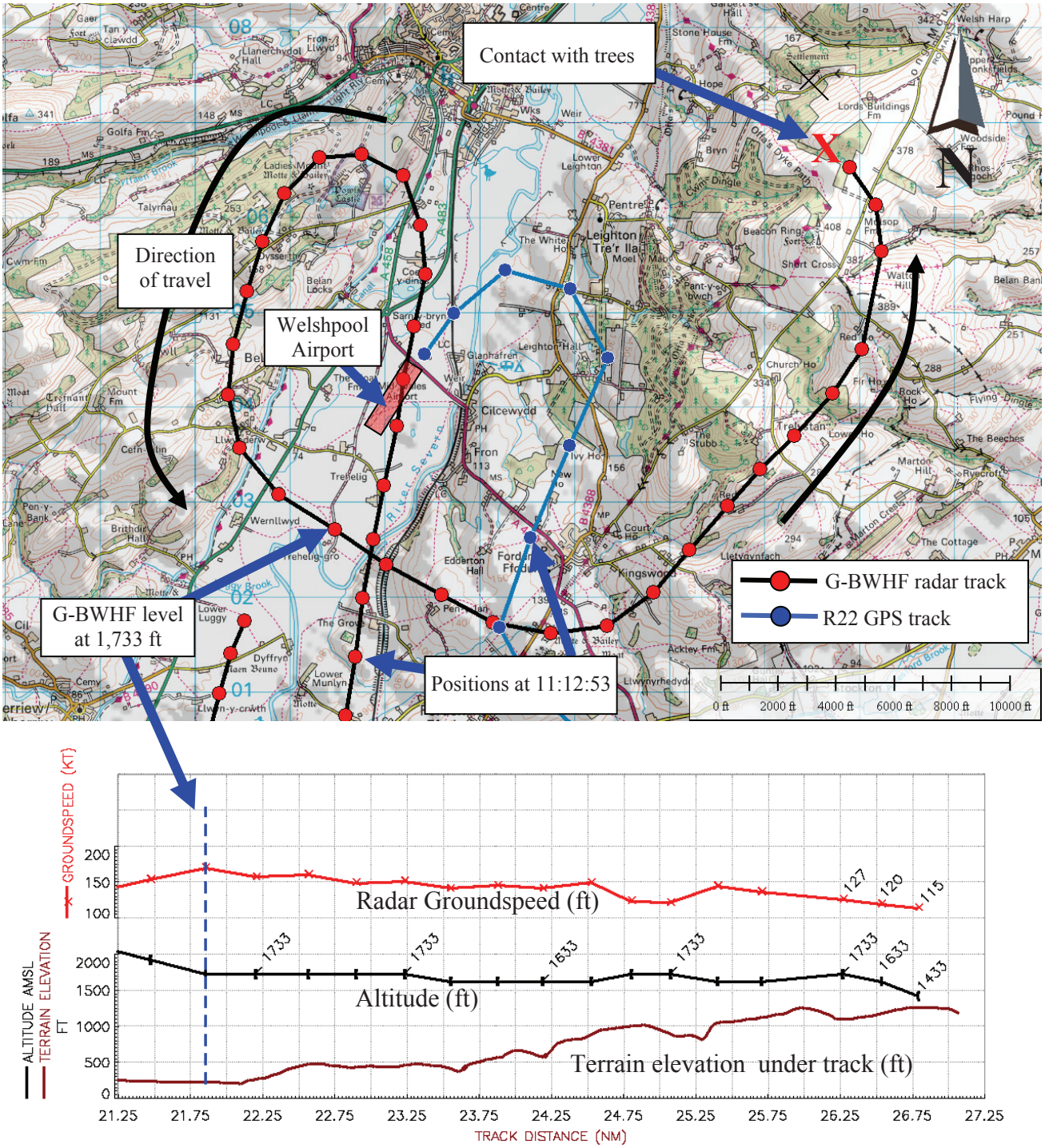


Figure 3

G-BWHF radar track and R22 GPS track

was north of the airfield commencing a 180° turn and starting to descend.

At 1115:26 hrs, G-BWHF levelled off at 1,733 ft amsl (1,500 ft aal) just to the south of the aerodrome. Thirty seconds later the aircraft turned to the left and flew over the southern tip of Long Mountain, maintaining altitude as it did so but over rising terrain.

The last three radar returns show the aircraft turning to the left towards the accident site. Between the penultimate and last radar return, the recorded altitude reduced by 200 ft. The final radar return, at 1117:34 hrs, indicated an aircraft groundspeed of 115 kt, an altitude of 1,433 ft and a terrain clearance of 157 ft. The position of the first contact with the trees was 315 m from the last radar return with an estimated tree elevation of 1,339 ft amsl.

Engineering investigation

The aircraft

The aircraft was a Piper PA-31-325 Navajo C/R, fitted with two counter-rotating turbocharged Lycoming TIO-540-F2BD engines, driving three-bladed Hartzell variable pitch propellers. The aircraft's log books indicated that, at the time of the accident, the aircraft had a total time in service of 5,480 hours. Both engines had been overhauled in August 2011 and had both accumulated 48 hours operation since overhaul. The aircraft had undergone a scheduled maintenance inspection in October 2011 and had a current Airworthiness Review Certificate when the accident occurred. The aircraft was equipped with two Garmin GNS430 GPS displays although the equipment manufacturer confirmed that neither unit had been modified to provide terrain warnings.

Accident site

The accident site was located on the top of Long Mountain. The aircraft had flown into an area of pine trees on the crest of the ridge, before impacting open ground on the downward-sloping westerly face of the ridge (Figure 4).

The aircraft's left wing had struck two 80 ft pine trees approximately 20 ft below treetop height, causing the outer 2.2 m of the left wing, outboard of the left flap, to fragment and detach. Witness marks on the severed tree trunks indicated that the roll attitude of the aircraft at impact with the trees was wings level.

The wreckage trail, from the point of the initial tree strikes to the aircraft's final resting position, was 230 m in length and was orientated on a heading of 298°M. Parts of all major sections of the structure and flying controls were identified at the accident site. The first ground impact scar was 185 m beyond the initial tree strike and had been made by the right wingtip; it was 20 cm wide and the narrowness of this mark indicated that the roll angle at ground impact was approximately 90° right wing low. The ground impact marks and distribution of the wreckage indicated that following the right wingtip strike, the right engine hit the ground and detached, shortly after which the aircraft impacted heavily on its nose. The absence of any significant ground scars between the nose impact crater and the main wreckage indicated that the aircraft then bounced a distance of 34 m, before finally coming to rest facing uphill. The wings were resting in a leading edge down orientation and the majority of the fuselage was lying inverted, with the tail furthest up the slope. An intense fuel fire had consumed approximately 60% of the aircraft, including the majority of the fuselage and empennage.

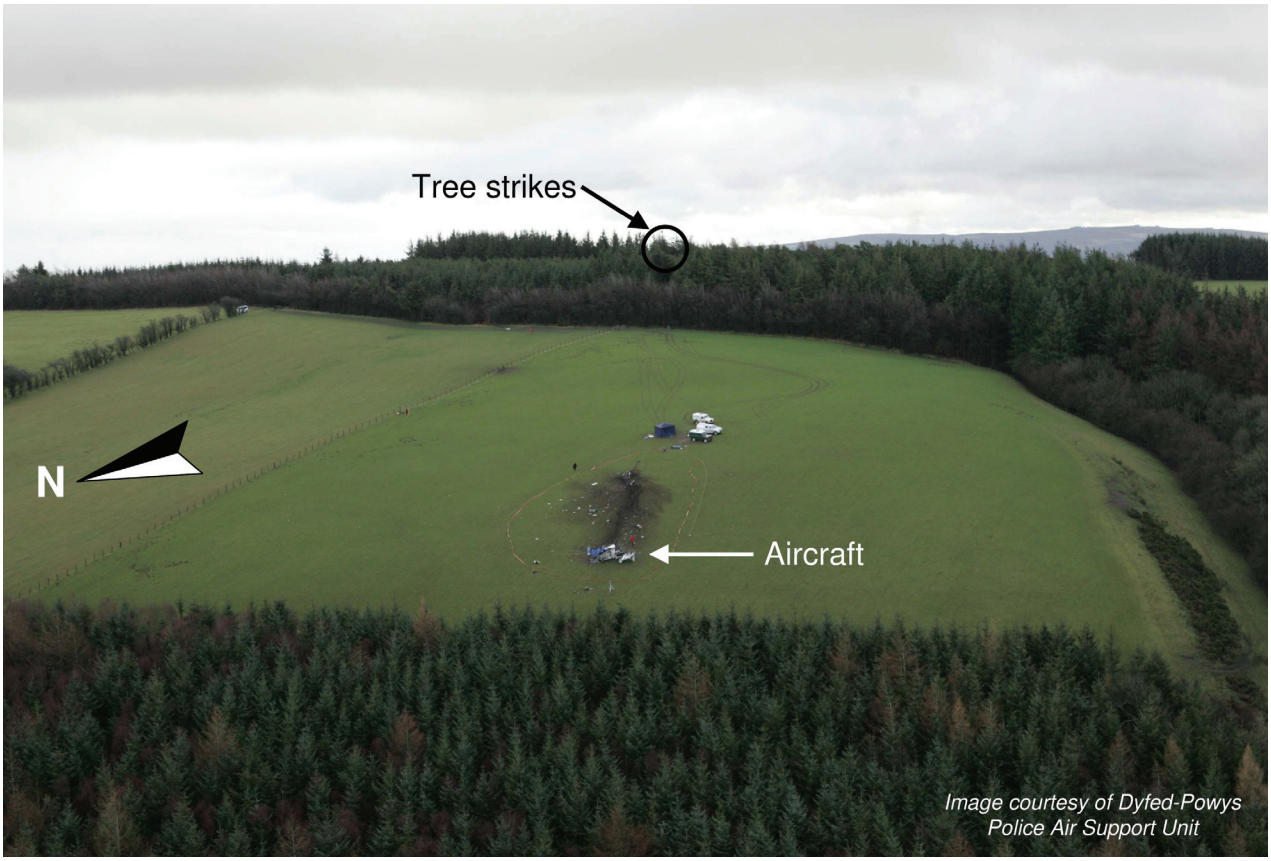


Figure 4

Accident site

The right engine had detached in the initial ground impact and three propeller blade slash marks were evident in the grass immediately before the engine's impact crater, indicating that the right propeller was rotating at impact.

Detailed examination

Following inspection of the wreckage in situ, it was recovered to the AAIB facility at Farnborough for detailed examination. Both engines were examined internally using a boroscope and no pre-impact mechanical failures were evident. The blades of both propellers exhibited chordwise scratching and shallow leading edge impact indentations, consistent with rotation under low power at impact. Both propellers were dismantled at an approved overhaul facility. They revealed internal witness marking of the blade pitch change mechanism and low pitch stops, consistent with both propellers operating at the fully fine position at impact.

The aircraft's left main landing gear leg was in the down and locked position. The right main leg was also extended although its side brace had fractured in the accident, preventing the leg from locking down thereafter. Both hydraulically-sequenced main wheel well doors were raised and locked, consistent with the landing gear being down before the accident occurred. The nose landing gear leg and its supporting structure had been heavily disrupted by the nose impact. However, the nose leg hydraulic actuator was found bent in the fully extended position, consistent with the nose leg also having been down prior to the accident.

The left and right wing flaps were symmetrically deployed and 10 threads were visible on the flap actuator screw jacks on both flaps. The aircraft manufacturer confirmed that this number of visible threads equated to a flap deflection of 10°, which is an intermediate position between flaps retracted and a fully deflected setting of 25°.

Due to disruption caused by ground impact and subsequent fire damage, it was not possible to confirm flying control continuity in the cockpit section of the aircraft. Continuity of the flying controls was traced between the wing front spar station to the individual control surfaces. All breaks in the control runs could be attributed to either mechanical overload sustained during the accident or intentional cuts made during the recovery of the wreckage. The rudder trim tab was observed to be in a neutral position. With the elevator in a neutral position the elevator trim tab was set to 13° trailing edge down, providing 'nose up' pitch trim.

It was not possible to determine the positions of the fuel tank selector controls and fuel distribution valves due to their disturbance as the aircraft broke up in the accident. No fuel samples were taken from the aircraft's fuel system as all the fuel onboard had either leaked or burned off in the post-accident fire. However, a helicopter had refuelled with avgas from the same fuel pump used by G-BWHF on two occasions; once on the day preceding the accident and immediately after the accident had occurred. The pilot of this helicopter did not report any fuel quality problems.

Steel components from both the upper and lower halves of the cabin entry door were identified in the wreckage. The steel latch pin that locks the lower door to the fuselage, whilst also retaining the upper door when both door halves are closed, was found in the latched position, indicating that the cabin door was closed and locked prior to the accident.

Whilst the majority of the aircraft's instruments were consumed in the post-accident fire, fragments of some instruments had been thrown clear of the aircraft following the ground impact. These included the face of the commander's primary altimeter, on which the subscale was set to 1014 mb. The face of the fuel flowmeter exhibited impact witness marks made by the fuel flow needles, indicating that at impact the gauge was displaying a fuel flow rate of 20 USG/Hr to both engines. Due to their fire-damaged condition it was not possible to establish rotational damage on either the electrical or vacuum driven gyro instruments. The left vacuum pump was examined and there was no evidence of pre-impact failures. The right vacuum pump had been destroyed by fire.

Flight trial

A Civil Aviation Authority test pilot carried out a flight trial using a PA-31-310, G-BEZL. The tested PA-31 differed from the accident aircraft in having engines 15 hp less powerful than the PA-31-325 which both rotated the same way rather than counter-rotating. The trial aircraft had also been modified by the fitting of a small sensor turret under its nose. This was likely to have increased the airframe drag compared to a standard aircraft but, according to the test pilot, by a "relatively negligible" amount in the gear and flap down configuration tested.

The trial takeoff weight was 5,800 lbs and CG 128" aft of datum.

Trials were completed with the gear down and the flaps pre-set before take-off to replicate the accident aircraft at the time of the crash. Mixture was fully rich and cowl flaps open. The following manoeuvres were flown:

- Straight and Level with Power For Level Flight at 108, 110, 115, 120 KIAS
- Descents at 20/20 USG/hr fuel flow at 115 and 120 KIAS
- Descent/Level flight at 20/20 USG/hr with elevator at accident trim
- Elevator Fixed & variable nose-up/nose-down trim
- Rate 1 turns left & descents from Straight and Level to replicate base turn
- Trim change assessed with change of rpm settings

A reference measurement was used to set the trim tab to the same position as on the accident aircraft. This was marked on the test aircraft trim indicator and then used to set up the test point. The aircraft was then set up with 20 USG/hr fuel flow on each engine and a descending flight path noted. At 115 KIAS approximately 3 lbs push force was required to prevent the nose from rising and to maintain the airspeed. If this push force was not applied the aircraft tended to remain in the level flight attitude with the airspeed decreasing. The centre of gravity on the test aircraft was approximately half an inch aft of the accident aircraft but this small difference would not account for the noticeable push force required. Although different aircraft might trim differently it is evident that the accident aircraft was unlikely to be in a nose-down trim configuration and releasing the controls in the lead up to the accident would not have been responsible for pitching the aircraft nose-down.

The aircraft elevator position was marked in straight and level flight at 115 KIAS. The control column was then held fixed and the electric elevator trimmer operated, such that the trim tab would behave like a small elevator, in the opposite sense to the trim input indicated in the cockpit. When trimmed fully nose-down the controls required approx 5 lbs push force to hold them fixed but the aircraft remained in level flight. When trimmed nose-up there was a noticeable nose-down attitude change despite a similar force being applied to hold the control column fixed.

With the aircraft trimmed at 115 KIAS in a "downwind" configuration at 2,400 rpm and 27/27 MAP set, the prop pitch controls were advanced briskly to fully fine. No pitch change was evident.

The descending turn prior to the accident would have required a deliberate reduction in power and would have required a pitch trim change. There was no evidence that the elevator trim applied at the time of accident would have contributed to a nose-down pitch change had the control column been inadvertently released.

Analysis

The aircraft commander was properly qualified to carry out the private flight, the purpose of which was to re-familiarise himself with G-BWHF. Having not flown the PA-31 for some years, he was accompanied by another pilot who was not a flight instructor but had recent experience of flying the aircraft. Although both pilots had a multi-crew background, the aircraft was normally flown as a single pilot operation. It is probable that the flight was being conducted as a single pilot operation but with the second pilot available to assist if required rather than fulfilling any instructional function. There were no witnesses to any crew briefing which may have taken place.

The weather had improved during the morning and cloud was thin enough to see through as evidenced by a witness who saw the aircraft take off. Visibility above the cloud was better than below, but even below, the cloud flight was possible under VFR. The circuit was wider than normal but this may have been an effort not to conflict with the Robinson helicopter or to give more time for the commander's first approach.

The aircraft made a descending left turn over the aerodrome and joined the downwind leg of the circuit. At some point the flap was set to about 10°, the landing gear was lowered and the propellers set to fully fine. During this configuration change, the elevator would normally have been re-trimmed nose-up. The witness who saw the aircraft coming towards him could not see the cloud covering Long Mountain but could clearly see the aircraft which, given his location, placed the aircraft above and clear of the cloud.

The flight trial demonstrated that the trimmed state of the aircraft would have required a forward control column input to achieve the nose-down attitude described by the witness. The flight trial established that, if the elevator was jammed, the application of nose-up trim would have resulted in the aircraft pitching nose-down. However, there was no evidence of the elevator having been jammed although it is probable that impact and fire would have destroyed any such evidence.

The investigation did not determine whether the nose-down attitude was the result of a jammed elevator or an attempt to reduce height. Both pilots would have been aware of the proximity of Long Mountain but may have thought they had cleared the high ground. It is unlikely that they would have deliberately entered the cloud but may have misjudged their height above it and inadvertently entered the top of the cloud which was obscuring the trees.

Conclusion

The aircraft struck the tops of the trees located on the upper slope of Long Mountain, while descending for a visual approach to land on Runway 22 at Welshpool Airport. The trees were probably not visible to the pilots because of cloud covering the upper slopes.

ACCIDENT

Aircraft Type and Registration:	Beech 95-B55 (T42A), N7148R
No & Type of Engines:	2 Continental Motors Corp IO-470 SER piston engines
Year of Manufacture:	1977
Date & Time (UTC):	22 October 2011 at 1618 hrs
Location:	Exeter Airport
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Underside of the aircraft and propellers
Commander's Licence:	Private Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	1,600 hours (of which 1,000 were on type) Last 90 days - 5 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

The crew were forced to make a wheels-up landing after the landing gear could not be extended by the normal or backup systems. Subsequent examination revealed the reason for the malfunction to be damage to the left gear operating mechanism, but it was not evident what had caused this damage.

History of the flight

The aircraft was being operated by the owner, accompanied by an instructor, for the purpose of carrying out his UK Multi Engine Piston rating proficiency check. The owner occupied the left seat with the instructor on the right. At the time, the owner's US pilot's licence was current.

Following takeoff from Dunkeswell and having flown a series of exercises, the owner was requested to demonstrate a stall recovery with the landing gear extended. Having reduced airspeed to below 153 kt, he selected landing gear down. Shortly afterwards a strong smell of burning was noted and some smoke was observed in the cockpit. The landing gear circuit breaker tripped and the smoke and smell dissipated.

The owner endeavoured to lower the gear using the manual extension system in accordance with the pilot operating handbook procedure. This requires 50 turns of a crank handle to lower the gear to the fully locked position. After approximately 30 turns, the system jammed. A series of fly-bys of the Dunkeswell operations

building were carried out between attempts to lower the gear. Observations of landing gear positions by ground personnel were radioed to the aircraft following each pass. After the third fly-by it became obvious that the gear could not be extended to the fully down position for landing. It was therefore raised manually in order to limit the landing hazard. A final fly-by was made after which observers reported that the gear was raised but the gear doors were not shut.

Owing to the limited fire cover and restricted runway length at Dunkeswell, the aircraft diverted to Exeter Airport. It was decided that less risk would result from a landing on the main runway than on the grass. In order to reduce fuel load and limit disruption to commercial traffic, the aircraft held off until deteriorating weather and approaching darkness dictated the need to land. A successful wheels-up landing was then executed.

Post-accident examination

The organisation that removed the aircraft from the runway reported that it was lifted and an attempt made to lower the landing gear using the manual handle. Only by turning the handle forcibly whilst another person pulled the left main gear leg towards the fully down position was it possible to make the gear safe to support the aircraft. On subsequent examination, no obvious reason for the failure to extend was evident. The wings were then removed and the aircraft transported to its maintenance base.

A more detailed examination, with the cabin floor panels removed, showed that the inboard section of the operating rod of the left main gear was severely distorted. The rivets securing the two curving channel sections together had failed and one of the two lugs supporting the inboard bearing forming the attachment to the operating bell crank had also failed. The corresponding leg of the bell crank was bent out of its normal plane. The distortion of the rod had allowed the curved channel section to come into contact with the cutout in the spar web in such a way that the system had become jammed and further movement in the extension sense was prevented. Consequently, further rotation of the bell crank in the corresponding direction was also prevented, stopping further extension of the nose and right landing gear legs.

On removal of the damaged operating rod, it was noted that the tubular section was also bent out of alignment. The bend took the form of localised compressive buckling of one side of the tube at approximately mid-length. Microscopic examination of the fracture faces of the failed lug indicated that failure had resulted from a tensile/shear mechanism.

Some of the damage to the channel sections and rivets, the inboard bearing lugs and the drive arm of the bell crank was consistent with buckling created when the forceful attempts to turn the manual lowering handle were resisted by the fouling of the channels against the spar web cut-out. Damage to the tubular section was however, only consistent with end-load applied over the whole length of the rod between its attachment to the leg and the attachment to the bell crank.

Operation of the actuator hand-crank, with the operating rods disconnected, showed that the mechanical gearbox functioned correctly.

Discussion

It was concluded that an obstruction to the free downward movement of the left gear leg had caused an end-loading on the operating rod sufficient to cause the buckling of the tubular section of the rod. Some degree of distortion or damage of the inboard channel

sections of the rod and the bell crank may also have been caused. The total distortion must have been sufficient, ultimately, to cause the channel sections to foul the spar web during the attempts to lower the gear.

It was not evident how this distortion had originated. There were no recent reports of landing gear problems on this aircraft.

SERIOUS INCIDENT

Aircraft Type and Registration:	Socata TB10 Tobago, G-RIAM
No & Type of Engines:	1 Lycoming O-360-A1AD piston engine
Year of Manufacture:	1982
Date & Time (UTC):	27 July 2011 at 1545 hrs
Location:	Coventry Airport
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Smoke and heat damage to windscreen and underneath inspection panel
Commander's Licence:	Private Pilot's Licence
Commander's Age:	21 years
Commander's Flying Experience:	86 hours (of which 15 were on type) Last 90 days - 3 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional AAIB inquiries

Synopsis

The occupants were on a local flight at 2,500 ft when they noticed smoke entering the cabin around the base of the windscreen. The aircraft diverted into Coventry Airport, with the intensity of the smoke increasing and affecting visibility, and made a safe landing. The smoke was caused by an internal failure in the alternator regulator and one Safety Recommendation is made to the EASA, to review this installation.

History of the flight

Whilst cruising at 2,500 ft during a local flight from Leicester, the aircraft occupants noticed smoke entering the cabin from around the base of the windscreen. The pilot handed control of the aircraft to the front seat passenger, who held an Airline Transport Pilot's Licence (ATPL) and who had flown more than 7,000 hours, including 13 on type. A MAYDAY was declared and the new handling pilot decided to divert to Coventry, which the aircraft had just passed. This pilot, having extensive commercial operating experience, carried out the Emergency Checklist items from memory; this document was otherwise not directly referred to during the incident. The actions included turning off the alternator field switch and closing the cabin air vents. The battery master was also turned off but was periodically turned back on to allow radio communication with Coventry Tower. During the descent the smoke increased in intensity and the

pilot who had been initially in command opened the 'storm panel' in the left side window. He also briefed the passengers in the rear of the aircraft on the brace position and the evacuation procedure to be followed after landing. By this time the smoke was affecting visibility and causing everyone on board to choke. On the instructions of the handling pilot, he then opened the left-hand door in an attempt to dissipate the smoke and used the aircraft's dry powder fire extinguisher in an attempt to contain the problem.

The aircraft made a rapid descent and landed, safely, at 90 kt. After coming to a halt on the apron the doors were immediately opened and the engine shut down; the aircraft was then vacated.

The investigation

Examination of the aircraft revealed that there had been an internal failure of the alternator regulator, with the underside of the casing having sustained visible heat damage (Figure 1). The regulator was located behind the engine compartment firewall and in front of the instrument panel. Access was gained by means of a panel in the nose close to the right side of the windscreen. It was apparent that the smoke had originated from a layer of cabin insulation material that was in close proximity to the regulator. This material exhibited extensive charring, with the smoke having left visible residue on the inside of the windscreen.

When the aircraft was examined by its maintenance organisation, it was noted that the 60 amp alternator circuit breaker had tripped and that the battery had boiled. It was not known if the breaker had tripped during the incident or had been pulled by an unknown person after the aircraft had landed. However the aircraft wiring loom had remained unaffected.

An engineer from the maintenance organisation commented that it was possible that this regulator had been installed on the aircraft at build.

An examination of the regulator was limited as the cavity that contained the internal circuitry had been filled with potting resin at manufacture, a process often used on this type of component. Whilst the resin, after setting, is intended to protect the electronic components against moisture and vibration, it effectively renders them subsequently inaccessible. It was thus not possible to identify the failure mode of the regulator, although the depth of charring that had occurred within the resin was indicative of the high temperatures that had been generated.

Similar occurrences

A search of the UK CAA Occurrence Database was conducted, which looked for any similar incidents involving the Socata TB series of aircraft over the last 25 years. Eleven events concerning a variety of electrical problems were listed, with one incident being apparently similar to the subject occurrence. This

Figure 1
View of underside of regulator, showing heat damage

occurred to another TB10 on 15 November 1996 and was not investigated by the AAIB. The report stated:

> *'Burning smell in cockpit accompanied by apparent loss of comms. A/c continued to Shoreham & landed without further incident'*

The report narrative concluded as follows:

> *'Investigation found voltage regulator intermittent & relay unserviceable, resulting in cooked battery & failure of both VHF radios.'*

The other listed incidents mostly consisted of battery or alternator failures, with one case of *'poorly regulated power supply'* causing instrument failures. No other incidents involved smoke or fumes.

The subject incident was similar in many respects to one that occurred to a Cessna 172, G-BHDZ, on 28 October 2006, and which was reported in AAIB Bulletin 7/2007. In that case, a failure of the voltage regulator caused the 60 amp alternator circuit breaker to trip. The pilot reset the breaker after he noticed that the radios had failed. However, this resulted in the melting of the brass and copper terminal fittings of the feed wires close to the circuit breaker casing, and associated melting of the insulation of much of the instrument panel wiring. Smoke and flames immediately issued from behind the instrument panel, with the pilot subsequently having to conduct a forced landing.

Examination of the regulator revealed that the failure had left evidence of heat damage on some of the internal components, although the alloy casing appeared unmarked.

Certification requirements

A significant difference between the Cessna 172 and TB10 is that the regulator on the Cessna is located in the engine compartment, mounted on the engine firewall. Although this is arguably a harsher environment than that of the TB Series regulators, which are on the cabin side of the firewall, it is at least clear of potentially combustible materials in the event that an internal failure results in the generation of intense heat.

The current European Aviation Safety Agency (EASA) certification standards for this type of equipment are covered by Certification Specification (CS) CS23, which is similar to the Federal Aviation Requirements (FAR) Part 23. The Type Certificate Data Sheet indicated that the TB10 was certificated in November 1975, with the applicable requirements being FAR (Federal Airworthiness Requirements) Part 23, Amendments 1 to 16 dated 14 February 1975.

The current FAA Code of Federal Regulations (CFR), Subpart F – Equipment, Systems and Installations, Section 23.1309 includes the following requirements:

> *'(2) When systems and associated components are considered separately and in relation to other systems;*
>
> *(i) The occurrence of any failure condition that would prevent the continued safe flight and landing of the airplane must be extremely improbable; and*
>
> *(ii) The occurrence of any other failure condition that would significantly reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions must be improbable.'*

This was last amended in 1996.

However, the version that was in force at the time of type certification was effective from December 1973 and stated:

> *'(a) Each item of equipment, when performing its intended function, may not adversely, affect: (1) The response, operation, or accuracy of any equipment essential to safe operation; or (2) The response, operation, or accuracy of any other equipment unless there is a means to inform the pilot of the effect.*
>
> *(b) The equipment, systems, and installations of a multiengine airplane must be designed to prevent hazards to the airplane in the event of a probable malfunction or failure. (c) The equipment, systems, and installations of a single-engine airplane must be designed to minimize hazards to the airplane in the event of a probable malfunction or failure.'*

The nature of the occurrence to G-RIAM suggests that the regulator installation would not meet the current requirements.

Checklist information

The relevant section of the TB10 Emergency Checklist is as follows:

ELECTRICAL FIRE IN FLIGHT

If Fire is in Engine Compartment

Master Switch..... Off

Cabin Air ..... Fire Shut Off

LAND AS SOON AS POSSIBLE

If Fire Is In Cabin

Master Switch..... Off

Alternator Switch. ..... Off

All Electrical Switches (Except Magnetos) ..... Off

Cabin Air ..... Fire Cut Off

Fire Extinguisher. ..... Use

The pilots' accounts suggest that they were confident that all these actions were completed and that they checked the circuit breakers, finding that none had tripped.

Discussion

This event occurred following the failure of the alternator regulator, which generated sufficient heat to cause charring in an adjacent layer of cabin insulation. The resulting smoke presented a genuine emergency for the inexperienced pilot, who was fortunately able to hand control of the aircraft to his front seat passenger, an experienced professional pilot. The latter's experience may have contributed to his decisive handling of the emergency, which included expediting the landing at Coventry after the smoke increased in intensity. But for his intervention, the outcome may have been more serious. In order to limit the extent of any fire, it is important to perform the items listed in the Emergency Checklist. Although this document was not referred to during the incident, it was apparent that many of the items were actioned.

Comparison with the Cessna 172 incident suggests that location of the regulator, aft of the firewall, was a significant factor in the G-RIAM event. The regulator in the Cessna failed in a way that similarly generated heat (although this is not necessarily an inevitable consequence of a regulator failure) but its location in the engine compartment did not directly lead to the in-flight fire; that was due to the injudicious resetting of the alternator circuit breaker.

Safety Recommendation

Certification requirements are continually evolving; thus the aircraft to which they apply are likely to become increasingly distant from the current standard as long as they remain in service. Generally, it is not a practical proposition to modify such aircraft to later requirements due to the associated cost and perhaps only marginal safety improvements to be gained. In this case however, the regulator failure resulted in a serious threat to the safety of the flight. The following Safety Recommendation is therefore made to the European Aviation Safety Agency:

Safety Recommendation 2012-022

It is recommended that the European Aviation Safety Agency review the alternator regulator installation of the SOCATA TB series of single-engine aircraft, with a view to reducing the risk to the operation of the aircraft as a result of smoke/fire arising from a failure of this component.

AAIB correspondence reports

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

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

The accuracy of the information provided cannot be assured.

ACCIDENT

Aircraft Type and Registration:	Cessna 421C Golden Eagle, G-HIJK
No & Type of Engines:	2 Continental Motors Corp GTSIO-520-L piston engines
Year of Manufacture:	1977
Date & Time (UTC):	16 May 2012 at 1535 hrs
Location:	Bournemouth Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Propellers, nose landing gear, nose bay doors and radome damaged, engines shock-loaded
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	42 years
Commander's Flying Experience:	3,458 hours (of which 50 were on type) Last 90 days - 50 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst landing at Bournemouth Airport, the pilot heard a whining sound followed by severe vibration and a swing to the left. He was unable to prevent the aircraft from leaving the paved surface, in the course of which the nose landing gear collapsed. The nosewheel tyre was found to have deflated.

History of the flight

The aircraft had made a standard visual approach to Runway 26 at Bournemouth Airport followed by a normal touchdown close to the runway aiming markers and on the runway centreline. As the nosewheel was lowered, the pilot heard a "whining, rubbing noise" from the nosewheel region and felt a slight nosewheel vibration or shimmy. He continued to decelerate to about 50 kt on the centreline at idle power and without using the brakes, having used about 500 metres of the runway. At this point the vibration increased markedly and the aircraft veered sharply to the left through about 45º. Despite application of full right rudder and toe brake, the pilot realised that the aircraft was going to leave the paved surface so he applied maximum braking to slow it as much as possible. The aircraft ran onto the grass at an estimated speed of about 10 to 15 kt, collapsing the nose landing gear (NLG) as it did so, before stopping a few metres from the runway edge.

After shutting down the aircraft, all the occupants

evacuated through the overwing emergency exit without any injury. The aircraft was resting on its main landing gear and the nose fuselage and the propeller tips had struck the ground. It was recovered to a hangar for examination where it was found that the NLG leg had folded into the retracted position due to overload failure of the downlock mechanism. The nosewheel tyre had completely deflated due to what appeared to be massive wear of the sidewall on the right side (see Figure 1). The inner tube had been liberated from the inside and was wrapped around the axle.

Examination and discussion

G-HIJK was fitted with a sheet metal mudguard attached to the nosewheel fork at the top and at the bottom used a shaped tubular brace which attached to the forks either side of the axle. The mudguard had remained attached at the top but had been buckled with the braces at the bottom broken. On the right side, the broken bracing tube had rotated through almost 180° and become jammed between the fork and the tyre (Figure 1). This was consistent with the pilot's recollection of a "whining noise" followed by severe vibration and shimmy as the tyre deflated.

There was no immediately apparent reason for the failure of the bracing tube. Circumstantially, it is most likely that it was damaged either during taxiing or ground handling, since the attachments were intact.

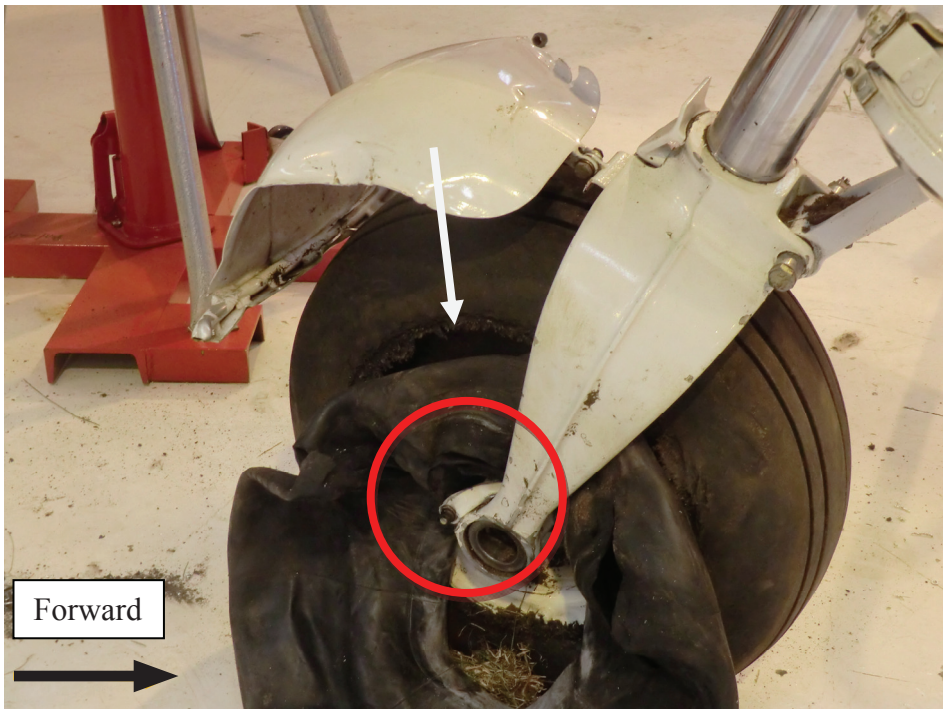


Figure 1

View of deflated nosewheel tyre showing worn tyre sidewall (arrowed) and broken mudguard bracing tube jammed between nosewheel fork and tyre (circled).

ACCIDENT

Aircraft Type and Registration:	Cessna 172S Skyhawk, G-SHSP
No & Type of Engines:	1 Lycoming IO-360-L2A piston engine
Year of Manufacture:	1999 (Serial no: 172S8079)
Date & Time (UTC):	13 April 2012 at 0850 hrs
Location:	Sleap Aerodrome, Shropshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller, engine, engine firewall and nose landing gear
Commander's Licence:	Student pilot
Commander's Age:	40 years
Commander's Flying Experience:	20 hours (of which 2 were on type) Last 90 days - 5 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The student pilot completed a 55-minute dual flight, practising visual circuits, before embarking on a solo flight to continue his circuit practise. The weather was fine, with good visibility and calm conditions. The first solo circuit proceeded normally until just before touchdown, when the pilot slightly over-flared the aircraft. To stop the aircraft climbing again, he moved the control column forward before re-applying rearwards pressure. The aircraft landed on its main wheels but then rocked forward onto its nosewheel. This rocking motion continued for about three cycles before the aircraft settled normally on its landing gear. The pilot taxied the aircraft from the runway but it was later found to have sustained damage to its propeller, engine and nose landing gear.

ACCIDENT

Aircraft Type and Registration:	EAA Biplane, G-BBMH
No & Type of Engines:	1 Lycoming O-320-E3D piston engine
Year of Manufacture:	1982
Date & Time (UTC):	15 April 2012 at 1100 hrs
Location:	RAF Benson, Oxfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller, spinner and engine possibly shock-loaded
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	970 hours (of which 67 were on type) Last 90 days - 9 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was at the holding point for Runway 01 at RAF Benson while the pilot carried out a pre-takeoff power check. The surface wind was reported as steady from 010° at 14 kt and the aircraft was stationary on a westerly heading. During a carburettor heat check at 1,500 rpm, the pilot became aware through his peripheral vision that the aircraft's attitude was changing. He looked up to see that the tail was starting to rise, despite application of full aft control column. He closed the throttle, released the wheel brakes and switched the engine off, but was unable to stop the propeller striking the ground.

The aircraft remained tipped forward, resting on its main wheels and nose. The pilot made the aircraft switches safe and vacated. The airfield fire service attended and assisted the pilot to right the aircraft. The pilot thought that a wind shift, combined with a forward centre of gravity (but which was within prescribed limits) may have contributed to the accident.

SERIOUS INCIDENT

Aircraft Type and Registration:	Europa, G-BYJI
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	1996
Date & Time (UTC):	28 April 2012 at 1000 hrs
Location:	Between York and Selby
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Pilot's door, its window and mounting
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	270 hours (of which 10 were on type) Last 90 days - 8 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was on a local flight from Pocklington Airfield and cruising at 1,800 ft. As the pilot accelerated the aircraft to 120 kt, his door opened causing damage to the door and its mounting. The door remained attached to the aircraft but its window detached. After assessing the aircraft's handling the pilot made an emergency call to Pocklington Airfield to request an immediate return to land. The aircraft landed without further incident.

Additional information

The pilot's door is of a gull wing arrangement and it is hinged in two places along its top edge, (Figure 1). A gas strut is fitted to the aft side of the door to support it in the open position. The door is held closed by two tapered shoot bolts which extend out longitudinally, from the lower corners of the front and rear sides of the door, into guides in the door frame. It is possible to have the door locking lever in the closed position with only the front shoot bolt engaged in its guide.

The pilot candidly reported that it is most likely that the rear shoot bolt was not engaged on this occasion and as the airspeed increased, the increasing aerodynamic forces caused the partially closed door to open. The LAA intend to remind their members of the importance of checking all doors and hatches are closed before every takeoff.

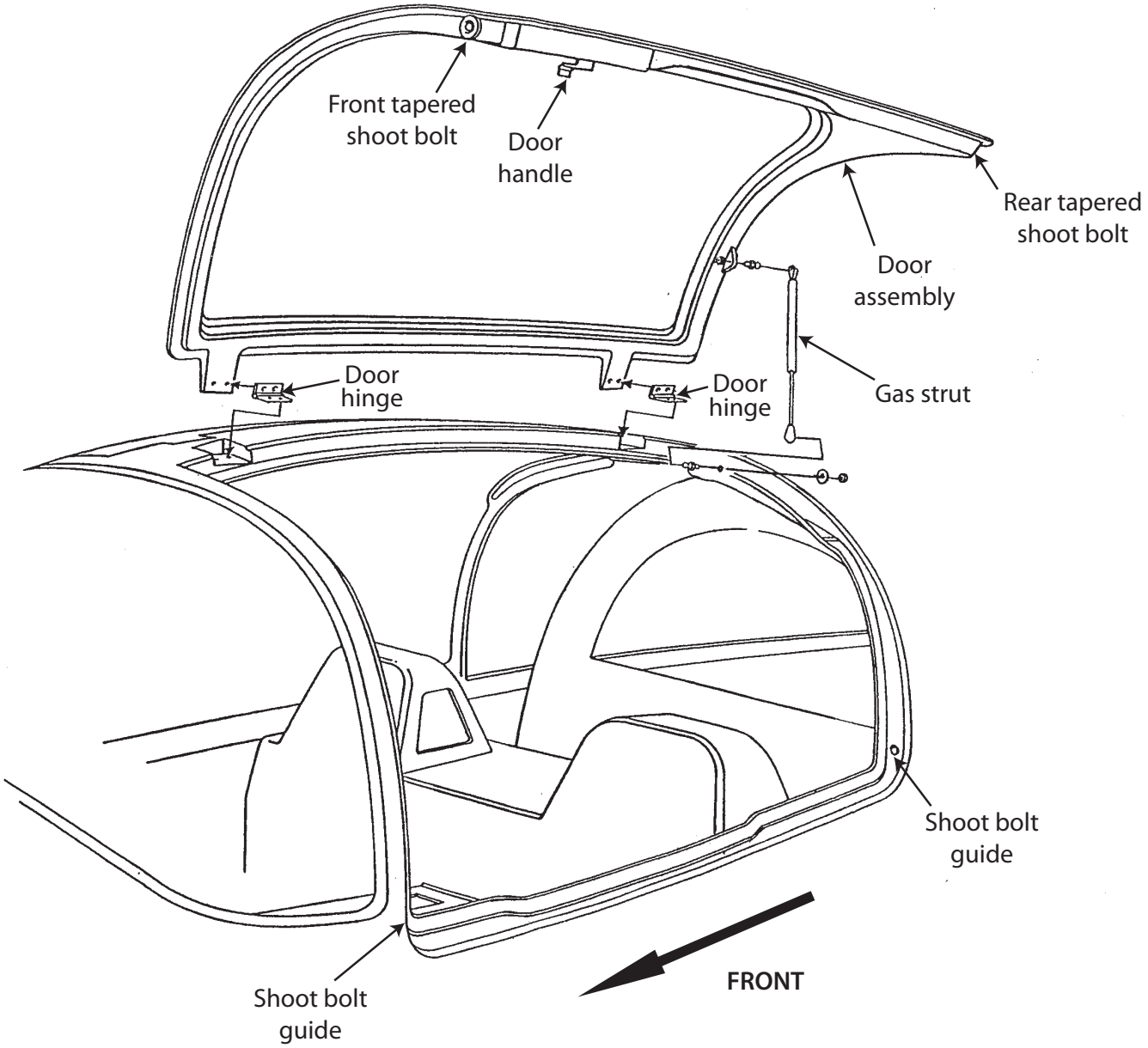


Figure 1

General arrangement of door
(courtesy Europa Aircraft (2004) Ltd)

ACCIDENT

Aircraft Type and Registration:	Europa XS, G-WIKI
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2011
Date & Time (UTC):	6 May 2012 at 1427 hrs
Location:	Sleap Airfield, Shropshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, forward fuselage and main landing gear
Commander's Licence:	Private Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	678 hours (of which 76 were on type) Last 90 days - 11 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft rejoined the circuit at Sleap Airfield after a local flight. It was a fine day, with calm air and good visibility, and Runway 18 was in use. The pilot was forced to carry out a go-around from his first approach as the runway was occupied by another aircraft. The same situation occurred on his second approach. On the third approach, and after the pilot had made his 'downwind' call on the Air/Ground frequency, another aircraft called on the frequency to request a straight-in-approach. The pilot was unable to see the other aircraft and continued normally to finals, making the standard circuit calls.

The aircraft landed but was too fast and it bounced. There were a number of other bounces, until the propeller struck the ground, causing the engine to stop. The aircraft came to a stop on the runway and both occupants, who were wearing full harnesses and were uninjured, vacated the aircraft through the normal access doors.

The pilot gave the cause of the accident as the excess speed on landing, and considered that the distraction posed by the other aircraft was a contributory factor.

ACCIDENT

Aircraft Type and Registration:	Gulfstream American GA-7 Cougar, G-OOGA
No & Type of Engines:	2 Lycoming O-320-D1D piston engines
Year of Manufacture:	1979
Date & Time (UTC):	6 January 2012 at 1215 hrs
Location:	Andrewsfield Airfield, Great Dunmow, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose cone, nose leg, propellors and wingtip
Commander's Licence:	Basic Commercial Pilot's Licence
Commander's Age:	74 years
Commander's Flying Experience:	9,953 hours (of which 1,630 were on type) Last 90 days - 36 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

Synopsis

During takeoff the aircraft became airborne at too low an airspeed, resulting in a loss of control. The pilot reduced engine power and the aircraft descended and impacted the ground. Both occupants were uninjured.

History of the flight

A witness at the airfield reported that the pilot encountered a number of delays and experienced problems starting the engines. The pilot stated that when he arrived at the aircraft he discovered that it had not been flown since 19 October 2011 and the battery was completely discharged. Personnel from the operating company assisted in starting the engines and the aircraft was then taxied to the refuelling bay. Once refuelled, the personnel again assisted with engine starting.

The pilot reported that on reaching the runway threshold he held the aircraft on the brakes, advanced the throttles to give 2,000 rpm on both engines, and confirmed the temperatures and pressures were correct. An instructor in an aircraft planning to take off behind G-OOGA confirmed that it appeared to have been held against the brakes for 20 to 30 seconds before the takeoff run began.

The pilot then applied full power and confirmed that both engines were turning at 2,700 rpm with correct

temperatures and pressures. As the aircraft gained speed the pilot noted that the ASI was live. As it approached 70 kt the aircraft started slithering to the left and the pilot applied right rudder to maintain runway heading. When approaching 75 kt the main wheels hit a hidden ridge and the aircraft became airborne without elevator input. The stall warner sounded intermittently and the aircraft yawed to the left despite the pilot using full right rudder. At about 15 to 20 ft agl the pilot, unable to control the yaw, decided to lower the nose and throttled back fully. The aircraft then struck the ground, pivoted to the right and the nose pitched down. The pilot closed down both engines and switched off the fuel before he and his passenger vacated through the exit door. The aircraft came to a halt well to the south of the runway, but facing north.

Eyewitnesses noted that the aircraft became airborne after what they considered was an unusually short ground run and subsequently was seen to be in a steep nose-up attitude. It was seen to roll to the left and views differed as to whether the wings then became level, but it was seen thereafter to sink and strike the ground in a tail-down attitude. Two individuals, one a flying instructor, observed the behaviour of the aircraft after it left the ground and were sufficiently concerned that they both began running, from different locations, towards the airfield crash alarm whilst the aircraft was still airborne.

A subsequent examination of the aircraft by the operator revealed no evidence of any technical problem with the rudder controls. A weight and balance calculation apparently made by the pilot assumed the aircraft was filled to “top tabs”. This indicated that the aircraft was being operated at maximum all-up weight. As some doubt existed as to the fuel state at takeoff, the actual takeoff weight could not be accurately determined.

ACCIDENT

Aircraft Type and Registration:	1) Piper PA-28-180 Cherokee, G-ZZIJ 2) DH82A Tiger Moth, G-AMTF
No & Type of Engines:	1) 1 Lycoming O-360-A4A piston engine 2) 1 De Havilland Gipsy Major 1C piston engine
Year of Manufacture:	1) 1966 (Serial no: 28-3639) 2) 1941 (Serial no: 84207)
Date & Time (UTC):	1 April 2012 at 1330 hrs
Location:	Lashenden (Headcorn) Aerodrome, Kent
Type of Flight:	1) Private 2) Private
Persons on Board:	1) Crew - 1 Passengers - 2 2) Crew - 1 Passengers - None
Injuries:	1) Crew - 1 (Minor) Passengers - None 2) Crew - None Passengers - N/A
Nature of Damage:	1) Damage to windscreen, side screen; left & right cowlings, propeller and 'A' pillar 2) Damage to propeller, right wing spar and ribs
Commander's Licence:	1) Private Pilot's Licence 2) Private Pilot's Licence
Commander's Age:	1) 48 years 2) 55 years
Commander's Flying Experience:	1) 201 hours (of which 101 were on type) Last 90 days - 15 hours Last 28 days - 5 hours 2) 395 hours (of which 245 were on type) Last 90 days - 6 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Forms submitted by the pilots

Synopsis

The Tiger Moth was taxiing after landing when it collided with the parked Cherokee, which was being readied for flight.

Description of the event

The Cherokee pilot reported that his aircraft was adjacent to the main aircraft parking area, stationary with the engine not running. He was looking inside the cockpit, carrying out normal pre-flight checks, when his front seat passenger exclaimed "LOOK OUT!" The pilot looked up to see the left wing of the taxiing

Tiger Moth strike the Cherokee's right engine cowling. This caused the Tiger Moth to swing to the left, until its propeller struck the pilot's windscreen and side 'A' pillar.

The Tiger Moth pilot reported that he had just vacated Runway 11 after landing and was taxiing back along the south side of the runway towards the refuelling area when his aircraft collided with the Cherokee. The pilot considered that he had not been weaving sufficiently to see the Cherokee ahead, which he observed was parked some distance from the normal parking area. He also thought that people walking near other parked aircraft, to his right, may have distracted him and caused him to turn too little to the right while weaving to be able to get an adequate view to the left. The Tiger Moth's propeller was damaged in the collision and the Cherokee's stationary propeller damaged the Tiger Moth's left lower wing, damaging the leading edge, some ribs and the main spar.

The airfield fire and rescue service attended the scene promptly. All occupants vacated their aircraft without difficulty and only the Cherokee pilot reported receiving an injury, which he described as minor.

ACCIDENT

Aircraft Type and Registration:	Rans S6-116 Coyote II, G-BWWP
No & Type of Engines:	1 Rotax 912 piston engine
Year of Manufacture:	1997
Date & Time (UTC):	15 April 2012 at 1500 hrs
Location:	Old Park Farm, near Port Talbot
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to gear legs, airframe, propeller and engine
Commander's Licence:	Private Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	577 hours (of which 13 were on type) Last 90 days - 4 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot started the engine and allowed it to warm up before taxiing to the end of the runway. He then completed the pre-takeoff checks, before taking off normally. As the aircraft climbed away the engine started to run roughly and vibrate, and the engine speed dropped. The pilot lowered the nose to maintain airspeed. He flared as the aircraft neared the ground but the left wing dropped and the aircraft struck a hedge. The pilot and passenger exited without injury.

The cause of the engine problem was not established, although carburettor icing was considered a possible cause by the pilot.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna FA152 Aerobat, G-MPBH
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1981
Date & Time (UTC):	28 April 2012 at 0921 hrs
Location:	11 nm south-west of RAF Kinloss
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Substantial damage to propeller, nose leg and left wing
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	97 hours (of which 51 were on type) Last 90 days - 6 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot carried out a bird avoidance manoeuvre, during which he closed the throttle. When the throttle was opened again the engine did not respond. Restart attempts were not successful and the pilot carried out a forced landing. Although the aircraft sustained damage, neither aircraft occupant was injured.

History of the flight

The pilot arrived at his RAF Kinloss-based flying club at about 0800 hrs and completed a daily inspection of the aircraft. An inspection of fuel samples revealed no abnormalities. The aircraft took off at 0835 hrs with the pilot and a passenger on board for a local flight. The pilot flew along the coast for a short while before turning inland and setting course for Aviemore, about 30 nm to the south-west. He contacted Inverness ATC to advise them of his intentions.

As the aircraft flew towards higher terrain, the pilot became concerned about cloud on the intended track, so decided to return to RAF Kinloss. Soon after turning back, he suddenly became aware of two birds in front of the aircraft. He pulled back sharply on the control wheel to avoid them, but then realised the aircraft was getting close to the cloud base. He reduced power and lowered the nose again to descend into clearer air.

When the pilot attempted to reapply power to level the aircraft, there was no engine response to throttle movement. A restart attempt was made without

success. He made a brief MAYDAY call to Inverness ATC and selected a field for an emergency landing, but it became apparent too late that the field had a steep downhill slope, with a steeper drop at its end. The pilot was unable to bring the aircraft to a stop before over-running the field and descending down the steep drop.

The aircraft sustained damage to the nose leg, propeller and engine area forward of the firewall. The left wing also sustained damage and there was a fuel leak. However, there was only minor damage to the cabin area and both occupants, who were wearing full harnesses and were uninjured, vacated the aircraft through the main doors.

Meteorological information

The pilot supplied a briefing sheet for RAF Kinloss, issued by the Met Office at RAF Lossiemouth on the morning of the accident. This showed a general cloud base of about 2,000 ft early in the day, rising to about 3,000 ft by mid-afternoon, with moderate icing in cumuliform clouds. The surface temperature at RAF Kinloss (which is on the coast) at the time of the accident was 7°C, the dew point was 0°C and the 0°C level was forecast to climb from about 1,200 ft to about 2,000 ft during the course of the morning.

Comment

The pilot's report did not include an assessment of the cause of the accident. Given the temperatures of the day and the evidently moist conditions, carburettor icing would have been a serious risk. If the aircraft had been so affected, there was a risk of the engine stopping after the throttle was retarded to idle, as the pilot reported doing in response to the inadvertent climb which had taken him close to the cloud base.

ACCIDENT

Aircraft Type and Registration:	SA341G Gazelle 1, G-WDEV
No & Type of Engines:	1 Turbomeca Astazou IIIA turboshaft engine
Year of Manufacture:	1973
Date & Time (UTC):	10 January 2012 at 0939 hrs
Location:	Salisbury, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - 1 (Minor) Passengers - 2 (Minor)
Nature of Damage:	Extensive
Commander's Licence:	Private Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	5,400 hours (of which 47 were on type) Last 90 days - 40 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, photographs of the accident site, eyewitness information and recorded GPS position data

Synopsis

The pilot reported a power loss and uncontrolled descent into trees while manoeuvring at slow speed and low height over a remote landing site.

History of the flight

The helicopter was prepared for a flight from a private site near Bath to a landing site adjacent to an industrial estate on the outskirts of Salisbury. A normal daily inspection was completed with no faults noted.

The two passengers arrived in good time and were given a safety briefing by the pilot. Pre-flight checks were normal and the helicopter took off at 0910 hrs. Fuel load on departure was 220 kg, and takeoff weight had been calculated as 1706 kg, nearly 100 kg below the maximum allowed.

The short flight to Salisbury was uneventful. The weather was suitable with a light westerly wind. The intended landing site was a clearing in a wooded area between an industrial site and a river. The pilot had not previously landed there but had previously seen the landing area from the air.

The pilot reported approaching the site from the west, before turning to conduct an overflight in a westerly direction at about 500 ft agl. He then flew an orbit to approach the site for landing. He reported flying a steep

approach into the site and establishing in a stable hover in ground effect. As he lowered the collective lever and the helicopter started to settle, it reached what the pilot considered to be an unacceptably tail-low attitude. He therefore lifted into the hover again with the intention of re-positioning.

The pilot manoeuvred the helicopter upwards and rearwards, whilst keeping the landing area in sight. After initially lifting to about 30 ft with the tail clear of obstruction, he was unable to determine a more favourable landing area so continued the climb. At about 60 to 70 ft the pilot noticed the tone of the main rotor RPM (RRPM) change, suggesting a reduction in RPM. He did not check the RRPM indication, but instinctively reduced collective input, believing the decline in RRPM would be transient. However, RRPM did not appear to recover and the helicopter started to sink.

At this point, the helicopter was to the side of the intended landing site and over tree tops. As it started to descend, the pilot pulled the collective lever up positively. He then heard pronounced popping and cracking noises and sensed a further reduction in RRPM (his perception was based on sound alone). He did not recall any appreciable yawing motion.

With RRPM dropping significantly and the flight controls appearing to lose effectiveness, the pilot steered the descending helicopter towards an area where the tree tops were lowest, whilst attempting to keep its nose from dropping. The helicopter came down through the trees; the pilot thought it struck the ground in an upright attitude but then rolled over onto its left side.

The engine was still running immediately after the accident. The pilot switched off the engine and electrical master switches and the fuel booster pump, but was unable to identify the engine throttle or manual fuel cut-off lever in the damaged roof panel. At this time the front seat passenger appeared unconscious but the rear seat passenger responded to the pilot's call. The pilot exited the aircraft through the broken front windscreen area and saw that flames were coming from behind the engine cowlings. With some difficulty, he was able to locate the throttle control and retard it to idle. This action reduced engine speed and noise but the flames persisted.

The pilot then retrieved the BCF fire extinguisher from the cabin and discharged it fully into the engine air intake, upon which the engine stopped and the flames died down. He helped the rear seat passenger from the helicopter and then the front seat passenger, who had regained consciousness. Onlookers from the industrial site soon arrived, including one with a large CO_2 extinguisher which was discharged into the engine area.

The emergency services had been alerted by eyewitnesses. The pilot and one passenger were subsequently taken to Southampton Hospital by air ambulance whilst the remaining passenger travelled the short distance to Salisbury Hospital by road ambulance.

Recorded information

Data from the aircraft's GPS navigation system was downloaded for analysis. The unit was set to record data every thirty seconds including position, GPS altitude, date and time, track and groundspeed[1]. This data showed that the helicopter flew past the landing site to the south at low level before turning left to approach the area from an easterly direction.

Footnote

[1] On this model of gps the recorded values of groundspeed include not only speed over the ground but also any vertical speed component.

As it turned left it was about 400 m east of the landing site, at a height (based on GPS altitude) of about 350 ft agl. The instantaneous track at this point was 353°(M) at 35 kt groundspeed, suggesting that the helicopter was turning left towards the landing site as reported by the pilot. The next recorded position was about 100 m south-east of the landing site, at a height of about 280 ft. The aircraft was tracking 245°(M) at 16 kt groundspeed.

The distance between these two points is 361 m, consistent with an approximately direct track between the two points at an average groundspeed of about 24 kt, midway between the two recorded values. One further data point was recorded. This occurred 38 seconds after the previous point and, as the normal recording interval was 30 seconds, indicates that a loss of satellite signal had occurred. The position of this point was very close to the crash site, with an instantaneous track of 141°(M) and at a height of about 220 ft. The reason for the loss of satellite signal between the last two recorded points could not be determined.

Witness information

A number of eyewitnesses at the industrial site had seen the helicopter and realised it was in difficulty. One reported that her attention was drawn to it by the fact that it was unusually low (although she was unaware that it intended landing in the area). She saw it initially moving in an easterly direction just above the trees and had the impression it was already in trouble. The tail appeared to clip the trees and the helicopter started to rotate before the nose dropped and it descended from view.

Accident site information

The intended landing site was a small clearing in a strip of wood and scrubland lying between the industrial site and a river, approximately 450 m by 100 m. The orientation of the wooded strip was approximately east-west. The helicopter came to rest among trees, about 45 m to the south-east of what is believed to have been the intended landing site.

Photographs of the wreckage and general area, taken before the wreckage was recovered, showed that the helicopter had descended through the trees with little forward motion. A noted anomaly was a tear in the aircraft skin at the forward base of the upper vertical fin, forward of the enclosed tail rotor. Trapped in the folded skin material were leaves from a fir tree, which was not a type found in the immediate vicinity of the crash site. Further photographs of what is believed to have been the intended landing area showed a substantial fir tree of a matching type, with what appeared to be damage to branches at less than half its height. With no height reference, an accurate height of the damage above ground could not be determined, but was estimated to be in the order of 15 to 20 ft.

The tear pattern of the skin material on the fin suggested a significant sideways motion (most likely a helicopter nose left / tail right yawing motion) at the time of contact. With the limited evidence available, it was not possible to be more specific about how the damage occurred or what part it may have played in the accident sequence.

ACCIDENT

Aircraft Type and Registration:	Vans RV-8, G-HILZ
No & Type of Engines:	1 Superior XP-IO-360-B1AA2 piston engine
Year of Manufacture:	2007
Date & Time (UTC):	21 April 2012 at 1600 hrs
Location:	Private airstrip near Stevenage, Hertfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to left landing gear, fuselage, left wingtip and left tailplane. Minor damage to hangar
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	12,713 hours (of which more than 750 were on type) Last 90 days - 112 hours Last 28 days - 53 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot encountered unexpectedly poor braking effect after landing on the grass airstrip. He was unable to prevent the aircraft over-running the strip and colliding with a small hangar at its end. The pilot was uninjured.

Description of the event

The pilot was landing the aircraft at a private airstrip (orientated 05/23) following a flight from Duxford Airfield when the accident occurred. The weather was generally favourable with calm conditions, but a recent shower had left the grass runway wet. The pilot made a normal approach in a south-westerly direction, achieving the target approach speed and touching down at the intended point along the approximately 525 m (1,720 ft) strip. The pilot applied the wheel brakes but, although feedback from the pedals appeared normal, almost no retardation was felt.

The pilot tried to improve braking through aerodynamic means and varying brake application, but with little effect. As a runway overrun became likely, the pilot attempted to steer the aircraft away from the small hangar building at the end of the strip. This was only partially successful in that, while the aircraft's heading altered about 80° to the right, its ground track changed only slightly. The aircraft encountered the concrete apron and grass reinforcement area before its left wing struck the side of the hangar. The aircraft came to a stop

on the small apron and the pilot, who was uninjured, made the aircraft safe and vacated it.

The pilot had flown from the strip for a number of years in varying conditions and had not known this or similar aircraft to encounter problems with the available landing distance. The aircraft's listed performance figures predicted a landing roll of between 300 and 500 ft, which the pilot felt was realistic in favourable conditions. He observed that, taking into account conservative allowances for the wet grass, slight down slope of the field, conditions of the day, and applying the recommended safety factor of 1.43[1], the aircraft's predicated landing roll would be 1,030 ft. In fact, the actual landing roll until contact with the building was about 1,350 ft.

The pilot further observed that the recent rain had fallen after an extended dry period, and thought that this, together with the particular characteristics of the local clay sub-soil, could have played a part in the unusually poor braking effect. The pilot intended highlighting his experience in the conditions to other users of the strip in future.

Footnote

[1] See CAA Safety Sense Leaflet 7 *'Aeroplane Performance'*.

ACCIDENT

Aircraft Type and Registration:	Cameron Z-350 balloon, G-CCSA
No & Type of Engines:	None
Year of Manufacture:	2004
Date & Time (UTC):	6 April 2012 at 08:35 hrs
Location:	8 nm south of Bath
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 1 Passengers - 15
Injuries:	Crew - None Passengers - 1 (Minor)
Nature of Damage:	Two panels of balloon's envelope ripped
Commander's Licence:	Commercial Pilot's Licence (Balloons)
Commander's Age:	56 years
Commander's Flying Experience:	1,728 hours (of which all were on type) Last 90 days - 11 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The balloon was launched from a site at Bath, with the pilot and 15 passengers on board. After about a one hour flight, the pilot descended the balloon towards a field for landing. The weather conditions were cold but fine, with a surface wind from 030°(M) at 4 kt, although the pilot thought that the conditions were becoming thermic, creating some slight gusts. On final approach, the wind changed direction just before touchdown and the balloon made contact with a tree, causing two fabric panels to be ripped. One of the passengers complained of some back pain after landing and was taken to hospital as a precaution but reportedly later discharged with only some bruising. No other injuries were reported.

ACCIDENT

Aircraft Type and Registration:	Gemini Flash IIA, G-MVPI
No & Type of Engines:	1 Rotax 503 piston engine
Year of Manufacture:	1989
Date & Time (UTC):	24 May 2012 at 1408 hrs
Location:	Perth Airport
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Wing damaged and trike scuffed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	2,650 hours (of which 2,335 were on type) Last 90 days - 50 hours Last 28 days - 15 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

History of the flight

The student, who had recently purchased the aircraft, was undergoing training in Gemini Flash operation with an experienced instructor. After a "well flown circuit and good landing" on Runway 09, the student, who was handling the aircraft, lost control of ground steering during the ground roll and the aircraft veered to the right and started to tip over. The instructor was unable to intervene because G-MVPI did not have dual control of the nosewheel steering and the aircraft rolled onto its side at about 10 mph.

The instructor instinctively extended an arm outside the open cockpit as the aircraft rolled over and suffered a broken arm and wrist. The student was uninjured. The instructor was of the opinion that the student, who was used to later models of trikes fitted with 'self centring' steering, may have been unfamiliar with the steering characteristics of G-MVPI, which was an early model without this feature. He also believed that dual steering controls might have prevented the accident.

ACCIDENT

Aircraft Type and Registration:	Mainair Blade, G-CBXV
No & Type of Engines:	1 Rotax 582-2V piston engine
Year of Manufacture:	2002
Date & Time (UTC):	9 May 2012 at 1130 hrs
Location:	Northrepps Airfield, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to trike, wing, keel tube, steering assembly and king post
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	65 hours (of which 18 were on type) Last 90 days - 4 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

The owner pilot arrived at the airfield and assembled his aircraft, intending to fly in the local circuit. He carried out a pre-flight inspection in accordance with the Mainair manual before starting the engine and taxiing to the apron, where he performed the pre-takeoff checks. He took off on Runway 15 into a light south-easterly wind and the aircraft climbed and performed normally.

The pilot "cut the power" to descend through base leg and finals at 50 mph. However, it did not appear to him that the aircraft was descending sufficiently rapidly so he went around. The second approach was also abandoned because the pilot felt he was too high and, on the third, he reduced power earlier and approached much lower such that he judged he would need to apply power to avoid undershooting. As he did so the main wheels struck a grass bank prior to the runway threshold, and the aircraft impacted a ploughed field to the northeast of the runway. The aircraft was severely damaged but the pilot was uninjured. He assessed the cause of the accident as misjudgement on approach to the runway.

ACCIDENT

Aircraft Type and Registration:	Scheibe SF25C Falke, G-BPZU
No & Type of Engines:	1 Limbach L 2000-EA1 piston engine
Year of Manufacture:	1989
Date & Time (UTC):	29 May 2012 at 1730 hrs
Location:	Field near Droke Lane, East Dean, Chichester
Type of Flight:	Private (Training)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Extensive, aircraft beyond economic repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	2,900 hours (of which 145 were on type) Last 90 days - 10 hours Last 28 days - 4 hours
Information Source:	AAIB investigation

Synopsis

During field landing practice, the aircraft approached a field with considerable upslope. At approximately 50 ft agl the instructor took control and executed a go-around, but the aircraft struck trees at the far end of the field.

History of the flight

The aircraft was being flown by two members of a gliding club. The instructor was an experienced glider and motor-glider instructor; the student was an experienced glider pilot and instructor. They had spent two days running a gliding course together at the club, and when the course finished set off on the flight to carry out the student's annual field landing training exercises.

The instructor reported clear skies, good visibility, and a south-westerly sea breeze at approximately 10 kt. The temperature was around 22°C. He had flown the aircraft during the day and reported it was performing normally. He had also carried out a briefing on field landings, which the student attended. The aircraft was loaded with an appropriate quantity of fuel to ensure it was operated below the relevant limiting weights.

Following an uneventful departure, the instructor flew the aircraft into an area near Droke Lane, Chichester, at approximately 2,000 ft amsl. He then reduced power to simulate a glider entering sink, and handed control to the student. Around this time, the student commented on the paucity of suitable fields in the area, but the

instructor pointed some out and the exercise continued. The student flew a circuit leading to an approach to a field with a firm smooth surface containing crop approximately 10-20 cm high. The field had a pronounced upslope in the direction of landing, which was towards the north-west. There were trees at the far end up to 15 m tall.

At approximately 50 ft agl, and with the aircraft satisfactorily positioned for a landing in the first part of the field, the instructor took control and applied power to go around. He pitched the nose up to maintain a speed of 50-55 kt, controlling the pitch attitude carefully to achieve this speed so as to avoid being led astray by illusory effects of the local horizon. However, he observed that the aircraft's climb performance was approximately equal to the upslope of the field.

The student suggested a turn to the left towards lower ground, but the instructor was concerned that a turn at low speed might result in a spin, and elected to continue straight ahead towards the trees at the far end of the field. Approaching the trees, the instructor realised that the aircraft would not clear them, and manoeuvred to fly between two tall trees.

The aircraft clipped a tree and fell to the ground in an area of dense brambles and brush beyond the tree line. It was substantially damaged in the process. Examination of the impact site suggested that the vegetation may have assisted in decelerating the aircraft gently.

The aircraft came to rest upright, the instructor switched off the fuel and master switch, and both occupants, who had been wearing four-point harnesses, vacated the aircraft with only bruises. Neither occupant had a mobile telephone with him, and, lacking means of communication, they walked to nearby houses to find help.

The instructor commented that factors leading to the accident may have included:

- Possible slight fatigue at the end of a busy two days flying in hot weather
- A late awareness of the degree of upslope in the chosen field and the proximity of the trees
- The ambient temperature, which reduced the engine and aircraft performance
- The absence of headwind and possibly other wind effects at low height
- The late stage at which he took control and executed the go-around

He added that in future, he would take a mobile telephone with him when flying.

Obstacles in the go-around may render fields, which are suitable for field landings in gliders, unsuitable for field landing practice in motor-gliders.

ACCIDENT

Aircraft Type and Registration:	Skyranger 912(2), G-CCTR
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2004
Date & Time (UTC):	26 March 2012 at 1730 hrs
Location:	Pound Green Airstrip, Bewdley, Worcestershire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Landing gear collapsed; damage to engine cowling, wheel spats and propeller.
Commander's Licence:	Private Pilot's Licence
Commander's Age:	67 years
Commander's Flying Experience:	1,945 hours (of which 6 were on type) Last 90 days - 5 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

After a local flight of approximately one and a half hours duration, the pilot made a normal approach to land on Runway 34 at Pound Green Airstrip. The weather conditions were good. The aircraft landed heavily causing the landing gear to collapse, which resulted in damage to the engine cowling, wheel spats and propeller. The pilot, who was uninjured, candidly reported that he had misjudged the round out.

ACCIDENT

Aircraft Type and Registration:	Thruster T600N 450, G-CBIO
No & Type of Engines:	1 Jabiru Aircraft Pty 2200A piston engine
Year of Manufacture:	2002
Date & Time (UTC):	17 January 2012 at 1150 hrs
Location:	Near Compton Abbas Airfield, Dorset
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Fuselage tube, nose pod and nose landing gear leg, empennage, right wing, propeller and engine damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	269 hours (of which 47 were on type) Last 90 days - 5 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further inquiries by the AAIB

Synopsis

Following a reduction in engine power due to carburettor icing, the pilot made a forced landing in a field during which the aircraft turned over. The aircraft's carburettor heat system had been modified in an unapproved manner, rendering the aircraft more susceptible to carburettor icing. Two safety actions are being implemented as a result of this accident.

History of the flight

The aircraft was flying from Sandown Airfield to Compton Abbas. After cruising at 1,700 ft amsl, the pilot applied carburettor heat, reduced power to 2,000 rpm and commenced a descent to position the aircraft on the downwind leg for Runway 08 at Compton Abbas. At 1,400 ft amsl (600 ft aal) he tried to open the throttle to level off, but found that although the throttle lever moved, the engine power did not respond. He retarded the throttle slightly, which reduced the engine rpm, but when he tried to open the throttle again the engine power still did not increase. At this point the aircraft was approximately 1 nm north east of Compton Abbas Airfield and, deciding that he was too low to reach the runway, the pilot transmitted a MAYDAY message and selected a field to land in. After touching down the aircraft rapidly decelerated due to soft ground conditions and turned over, coming to rest inverted (Figure 1). Both occupants were uninjured and were able to vacate the aircraft without difficulty.

Figure 1
G-CBIO following the accident

Meteorology

An aftercast was provided by the Met Office for the Compton Abbas area at the time the accident occurred. It estimated that, at 1,700 ft altitude, the air temperature was +2°C and the dewpoint was +1°C. These conditions were conducive to serious carburettor ice formation at any power setting (Figure 2).

Aircraft inspection

Shortly after the accident the pilot moved the throttle control forwards to the OPEN position and observed that the Bowden-type throttle cable formed a bow between the throttle lever and the point where the cable entered the fixed outer sheath, indicating resistance in the throttle control circuit.

The aircraft was recovered from the field three hours after the accident by an aircraft maintenance engineer familiar with the aircraft type. He noted that the throttle butterfly spindle was free to rotate and the throttle cable between the throttle lever and the butterfly spindle was mechanically intact, and moved freely within the outer sheath.

Carburettor heat system

The aircraft was fitted with a carburettor heat system comprising an electrically heated jacket fitted to the inlet throat of the carburettor body, Figure 3(a). This differed from the production standard carburettor heat system installed when the aircraft was manufactured in 2002, in which hot engine oil is circulated through a hollow jacket attached to the exit throat of the carburettor body, in close proximity to the throttle butterfly Figure 3(b).

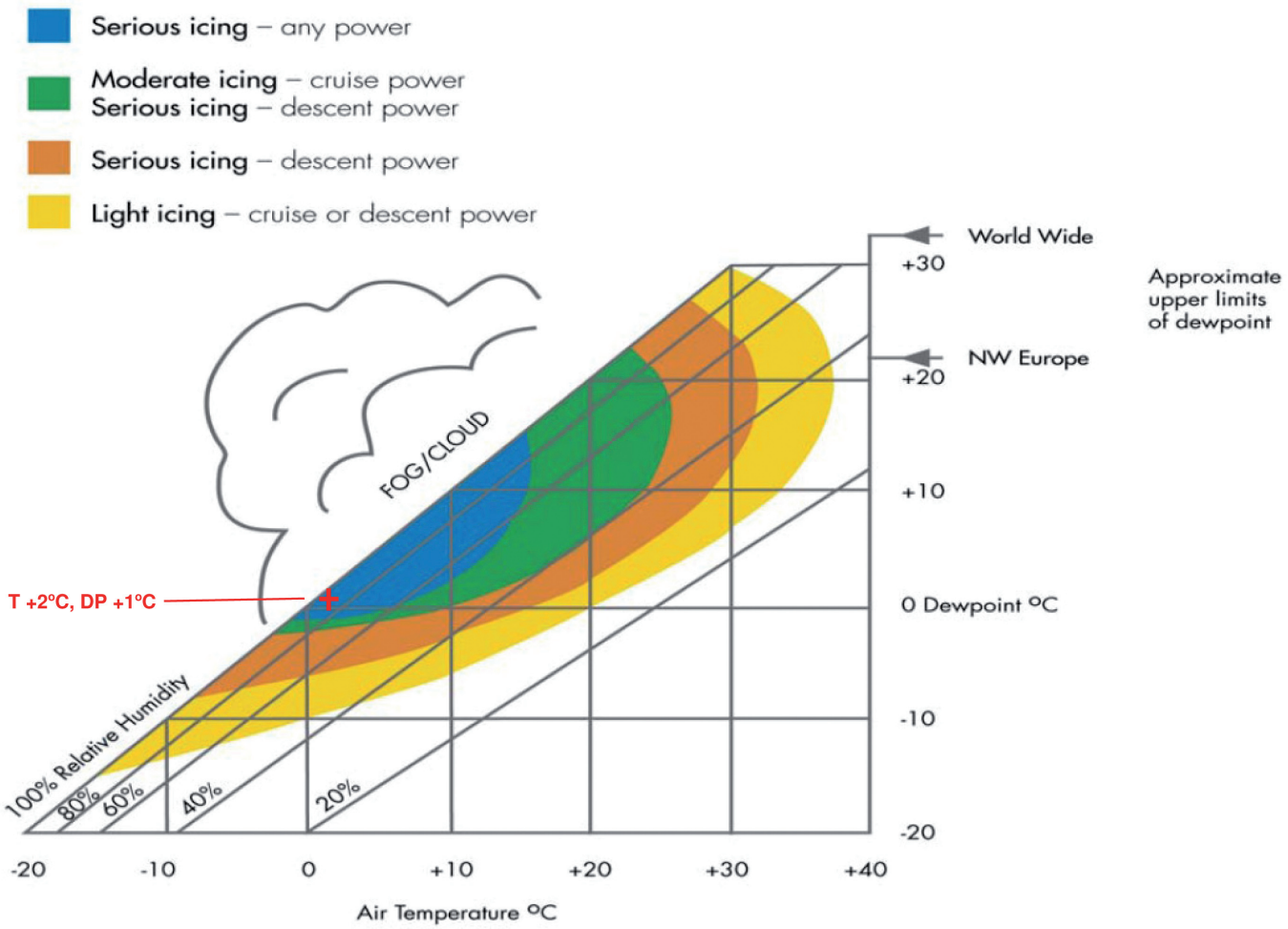


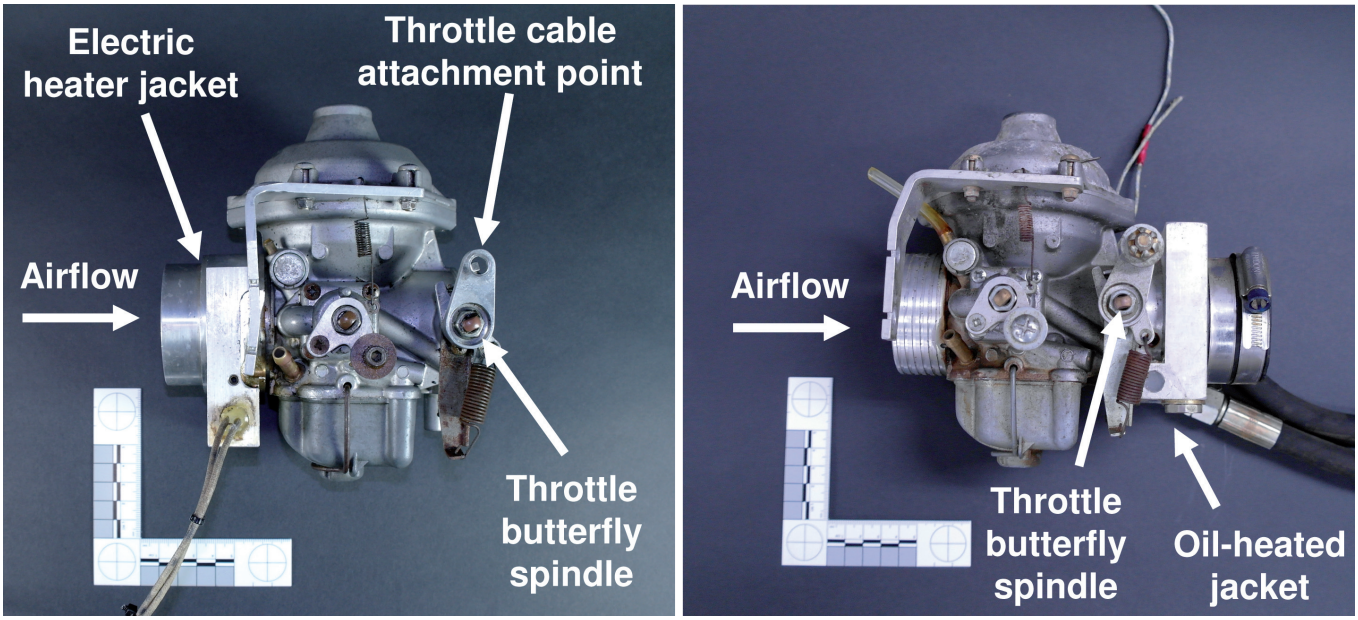
Figure 2

Carburettor icing chart

The ability of the electric heater jacket to warm the carburettor throttle butterfly valve was tested by cooling the entire carburettor in a refrigerator to 1ºC and applying 12 Volts to the heater jacket electrical terminals. Thermocouples were attached to the electric heater jacket and the butterfly valve, allowing the temperature of both components to be monitored. The results showed that after three minutes of heat application, the heater jacket had reached a temperature of 30ºC, whereas the butterfly valve temperature has risen by only 1ºC, to 2ºC. After six minutes the heater jacket had reached 45ºC and the butterfly valve temperature had risen to just 6ºC. The test was performed in static airflow conditions and without fuel evaporation from the carburettor jet, both would cause a large cooling effect at flight conditions. Therefore the butterfly valve's small temperature rise measured during the test would be very significantly reduced in the conditions encountered during the accident flight.

Aircraft records

The aircraft manufacturer confirmed that when the aircraft was built in 2002, the carburettor had been fitted with a production standard oil-heated jacket mounted downstream of the carburettor body, directly adjacent to the throttle butterfly valve. The engine fitted to G-CBIO at the time of the accident was confirmed, by



(a) G-CBIO carburettor heat configuration (b) Production configuration

Figure 3

Modified and production configuration carburettor heat arrangements

engine serial number, to be the same engine installed at the original build date. No details of the approved carburettor heat system were contained in either the aircraft maintenance manual or the CAA-issued Microlight Type Approval Data Sheet (TADS) for the Thruster T600N 450.

The aircraft logbook contained an entry in December 2003 stating that an electric carburettor heat system had been installed, although no additional details or part numbers were recorded, nor was the reason for the change in carburettor heat system. As the Thruster T600N 450 is a CAA Type Approved microlight, modifications to the aircraft may only be approved by either the aircraft manufacturer or the BMAA. Both organisations confirmed that, in relation to alteration of the carburettor heat system on G-CBIO, no such modification approval had been sought or granted.

The aircraft had undergone a total of seven 'permit to fly' maintenance inspections following modification of the carburettor heat system. The aircraft records did not contain any written findings regarding this non-conformance with the aircraft's production standard configuration.

Airworthiness requirements

The aircraft was approved to BCAR Section S airworthiness requirements, which do not contain any specific requirements relating to either engine reliability or induction system ice protection systems. Therefore the installation of the production-standard oil jacket carburettor heater was an enhancement of the aircraft over and above BCAR Section S requirements. A survey of AAIB accident records for Jabiru 2200A-powered Thruster T600N aircraft over a 10-year period between 2002 and 2012 revealed only one other accident in which carburettor icing may have been a factor. The UK fleet of this mark of Thruster aircraft currently stands at 64 and the low incidence of previous carburettor icing accidents suggests that the production-standard

carburettor heating system is effective in preventing serious carburettor ice formation.

Discussion

The cause of the reduction in available engine power in G-CBIO was probably due to the formation of ice within the carburettor, restricting the opening movement of the throttle butterfly valve. The possibility that water may have been present in the throttle control Bowden cable which subsequently froze during flight, replicating the reported throttle symptoms, was considered unlikely due to the air temperature being above 0ºC at the aircraft's operating altitude. By the time the pilot had recognised the power loss, the aircraft was too far away from the runway to allow a landing at Compton Abbas Airfield, resulting in a forced landing. Pilots are reminded that the presence of carburettor icing may become evident when power changes are made, particularly a reduction in power. In conditions where carburettor icing is likely, it is advisable to make power reductions at locations and heights from which a successful forced landing may be made.

The vulnerability of the carburettor to icing was significantly increased by the installation of an unapproved electrical carburettor heat system. Testing conducted by the AAIB demonstrated that this unapproved system was unlikely to be effective at melting ice within the carburettor.

The aircraft had undergone seven 'permit to fly' maintenance inspections between installation of the electric carburettor heat system and the accident flight and the non-conformity remained undetected during this period. Neither the TADS nor the aircraft maintenance manual contained details of the production standard system and therefore the only remaining safety barrier in place was the Thruster T600N 450 type-specific knowledge of the BMAA inspectors conducting the annual inspections. Thus, in this instance, the presence of a carburettor heat system (of an unapproved and inappropriate type) combined with the lack of available technical information may be considered to have been a contributory factor in the resulting accident.

Safety actions

The BMAA will issue a defect alert to their inspectors to highlight the issue of unapproved modifications in general, and remind inspectors of the approved type of Thruster T600N 450 carburettor heat system. The aircraft manufacturer will also amend the Thruster T600N 450 TADS to include details of the approved carburettor heat system on this aircraft.

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

1/2010 Boeing 777-236ER, G-YMMM at London Heathrow Airport on 17 January 2008.

Published February 2010.

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

Published May 2010.

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

Published May 2010.

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.

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