Air Accidents Investigation Branch

AAIB Bulletin 4/2019

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The sole objective of the investigation of an accident or incident under these Regulations is the prevention of future accidents and incidents. It is not the purpose of such an investigation to apportion blame or liability.

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AAIB Air Accidents Investigation Branch

AAIB Bulletin S1/2019 *SPECIAL*

ACCIDENT

Aircraft Type and Registration:	Piper PA-46-310P Malibu, N264DB	
No & Type of Engines:	1 Teledyne Continental TSIO-520-BE engine	
Year of Manufacture:	1984 (Serial no: 46-8408037)	
Date & Time (UTC):	21 January 2019 at 2016 hrs	
Location:	22 nm north-north-west of Guernsey	
Type of Flight:	Unknown	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 1 (Missing)	Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	59 years	
Commander's Flying Experience:	Approximately 3,700 hours Last 90 days - unknown Last 28 days - unknown	
Information Source:	AAIB Field Investigation	

Introduction

At 2122 hrs on 21 January 2019, the AAIB was informed that a Piper PA-46-310P Malibu aircraft, registration N264DB, had been lost from radar in transit from Nantes, France, to Cardiff in the UK, and that a surface search for survivors was underway using assets from the Channel Islands, UK and France. The wreckage of the aircraft had not been located by the time the official search ended at 1515 hrs on 24 January 2019, and the event therefore became classed as an aircraft accident under the terms of Annex 13 to the Convention on International Civil Aviation[1]. There were two persons on board the aircraft but neither was found by the surface search.

Footnote

[1] Annex 13 contains International Standards and Recommended Practices for Aircraft Accident and Incident Investigation.

The aircraft was lost in international waters and, in such circumstances, Annex 13 places a responsibility on the State of Registration of the aircraft, in this case the USA as represented by the National Transportation Safety Board (NTSB), to commence an investigation. However, the State of Registration may, by mutual agreement, delegate the investigation to another State. On 22 January 2019, in anticipation that an accident investigation would be required, the NTSB delegated responsibility for the investigation to the State of the Operator, in this case the UK as represented by the AAIB.

The AAIB began an investigation assisted by the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA) in France, which had been supporting search activities since the accident occurred, the NTSB in the USA, and the Junta de Investigación de Accidentes de Aviación Civil (JIAAC) in Argentina.

This Special Bulletin contains preliminary factual information on the investigation and general information about how aircraft registered in the USA may be operated between the UK and France.

History of the flight

The pilot of N264DB flew the aircraft and a passenger from Cardiff Airport to Nantes Airport on 19 January 2019 with a return flight scheduled for 21 January 2019. The pilot arrived at the airport in Nantes at 1246 hrs on 21 January to refuel and prepare the aircraft for the flight. At 1836 hrs the passenger arrived at airport security, and the aircraft taxied out for departure at 1906 hrs. Figure 1 shows the aircraft on the ground before departure.

Figure 1

N264DB on the ground at Nantes prior to the flight

The pilot's planned route would take the aircraft on an almost direct track from Nantes to Cardiff, flying overhead Guernsey en route (Figure 2). The Visual Flight Rules (VFR) flight plan indicated a cruise altitude of 6,000 ft amsl[2] and a distance of 265 nm.

Figure 2

Planned route from Nantes to Cardiff

The aircraft took off from Runway 03 at Nantes Airport at 1915 hrs, and the pilot asked ATC for clearance to climb to 5,500 ft. The climb was approved by Nantes Approach Control and the flight plan was activated.

The aircraft flew on its planned route towards Cardiff until it was approximately 13 nm south of Guernsey when the pilot requested and was given a descent to remain in Visual Meteorological Conditions (VMC)[3]. Figure 3 shows the aircraft's subsequent track. The last radio contact with the aircraft was with Jersey Radar at 2012 hrs, when the pilot asked for a further descent. The aircraft's last recorded secondary radar point was at 2016:34 hrs, although two further primary returns were recorded after this[4]. The wreckage of N264DB was subsequently found on the seabed about 30 metres from the position of the last secondary radar point recorded by the radar at Guernsey.

Footnote

2 amsl: above mean sea level.

3 Pilots must remain in VMC to continue flight under Visual Flight Rules, the rules under which this flight was undertaken. The aircraft was in Class D airspace and so the pilot was required to remain 1,500 m horizontally and 1,000 ft vertically clear of cloud, and have an in-flight visibility greater than 5,000 m.

4 See later section, *Recorded information*, for an explanation of the radar data.

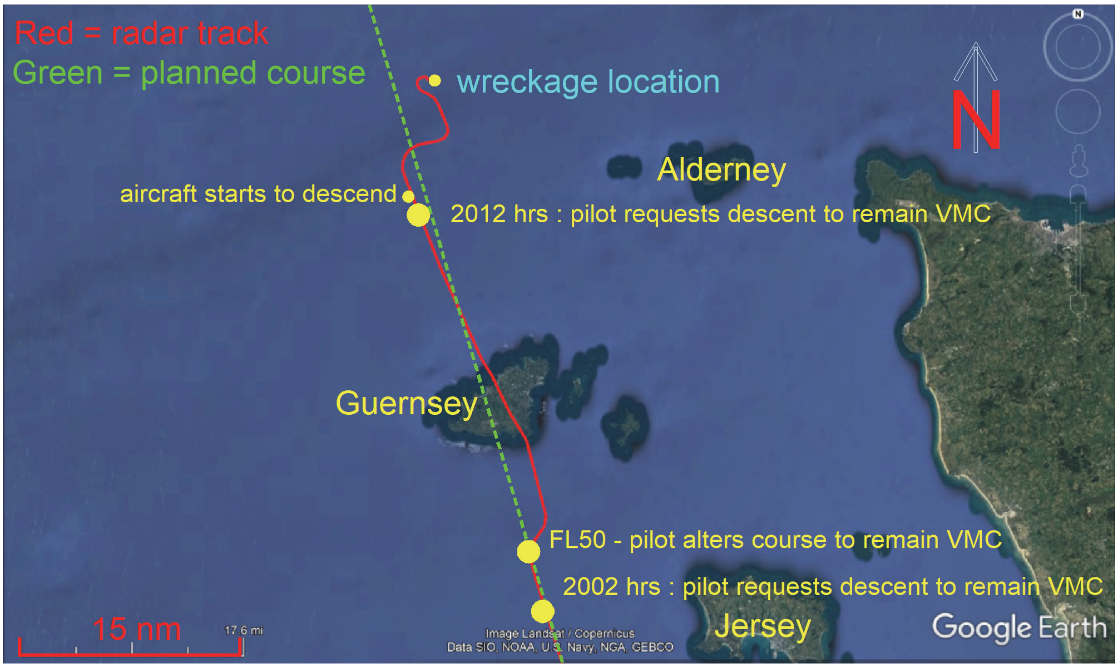

Figure 3

Aircraft track in the vicinity of Guernsey

Weather conditions

A weather forecast was issued by the Jersey Meteorological Department at 1502 hrs on 21 January 2019, valid for the period between 1600 hrs and 2200 hrs. This forecast showed a cold front moving in from the northwest, which was forecast to bring rain spreading in from the northwest overnight. The forecast included the possibility of isolated showers for the whole period of validity. Actual observations at Guernsey Airport for 1950 hrs showed that the visibility was in excess of 10 km and the cloud was FEW[5] at 1,000 ft above the level of the airfield (aal). At 2020 hrs, Guernsey was reporting light showers of rain and FEW clouds at 1,000 ft aal.

The rainfall radar picture at 2015 hrs showed a band of showers, some heavy, passing through the area of flight as shown in Figure 4.

Data from the UK Met Office indicated that the freezing level around the Channel Islands was between 3,000 ft and 4,000 ft amsl.

Footnote

[5] Cloud cover is often given in eighths of the sky covered, or oktas. FEW refers to 1-2 oktas of cloud which is 1-2 eighths of the sky covered.

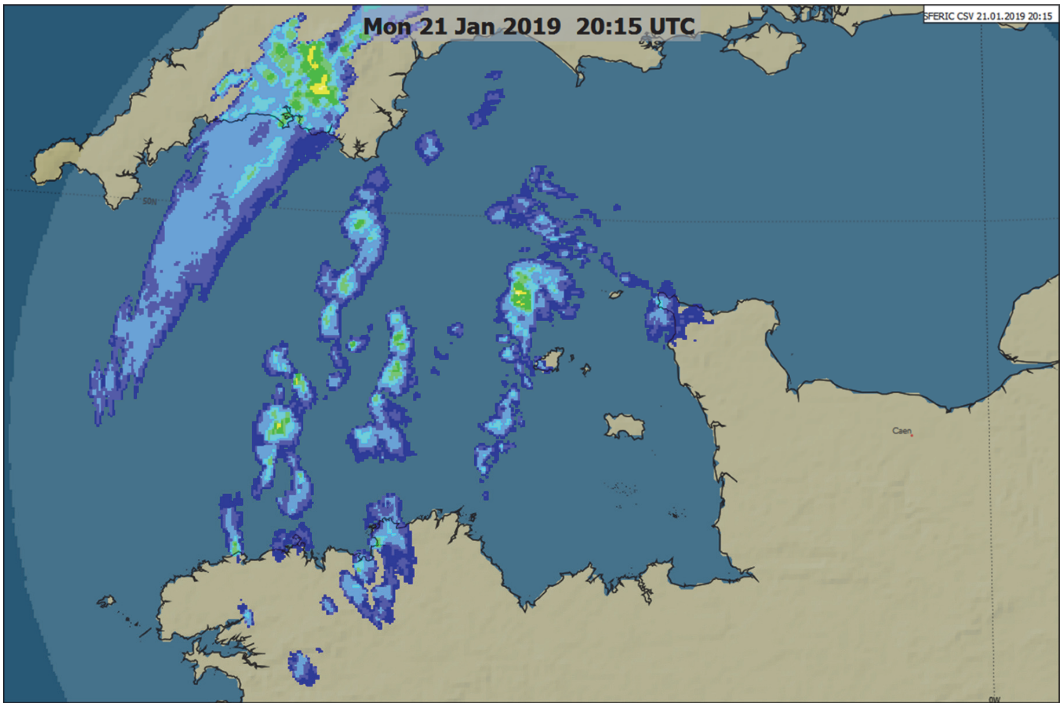

Figure 4
Rainfall radar for 2015 hrs

Aircraft description

The PA-46-310P Malibu is a single engine, all metal, low wing, pressurised aircraft fitted with retractable landing gear and a single turbocharged piston engine, driving a two-blade constant speed propeller. The primary flight controls are conventional in operation and are operated by cables. The aircraft is also equipped with four-position, hydraulically operated flaps, a stall warning device and an electrically heated pitot probe. The aircraft has a fuel capacity of 122 gal (US) stored in an integral fuel tank located in each wing.

N264DB was equipped with an ice protection system that allowed it to fly into known icing conditions. It was also fitted with avionic equipment that allowed it to be flown safely at night in Instrument Meteorological Conditions (IMC[6]).

The aircraft was equipped with six seats. The two forward passenger seats faced aft, and all passenger seats had adjustable backs with built-in headrests. The rearward facing passenger seats were equipped with lap straps and all the other seats with three-point harnesses (car style). Entry to the aircraft was through a rear door on the left side of the cabin. An emergency exit was located on the right side of the cabin behind the front seat. The aircraft was equipped with an Emergency Locator Transmitter (ELT) with a three-position switch: ON, OFF, ARMED. When selected to ARMED the ELT would automatically start to

Footnote

[6] If meteorological conditions are less than the VMC limits detailed in Footnote 3, they are Instrument Meteorological Conditions and the aircraft must be operated in accordance with Instrument Flight Rules.

transmit when it detected an impact. ELT transmissions cannot be detected underwater. The aircraft was also equipped with life jackets for each occupant and a six-man life raft, kept in the rear baggage compartment and accessible from the cabin.

Aircraft history and maintenance

N264DB was manufactured in 1984, and on 30 November 2018 the airframe had flown 6,636 hrs and the engine had operated for 1,195 hrs since overhaul. The Certificate of Registration was issued on 11 September 2015 and had an expiry date of 30 September 2021. The Airworthiness Certificate was dated 27 April 1984. This certificate remains valid if aircraft maintenance has been performed in accordance with Federal Aviation Regulations (FAR) Parts 21, 43 and 91. The last significant maintenance was an Annual / 100-hour maintenance that was completed on 30 November 2018; the Certificate of Release to Service was signed by the holder of a Federal Aviation Administration (FAA) Inspector Authorization (IA).

Underwater search

Background

Following an aircraft accident at sea, an underwater search operation may be undertaken by the Safety Investigation Authority (SIA) leading an investigation to locate and gather evidence which may establish the cause of the accident. The decision to conduct an underwater search is determined on a case-by-case basis and a search would only be carried out if it was considered safe and practical to do so. The aim of a search would be to determine the location of the wreckage and to undertake an underwater survey; wreckage would only be recovered if it was considered feasible and necessary in order to understand the cause of the accident.

Probable location of the wreckage

The AAIB established the most likely location for where the aircraft struck the surface of the sea by analysing radar data and the flight profile during the final minutes of the flight. The Ministry of Defence's Salvage and Marine Operations (SALMO) Project Team then factored in the depth of water and tidal flow to determine the primary area for the seabed search, which was an area of 4 nm^2 approximately 22 nm north-northwest of Guernsey.

Coordination of the seabed search

Through SALMO, the AAIB contracted a specialist survey vessel, the Geo Ocean III, to undertake an underwater survey of the seabed to try to locate and identify wreckage from the aircraft. The AAIB was aware that a separate, privately funded search was to be conducted and established close liaison with those involved to maximise the chance of locating any wreckage and to ensure a safe search operation. The privately contracted vessel was the FPV Morven.

The search was planned to be conducted in two phases. The first phase would be a survey of the seabed by both vessels using towed side-scan sonar to identify objects of interest. The second phase would be an examination of those objects when the tidal flow allowed[7] using the camera on a Remotely Operated Vehicle (ROV) deployed from the Geo Ocean III. To ensure safe separation between the vessels and towed sensors, and to maximise the efficiency of the search, the area was split into two parts and each vessel was allocated one part (Figure 5).

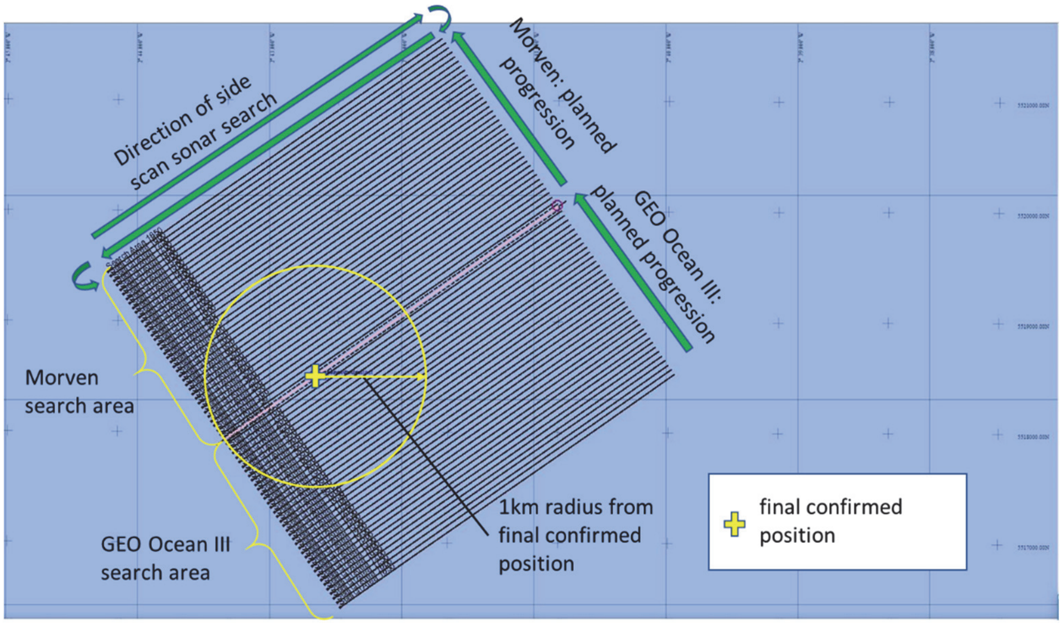

Figure 5

Seabed search strategy

Both vessels began their side-scan survey of the seabed on the morning of Sunday, 3 February 2019. Early in the search, the FPV Morven identified an object of interest at a depth of approximately 68 m and cleared the immediate area to allow the Geo Ocean III to launch its ROV and examine the object, which was identified as the missing aircraft. Figure 6 shows a side-scan sonar image taken from the Geo Ocean III.

An initial survey of the scene using the camera on the ROV revealed that there was a body present, held in place by the wreckage. The body was recovered to the vessel in the early hours of 6 February 2019 but, despite a further search of the wreckage and surroundings, no evidence was found of the second occupant of the aircraft. Shortly afterwards, a deterioration of the weather and sea conditions meant that it was not possible to safely continue the operation or recover the wreckage.

Footnote

[7] The search was made in an area of strong tidal flows which restricted the time the ROV could be deployed to periods of slack water.

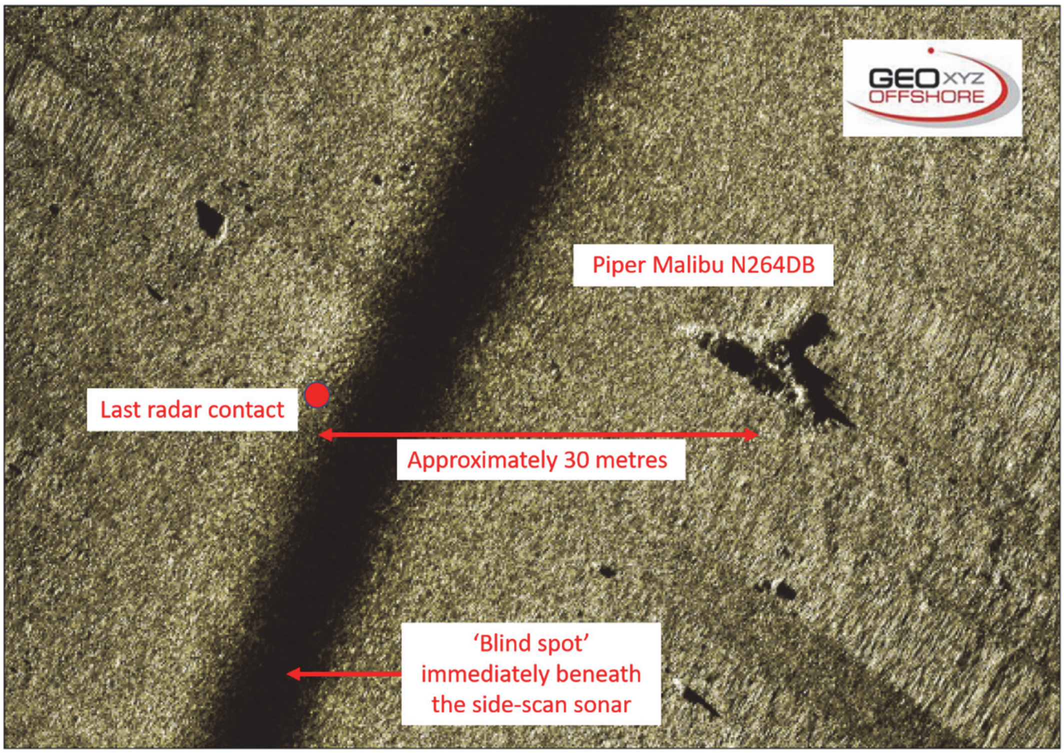

Figure 6

Side-scan sonar image of N264DB

Aircraft wreckage

ROV video footage

From the ROV video examination it was possible to establish that the aircraft was extensively damaged, and the main body of the aircraft was in three parts held together by electrical and flying control cables. The engine had disconnected from the cockpit area, and the rear section of the fuselage had broken away from the forward section adjacent to the trailing edge of the wing. The outboard section of both wings, tail plane and fin were missing. Figures 7 to 9 show images taken by the ROV.

Other wreckage

In the days following the accident two seat cushions, an arm rest and possible skin from the fuselage washed up along the coast of the Cotentin Peninsula, France. A seat cushion also washed up in Bonne Nuit Bay on the north coast of Jersey.

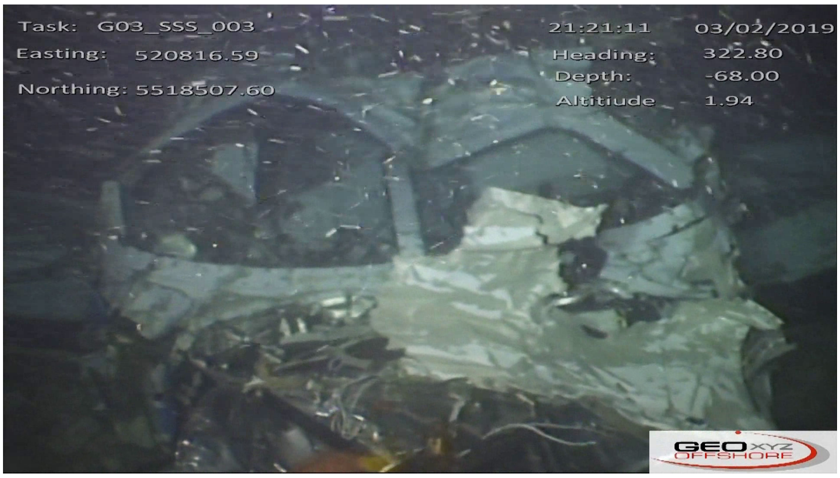

Figure 7

View looking at windscreen and cockpit area

Figure 8

View looking at cabin and break in fuselage

Figure 9

View looking at remains of inner wing

Recorded information

Sources of recorded information

Recorded radar information (primary, and secondary Mode A and C[8]) was available from separate ground-based sites in Guernsey, Jersey and France. The radar data provided an almost complete record of the accident flight, starting as the aircraft took off and ending shortly before it struck the sea. The radar tracks from the different sites predominantly aligned, corroborating the relative accuracy of the independent data sources.

Recordings of RTF communications between the pilot and ATC were available and included the last radio transmission.

The pilot used a flight planning and navigation software application installed on his portable tablet computer to create a route between Nantes and Cardiff and file the VFR flight plan. This information had been uploaded to the pilot's cloud account[9]. During flight the tablet computer displays the aircraft position and planned route overlaid on a moving map, and records GPS-derived position information. The pilot's tablet computer was not found within the wreckage.

The aircraft was not fitted with an accident-protected flight data recorder or cockpit voice recorder and was not required to be.

Information from the recorded data

All times are UTC, and altitude is derived from Mode C data (transmitted in 100 ft increments with a tolerance of ±50 ft), corrected for local atmospheric pressure (QNH)[10].

After departure from Nantes, N264DB climbed progressively to 5,500 ft and its average ground speed was about 170 kt, equivalent to an estimated airspeed of 169 kt TAS based on a calculated wind from 250° at 25 kt. When the aircraft was about 20 nm south of Jersey, the pilot was transferred to the Jersey Control frequency.

On initial contact with Jersey ATC, the aircraft was cleared to enter controlled airspace and maintain FL55[11], following which the pilot was asked to advise ATC if at any time he would not be able to "MAINTAIN VMC"; this was to enable ATC coordination with other aircraft in the area should it be necessary for N264DB to descend or climb. At 1958 hrs, the controller asked the pilot to check if the aircraft's altimeter pressure setting was correctly set to 1013 hPa, because the information on the radar indicated FL53. The pilot acknowledged

Footnote

[8] Mode A refers to the four-digit 'squawk' code set on the transponder, and Mode C refers to the aircraft's pressure altitude which is transmitted in 100 ft increments. Secondary radar typically provides greater accuracy than primary radar.

[9] Cloud account refers to storage of data which is hosted remotely and made available to a user over a network (typically the Internet).

[10] Transmitted Mode C values are based on a standard pressure setting (see next footnote). This report has adjusted those values to reflect the local atmospheric pressure (QNH) so that they indicate altitude ie the vertical distance above mean sea level.

[11] Flight Levels (FL) are referenced to the International Standard Atmosphere (ISA) setting of 1013 hPa. FL55 is equivalent to 5,500 ft based on the standard pressure setting.

and, shortly afterwards, the aircraft climbed to FL55; the aircraft was about 11 nm south-west of Jersey.

At 2002:10 hrs, N264DB was about 11 nm west of Jersey and 13 nm south of Guernsey when the pilot requested clearance to descend to "MAINTAIN VMC" (Figure 3). The aircraft was cleared to FL50, with the instruction to advise ATC if a further descent was required. Shortly afterwards, the aircraft began to descend whilst also making a right turn followed by a left turn. This positioned the aircraft overhead Guernsey, about 1.5 nm parallel to the planned track. The controller then inquired if N264DB required a further descent, to which the pilot responded: "NEGATIVE, JUST AVOIDED A PATCH THERE, BUT BACK ON HEADING FIVE THOUSAND FEET".

At 2012 hrs, N264DB was about 11 nm north of Guernsey when the pilot requested a further descent to maintain VMC. The aircraft was cleared to descend at the pilot's discretion, and the pilot was given the Jersey QNH, which was 1017 hPa. The pilot acknowledged, and this was the last radio communication received from N264DB.

N264DB started to descend gradually and turned onto a track of about 060°T (Figure 10). Approximately 30 seconds later the aircraft turned left onto about 305°T. During this sequence of turns the aircraft descended from about 4,800 ft to 4,300 ft, climbed to about 5,000 ft, and then descended again to about 3,900 ft. The aircraft then proceeded to climb to about 4,200 ft on a track that was nearly parallel with the planned course of 343°T. Its average groundspeed was about 175 kt.

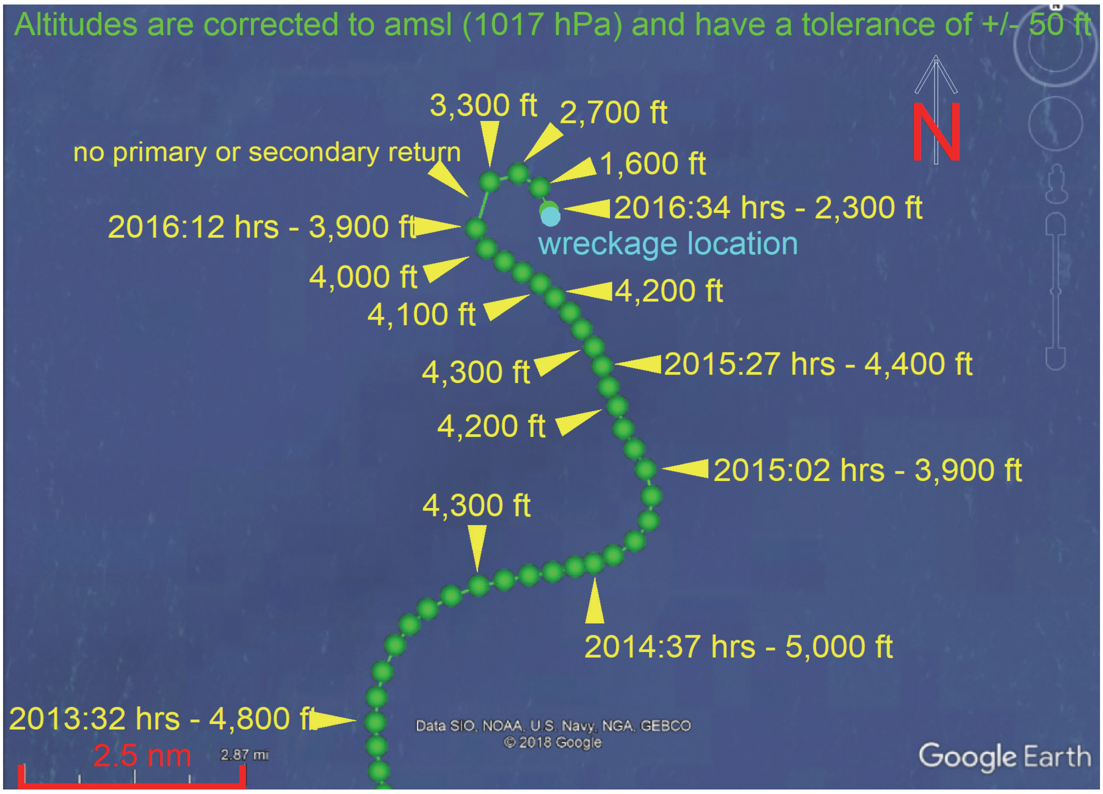

Figure 10

Radar track of final section of flight
(created from a combination of data from Jersey (Les Platons) and Guernsey radars)

At about 2015:30 hrs, N264DB started to make a gradual left turn, which was followed at about 2016:10 hrs by a right turn of approximately 180°. During this turn, data from two independent radars (Guernsey and Jersey[12]) showed the aircraft descend to an altitude of about 1,600 ft at an average rate of approximately 7,000 ft/min. A few seconds later (at 2016:34 hrs) the final secondary radar return was recorded, which indicated that the aircraft may have climbed rapidly to about 2,300 ft. Two more primary radar returns were recorded, timed at 2016:38 hrs and 2016:50 hrs respectively, but it is not yet known whether they represent valid returns from the aircraft.

The regulatory framework for the accident flight

The investigation is considering the regulations applicable to the operation of this flight including airworthiness requirements; flight crew licencing; and the carriage of passengers. The requirements are set out below.

Airworthiness, aircraft permissions and maintenance

Aviation in the USA is regulated by the FAA. The Code of Federal Regulations (CFR) Title 14 Aeronautics and Space (known as 14 CFR) contains the Federal Aviation Regulations and is available through the FAA website[13]. Any aircraft registered in the USA, wherever it is based in the world, is regulated in accordance with the FAA 14 CFR.

N264DB was subject to the requirements of FAR Part 91, *General Operating and Flight Rules*. These regulations allowed the aircraft to be flown by private pilots holding an appropriate licence, but it was not allowed to be used for commercial operations without the owner or operator first obtaining permission from the FAA and the UK Civil Aviation Authority (CAA).

Ownership of N264DB had been transferred into a US Citizen Corporate Trust (known by the FAA as the Trustee and the CAA as the Owner Trust), which was a requirement to allow it to operate on the US register. The Trustee had a written contract with a UK Company, the Trustor, which had originally purchased the aircraft before transferring the title deed to the Trustee on 7 August 2015. The Trustee was responsible for registering the aircraft and passing all applicable airworthiness directives to the Trustor (which is known by the CAA as the Beneficial Owner).

The Trustor was responsible for the operation of the aircraft, ensuring it was maintained in accordance with applicable regulations and met all airworthiness requirements. The Trustor had an informal arrangement with a third party to manage the aircraft on its behalf.

Neither the Trustee nor the Trustor had applied to the FAA or the CAA to operate the aircraft for commercial reasons. The CAA advised the AAIB that they had no record of an application for permission to operate the aircraft commercially.

Footnote

[12] Data points were recorded once every four seconds by the radar located at Guernsey and once every five seconds for the radar located at Jersey (Les Platons).

[13] https://www.faa.gov/regulations_policies/faa_regulations/ [accessed February 2019]

Oversight for the maintenance of aircraft operating in the UK which are registered in another State is carried out by, or on behalf of, the State of Registration, in this case the USA as represented by the FAA. The CAA may be asked to assist the FAA with safety checks or where a safety concern has been identified relating to a US registered aircraft operating in the UK.

Flight crew licencing

To fly an aircraft registered in the USA a pilot must hold a suitable licence, and licencing is governed by FAR Part 61, *Certification: Pilots, Flight Instructors, and Ground Instructors*. Part 61.3(a)(vii) states:

> *'When operating an aircraft within a foreign country, a pilot license issued by that country may be used.'*

Aviation in the European Union (EU) is regulated by the European Aviation Safety Agency (EASA), but pilot licences issued in accordance with EASA regulations are issued by Member State National Aviation Authorities (the CAA in the UK). A pilot may only hold one EASA licence, issued by a single Member State. The USA does not consider the European Union to be a State and so a flight between two EU Member States is a flight between two foreign countries within the meaning of Part 61.3(a)(vii). Such a flight would require the pilot to hold a licence issued in each Member State, which is not possible in the EU. Therefore, when an EASA licence issued in an EU Member State is used to fly an aircraft registered in the USA, the flight must remain within the borders of that Member State. The corollary is that, to fly an aircraft registered in the USA between two EU Member States, as was the case with the accident flight, a pilot must use an FAA licence.

Part 61 offers two routes to gain an FAA PPL and the first is laid out in Part 61.103. An FAA PPL would be gained this way by completing the FAA syllabus, examinations, flight training and flight test. Such a licence includes a night flying qualification because night flying is part of the FAA PPL syllabus.

The second way to gain an FAA PPL is through a certificate issued on the basis of a foreign pilot licence ('piggybacking'). The rules for this are contained in Part 61.75 which state that such a certificate:

> *'Is subject to the limitations and restrictions on the person's U.S. certificate and foreign pilot license when exercising the privileges of that U.S. pilot certificate in an aircraft of U.S. registry operating within or outside the United States.'*

It is possible for aircraft ratings and instrument ratings to be piggybacked onto an FAA licence from a foreign licence. For example, an FAA PPL issued on the basis of an EASA PPL could be used for night flying if the pilot had an EASA night rating (night flying is not included in the EASA PPL syllabus).

The pilot of N264DB held an EASA PPL, issued by the CAA in the UK, and an FAA PPL, issued on the basis of his EASA PPL. It is thought that the pilot's licence and logbook were lost with the aircraft and so the ratings on his licences and their validity, and the extent of his recent flying have not yet been determined.

Carriage of passengers

A PPL does not allow a pilot to carry passengers for reward; to do so requires a commercial licence[14]. The basis on which the passenger was being carried on N264DB has not yet been established but, previously, the pilot had carried passengers on the basis of 'cost sharing'. Cost sharing allows a private pilot to carry passengers and for those passengers to contribute towards the actual cost of the flight. Cost sharing brings benefits to private pilots who, by sharing the expense of their flying, can fly more than they might otherwise be able to, thereby increasing their level of experience. A higher level of regulatory burden applies to commercial, compared with private flights (such as more stringent medical, licencing and airworthiness requirements), and the additional requirements increase the level of safety assurance. Therefore, although the UK, EU and US regulatory authorities allow cost sharing, they apply restrictions to it.

European and UK national regulations permit pilots to share the direct costs of a flight without having to comply with regulations applicable to Commercial Air Transport or Public Transport flights. The proportion of the costs that must be shared by the pilot is not specified; however, the pilot must contribute to the actual direct costs of the flight being conducted. The CAA has produced guidance documents for the General Aviation community such as CAP1590, *Cost sharing flights: guidance and information,*[15] and CAP 1589, *Cost sharing flights: GA Guide*[16].

The EASA permits cost sharing on aircraft registered in a third country, such as the USA, but the relevant EASA rules state there may also be a requirement to comply with any regulations of the State of Registry. FAR Part 61.113 prohibits holders of a PPL from acting as Pilot in Command (PIC) of an aircraft carrying passengers for compensation or hire except in certain circumstances. When carrying passengers under the relevant dispensation a private pilot:

> *'may not pay less than the pro rata share of the operating expenses.'*

Footnote

[14] Commercial Pilots Licence (CPL) or Airline Transport Pilots Licence (ATPL).

[15] CAP 1590. Available: https://publicapps.caa.co.uk/docs/33/CAP1590%20Cost%20Sharing%20Flights%20(Aug%202018).pdf [accessed February 2019]

[16] CAP 1589. Available: http://publicapps.caa.co.uk/docs/33/CAP1589%20-%20cost%20sharing%20GA%20guide_v3%20(Aug%202018).pdf [accessed February 2019]

The FAA issued legal interpretations in 2009[17] and 2014[18] making clear that a pilot must not pay less than the pro rata share for the flight. If the flight involves the pilot and one passenger, then the pilot must pay half the operating expenses. The ruling also made clear that the pilot must have a bona fide purpose (also known as common purpose) for making the flight and must dictate when the flight is to go. The flight must not be made for the purpose of merely transporting the passenger.

Summary of regulatory issues

N264DB was registered in the USA and could not be used for commercial operations without permission from the FAA and CAA. At the time of writing there was no evidence that such permission had been sought or granted.

To fly an aircraft registered in the USA between EASA Member States, a pilot must operate using the privileges of an FAA licence. This licence may be:

a. Issued based on the privileges of an existing EASA PPL. If the EASA PPL contains a night rating, the FAA PPL will have night flying privileges.

b. Issued by the FAA following the completion of an approved PPL course. The privileges of a licence gained in this way will include night flying.

The pilot had an FAA PPL issued on the basis of his EASA PPL. His logbook and licence were not recovered from the aircraft, and the ratings on his licences and their validity dates have not yet been established.

If the flight was planned to be operated on a cost sharing basis, FAA rules regarding pro rata costs and a common purpose were applicable.

Further work

The investigation continues to examine all pertinent operational, technical, organisational and human factors which might have contributed to the accident. In particular, work will be undertaken to:

a. Refine the analysis of the radar information to try and understand the last few minutes of the flight.

b. Assess the possible implications of the weather conditions in the area at the time of the accident.

Footnote

17 https://www.faa.gov/about/office_org/headquarters_offices/agc/practice_areas/regulations/interpretations/data/interps/2009/mangiamele%20-%20(2009)%20legal%20interpretation.pdf [accessed February 2019]

18 https://www.faa.gov/about/office_org/headquarters_offices/agc/practice_areas/regulations/interpretations/data/interps/2014/macpherson-jonesday%20-%20(2014)%20legal%20interpretation.pdf [accessed February 2019]

c. Analyse video from the ROV to determine the aircraft attitude as it entered the water.

d. Consider the regulatory requirements surrounding the flight including airworthiness requirements, aircraft permissions and flight crew licencing.

A final report will be published in due course.

Published 25 February 2019

AAIB Field Investigation Reports

A Field Investigation is an independent investigation in which AAIB investigators collect, record and analyse evidence.

The process may include, attending the scene of the accident or serious incident; interviewing witnesses; reviewing documents, procedures and practices; examining aircraft wreckage or components; and analysing recorded data.

The investigation, which can take a number of months to complete, will conclude with a published report.

ACCIDENT

Aircraft Type and Registration:	Cessna 172M Skyhawk II, N9085H
No & Type of Engines:	1 Technify Motors TAE 125-02-114 turbocharged diesel piston engine
Year of Manufacture:	1975 (Serial no: 17265932)
Date & Time (UTC):	30 April 2018 at 2045 hrs
Location:	Bermuda Airport, Bermuda
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - Minor Passengers - N/A
Nature of Damage:	Aircraft damaged beyond economic repair
Commander's Licence:	FAA Commercial Pilot's Certificate
Commander's Age:	36 years
Commander's Flying Experience:	878.6 hours (of which 748.6 were on type) Last 90 days - 0 hours Last 28 days - 0 hours
Information Source:	AAIB Field Investigation

Synopsis

Shortly after takeoff the aircraft exhibited a tendency to pitch nose down despite the application of NOSE UP trim. During the subsequent approach to land, the forces required to maintain the approach path increased to the point where the pilot could no longer control the glidepath and the aircraft struck the ground short of the runway. The investigation found that the drive chain for the elevator trim actuator had been fitted incorrectly, which resulted in the elevator trim tab moving in the opposite sense to the movement of the trim wheel.

The maintenance organisation has introduced procedures to ensure that duplicate inspections of all flight critical systems are carried out following maintenance.

History of the flight

The flight was planned to consist of a number of circuits and landings to refamiliarise the pilot with the aircraft. The pilot had not flown for several months while the aircraft had undergone a prolonged maintenance input. As this was the aircraft's first flight after maintenance, the pilot fully checked the flying controls and their range of movement during the pre-flight checks. On completion of the in-cockpit pre-flight checks, the pilot confirmed that the elevator trim was set to the correct position for takeoff by checking that the trim indicator was in the TAKEOFF position.

The initial stage of the takeoff appeared normal but as the aircraft passed through 200 ft the pilot noted that the rate of climb appeared lower than expected. After reaching 1,000 ft, the pilot levelled the aircraft and reduced the engine power to maintain circuit height but found that the aircraft tended to pitch nose down even after the application of NOSE UP trim. The pilot increased engine power on the downwind leg of the circuit, which alleviated the tendency to pitch down and reduced the control forces.

The pilot decided to terminate the flight and informed ATC of her intentions. After turning onto the base leg and reducing airspeed, the pilot found that the nose-down pitch forces increased despite applying more NOSE UP trim. In an attempt to stabilise the aircraft, the pilot applied more engine power which reduced the forces but increased the aircraft's ground speed. During the final approach, the pitch-down tendency increased to the point where the pilot was unable to maintain the glidepath. The aircraft struck the ground approximately 15 metres from the runway threshold and continued along the ground before coming to a halt on the paved surface. The aircraft suffered significant damage (Figure 1) and the pilot, who had suffered minor injuries, was assisted from the aircraft by the AFRS.

Figure 1
Image of the aircraft taken shortly after the accident

Cessna 172 elevator trim system

The Cessna 172 is fitted with a moveable trim tab on the right elevator. The trim tab is used to 'trim' the aircraft and allow it to be flown at various attitudes with minimal pilot control force. The elevator trim system consists of a cockpit-mounted wheel and position indicator connected to a pair of cables which extend, through a series of pulleys, to the elevator trim tab actuator (Figure 2). The two cables are connected at the elevator by a length of chain which is looped around a sprocket on the trim tab actuator. A chain guard ensures that the chain remains engaged with the sprocket.

Rotation of the trim wheel moves the drive chain on the actuator sprocket, extending or retracting the actuator which in turn moves the trim tab. When the cockpit control wheel is turned, the position indicator moves to indicate the direction of trim wheel movement, either NOSE UP or NOSE DOWN. Movement of the trim wheel in a NOSE UP direction results in the elevator trim tab moving downwards in relation to the elevator and movement of the trim wheel in a NOSE DOWN direction results in the elevator trim tab moving up. Prior to takeoff, to ensure that adequate pitch control is available, the elevator trim tab is set to the neutral position, identified by the TAKEOFF position marked on the trim position indicator.

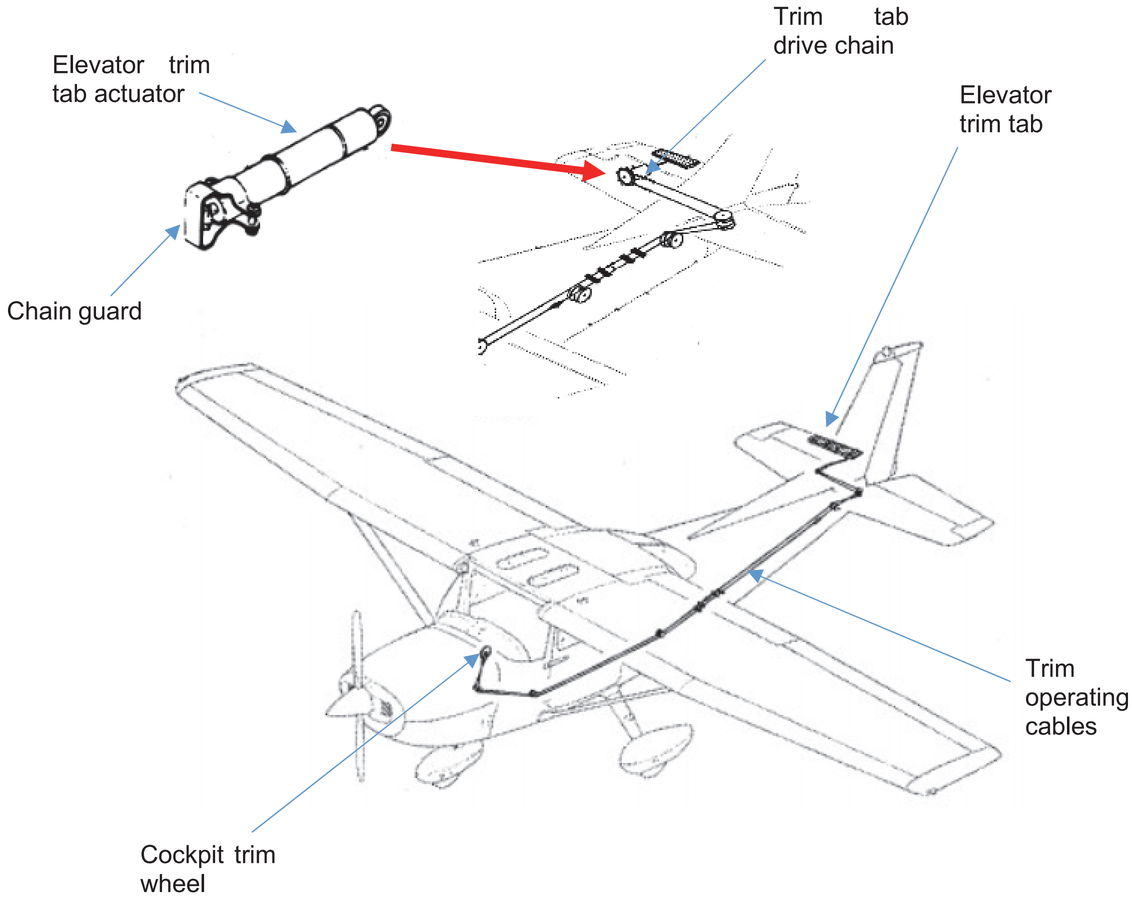

Figure 2

Cessna 172 pitch trim system

Aircraft examination

Examination of the aircraft was conducted by members of the Bermuda Civil Aviation Authority (BCAA) under the guidance of the AAIB and by representatives of the aircraft operator and maintenance organisation.

To identify engine-related issues, the engine's control unit (ECU) was removed from the aircraft and shipped to the AAIB where it was downloaded. The data showed several power and rpm exceedances associated with the pilot's use of engine power to assist with pitch control on the downwind leg of the circuit and during the approach to land. No other exceedances, cautions or fault messages were recorded during the flight.

Given the pilot's report, the investigation focussed on the aircraft's flying controls. No defects were found within the aileron, rudder or elevator control circuits or the range and freedom of control surface movement. Photographs of the aircraft, taken immediately after the accident (Figure1) showed the elevator trim tab in a position which corresponded to a NOSE DOWN trim position. Operation of the elevator trim system showed that the elevator trim tab moved in the opposite sense to the movement of the elevator trim wheel in the cockpit, with movement of the trim wheel to increase NOSE UP trim resulting in movement of the trim tab to increase the aircraft's tendency to pitch NOSE DOWN. Detailed examination of the aircraft, carried out by the BCAA and the operator, confirmed that the trim tab drive chain was engaged on the actuator drive sprocket and that the chain guard was correctly fitted. Further examination showed that the elevator trim system cables were correctly routed through the fuselage but the section of the cables and chain in the horizontal stabiliser had been rotated through 180°, crossing the cables and drive chain. This resulted in the trim tab moving in the opposite sense to that commanded by the trim wheel input.

Aircraft maintenance oversight

N9085H was operated and maintained by a Bermuda-based organisation, holding BCAA approvals for the continued airworthiness and maintenance of several aircraft. Prior to the leasing of N9085H, the BCAA had requested changes to the aircraft's maintenance program, which were implemented, but responsibility for airworthiness regulatory oversight remained with the FAA and the maintenance of the aircraft was carried out by two FAA-licensed engineers.

The maintenance organisation's procedures for Bermuda-registered aircraft included a requirement to carry out duplicate inspections of all flight-critical components, including flying controls and trim systems, after any maintenance action. There was no equivalent FAA requirement for the maintenance of N9085H.

Maintenance history

Examination of the aircraft's maintenance records showed that the aircraft had undergone a prolonged maintenance input prior to the accident flight during which the elevators, rudder and horizontal and vertical stabilisers had been removed to allow replacement of the horizontal stabiliser's forward spar.

The procedure for the removal and reinstallation of the elevators, elevator trim system and rudder are detailed respectively in sections 8, 9 and 10 of the Cessna 172 Aircraft Maintenance Manual (AMM). Section 9, states in paragraph 9-2 " *A "nose-up" setting results in a tab-down position".* The instructions also provide a warning at the end of the procedure which states:

WARNING

Be sure trim tab moves in correct direction when operated by trim wheel.
Nose down trim corresponds to tab up

Interviews with the mechanics involved in the maintenance of N9085H, conducted by the operator, confirmed that reference had been made to the AMM, including the warning relating to the trim tab movement, when reinstalling the flying controls. No abnormalities were identified during any of the post-installation function checks. Because there was no requirement to do so, a duplicate inspection of the elevator trim system was not carried out.

Analysis

The investigation confirmed that the elevator trim system had been rigged incorrectly, resulting in movement of the elevator trim tab in the opposite sense to the pilot's control inputs. The cables and drive chain which operated the trim tab actuator were rotated by 180° from their normal position within the horizontal stabiliser, reversing the movement of the trim tab. The presence of the elevator trim tab actuator chain guard, and the fact that the drive chain was still engaged on the actuator drive sprocket, confirmed that the actuator drive system had been assembled incorrectly during the maintenance input prior to the accident flight.

The movement of the elevator trim tab in the opposite sense to the movement of the control wheel, highlighted in the warning at the end of the AMM trim system reinstallation procedure, provided an opportunity for an incorrectly-connected trim system to be identified and corrected. The use of a duplicate inspection of flight critical systems, such as the elevator trim system, would have provided an additional opportunity to identify the mis-assembly of the pitch trim system. As the aircraft was being maintained in accordance with FAA regulations, there was no requirement to carry out a duplicate inspection.

The behaviour of the aircraft shortly after takeoff did not match the behaviour anticipated by the pilot. It has been demonstrated that such situations[1] induce a significant increase in the pilot's mental workload which greatly increases the time taken to assess the unexpected situation and carry out corrective actions. The pilot's lack of recent flying experience in the aircraft, and the increase in physical workload, required to control the aircraft, would have compounded this effect.

Safety actions taken

> The Bermuda-based maintenance organisation has introduced procedures to ensure that duplicate inspections of all flight critical systems are carried out, in line with its BCAA-approved maintenance procedures, on any aircraft that they operate or maintain, regardless of its State of Registration.

Footnote

1 Annemarie Landman, Eric L. Groen, M. M. (René) van Paassen, Adelbert W. Bronkhorst & Max Mulder (2017) The Influence of Surprise on Upset Recovery Performance in Airline Pilots, The International Journal of Aerospace Psychology, 27:1-2, 2-14, DOI: 10.1080/10508414.2017.1365610

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.

SERIOUS INCIDENT

Aircraft Type and Registration:	Britten-Norman BN-2B-21 Islander, VP-AEJ	
No & Type of Engines:	2 Lycoming IO-540 piston engines	
Year of Manufacture:	1980	
Date & Time (UTC):	4 July 2018 at 1940 hrs	
Location:	On approach to Robert L. Bradshaw Airport, Saint Kitts	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 1	Passengers - 4
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Broken aileron drive rod	
Commander's Licence:	FAA Commercial Pilot's License	
Commander's Age:	30 years	
Commander's Flying Experience:	875 hours (of which 700 were on type) Last 90 days - 95 hours Last 28 days - 33 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

During a short flight between the islands of Saint Eustatius and Saint Kitts, Caribbean, the pilot noticed that the ailerons felt "sluggish" but the aircraft landed successfully at Saint Kitts. It was found that a drive rod for the right aileron had broken and a spherical bearing, fitted to one end of the rod, had corroded heavily and was seized. Several safety actions have been taken to reduce the maintenance interval for control rods due to an increased risk of corrosion from the environmental factors where the aircraft operated. This investigation was delegated by the Dutch Safety Board to the AAIB in accordance with paragraph 5.1 of ICAO Annex 13.

History of the flight

The aircraft took off from Runway 06 at F. D. Roosevelt Airport on the island of Saint Eustatius, Caribbean, at 1930 hrs and routed to Robert L. Bradshaw International Airport on the island of Saint Kitts. Once airborne, the pilot noticed the ailerons felt "sluggish" on a right turn. The flight time between the islands was estimated to be 10 to 12 minutes, so the pilot continued the flight and landed at Saint Kitts at 1942 hrs. Despite reduced aileron control on the final approach, the pilot landed safely and the passengers disembarked normally. The pilot then carried out a walk-around inspection of the aircraft and found the right aileron drive rod had broken, so he informed the maintenance organisation.

Aircraft examination

On the evening after the incident flight, the maintenance organisation attended the aircraft and replaced the broken aileron drive rod in the right wing (Figure 1).

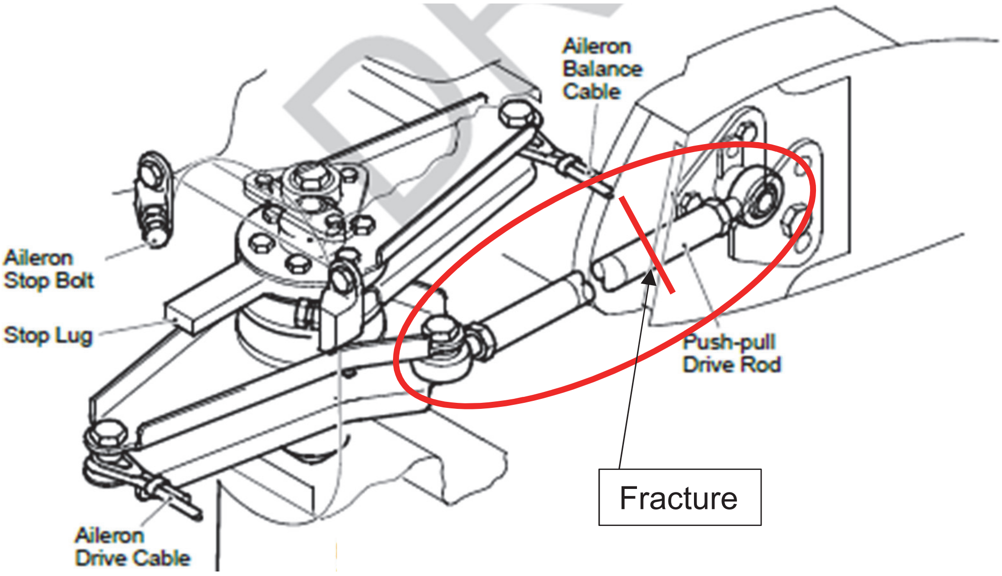

Figure 1

Aileron drive mechanism

An examination of the drive rod found that the spherical bearing in the rod end that connected to the aileron was heavily corroded and had seized. The rod had suffered an overload fracture 70 mm from the rod end at an area where the rod end had been riveted (Figure 2).

Figure 2

Broken drive rod

Analysis

It is the assessment of the aircraft manufacturer that the cause of the failure of the drive rod was initiated by the bearing corroding, which resulted in the seizure of the bearing. When normal operation loads were applied to the aileron drive mechanism they were sufficient to overload the rod and cause it to fracture. The aircraft manufacturer has published Service letter SL 127 '*Greasing of Aileron Rod End Bearings*' to remind operators of the greasing requirements and to request relevant feedback on bearing corrosion.

The maintenance organisation stated that much of the Caribbean coastline had recently been inundated with large quantities of Sargassum seaweed and as it decomposes, it releases hydrogen sulphide into the atmosphere. There had been several large storms and hurricanes pass through the region recently and this, coupled with the increased levels of hydrogen sulphide, may have resulted in accelerated corrosion in some components. The maintenance programme for the aircraft states a lubrication interval of 1,000 hours but the maintenance organisation is amending their programme to reduce this interval to 100 hours to prevent reoccurrence. Further, they have initiated a fleet-wide inspection programme of all aircraft drive rods and bearings to identify corroded bearings.

Conclusion

An aileron drive rod bearing had corroded and seized which resulted in the drive rod becoming overloaded and failing under normal operational loads. It is possible that the operating environment was more corrosive than the aircraft manufacturer expected when defining the lubrication tasks in the aircraft maintenance programme.

Safety actions

The following safety actions have been taken:

Aircraft manufacturer

Service Letter SL127 published to remind operators of the greasing requirements and to provide relevant feedback.

Maintenance organisation

A reduction in the lubrication task interval from 1,000 hours to 100 hours for the aileron drive rod bearings.

A fleet-wide corrosion inspection of all drive rod/bearing assembles.

ACCIDENT

Aircraft Type and Registration:	Cessna 404, N97AQ
No & Type of Engines:	2 Continental Motors Corp GTSIO-520M piston engines
Year of Manufacture:	1977
Date & Time (UTC):	28 December 2018 at 2347 hrs
Location:	Terrance B. Lettsome International Airport, British Virgin Islands
Type of Flight:	Commercial Air Transport (Non-Revenue)
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propellers, wings and fuselage
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	21,318 hours (of which 5,095 were on type) Last 90 days - 120 hours Last 28 days - 50 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was the only person on board for the repositioning flight which was in night VMC. He received landing clearance and the winds were reported to be gusty. He configured the aircraft for landing and enquired twice about the wind conditions before deciding to leave the flaps at their current setting of 10°.

As the aircraft flared and contacted the runway, the pilot realised that he had not lowered the landing gear. The aircraft came to rest on the runway and he was uninjured.

The pilot attributed the accident to failing to complete his checklist and confirm that the landing gear was down and locked. He considered that a contributory factor was allowing himself to become distracted when flying at night in turbulent and gusty wind conditions.

INCIDENT

Aircraft Type and Registration:	ERJ 190-100 SR Embraer 190, G-LCYL
No & Type of Engines:	2 General Electric Co CF34-10E5A1 turbofan engines
Year of Manufacture:	2010 (Serial no: 19000346)
Date & Time (UTC):	8 October 2018 at 1755 hrs
Location:	London City Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 76
Injuries:	Crew - None Passengers - 4 (Minor)
Nature of Damage:	Damage to armrest bumper at seats 18B and 18C
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	3,618 hours (of which 1,864 were on type) Last 90 days - 170 hours Last 28 days - 63 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

On landing at London City Airport an unsecured rear galley cabin bar trolley came out of its stowage and rolled forward through the passenger cabin. The trolley was stopped by a cabin crew member seated by Door 1 Left and then secured in the forward galley. Consequently, Door 1 Right would have been unusable in the event of a cabin evacuation. Four passengers were injured by the trolley as it passed down the cabin and were treated on board and in the terminal after arrival. One of the four passengers went to a local hospital for further treatment.

The operator reviewed and revised some of its Safety and Emergency Procedures to ensure that both cabin and galley areas are declared as being secure before landing.

SERIOUS INCIDENT

Aircraft Type and Registration:	MBB-BK 117 D-2 EC145, G-HEMC
No & Type of Engines:	2 Turbomeca Arriel 2E turboshaft engines
Year of Manufacture:	2014 (Serial no: 20012)
Date & Time (UTC):	15 December 2018 at 0026 hrs
Location:	Near Hollesley, Suffolk
Type of Flight:	Commercial Air Transport
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nil
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	3,954 hours (of which 464 were on type) Last 90 days - 62 hours Last 28 days - 24 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst repositioning to land during a Helicopter Emergency Medical Service (HEMS) operation at night, the aircraft struck a wire. No damage was caused. Despite a reconnaissance from the air and on foot, the presence of the wire was not known to the crew.

History of the flight

The aircraft was operating a HEMS flight in a rural area at night to collect and transfer a patient to hospital. It was crewed by two pilots. The weather at the time was good, with visibility reported to be in excess of 10 km and a broken cloudbase of 3,500 ft. The crew identified a large field in which to land. After carrying out an airborne check of its suitability, they made an uneventful approach to the field, then hover taxied across to their selected landing site.

There was then a request by the medical team on the ground to reposition the aircraft to a different landing site, in the same field, to assist in loading the patient. The medical team reported there were some wires running along a road near the new landing site, so a check was carried out by one of the pilots on foot with the aid of a powerful torch. The wires were located, but there was no evidence of any further wires in the vicinity. The crew also checked an electronic map carried on the aircraft which had the position of powerlines (but not telegraph lines) overlaid on it, which again showed no other wires in the field.

All times are UTC

The helicopter was then re-positioned to the new landing site, using the steerable landing light to check for obstacles as it taxied. The pilot reported the aircraft felt slightly unstable as he attempted to touchdown at the new landing site, so he repositioned the aircraft a short distance before landing and shutting down the engines.

The aircraft commander reported that on exiting the aircraft a single telegraph wire was found hooked over the radio antenna on the rear of the aircraft's tail. A check of the aircraft with the torch found no evidence of any damage. The telegraph wire was still intact and had no obvious damage from its contact with the aircraft. It had been pulled from a post positioned in the field which had not been seen, either during the obstacle check on foot, or whilst the aircraft was being taxied across the field.

As a precaution, the patient was transferred by road and the helicopter flown back to its base for a further inspection to be carried out. Again, no damage was found and there was no sign of any impact point with the wire.

Comment

The incident highlights the difficulty in seeing wires during such operations, despite careful reconnaissance both from the air and on the ground. Several technical solutions have been developed to assist in locating wires, but the issue remains a technical challenge. The operator is re-examining the suitability of some of these systems and is planning to develop an overlay map containing telegraph wires, for their area of operation, as such a system does not currently exist.

ACCIDENT

Aircraft Type and Registration:	Cessna 414, N414FZ (previous registration G-AZFZ)
No & Type of Engines:	2 Continental Motor TSIO-520 piston engines
Year of Manufacture:	1971 (Serial no: 414-0175)
Date & Time (UTC):	26 June 2018 at 1320 hrs
Location:	Farm building at Enstone Airfield, Oxfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Serious)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	1,194 hours (of which 9 were on type) Last 90 days - 60 hours Last 28 days - 26 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB enquiries

Synopsis

Shortly after taking off from Enstone Airfield, and while in a climbing turn to the right, the right engine stopped. The aircraft descended and returned to the airfield, crossing the runway at a low height before crashing into a poultry farm on the north side of the airfield. The aircraft and part of the poultry farm were destroyed in the subsequent fire. The pilot sustained minor injuries and the passenger multiple injuries, including a fractured vertebra.

Introduction

This investigation was carried out as a correspondence investigation and was based on information provided by the aircraft commander, witnesses, technical publications and photographs taken at the scene of the accident.

History of the flight

The aircraft departed Dunkeswell Airfield on the morning of the accident for a flight to Retford (Gamston) Airfield with three passengers on board, two of whom held flying licences. The passengers all reported that the flight was uneventful and after spending an hour on the ground the aircraft departed with two passengers for Enstone Airfield. This flight was also flown without incident.

The pilot reported that before departing Enstone he visually checked the level in the aircraft fuel tanks and there was 390 ltr (103 US gal) on board, approximately half of which was in the wingtip fuel tanks. After spending approximately one hour on the ground the pilot was heard to carry out his power checks before taxiing to the threshold of Runway 08 for a flight back to Dunkeswell with one passenger onboard (Figure 1).

During the takeoff run the left engine was heard to stop and the aircraft veered to the left as it came to a halt. The pilot later recalled that he had seen birds in the climbout area and this was a factor in the abandoned takeoff. The aircraft was then seen to taxi to an area outside the Oxfordshire Sport Flying Club, where the pilot attempted to start the left engine, during which time the right engine also stopped. The right engine was restarted, and several attempts appeared to have been made to start the left engine, which spluttered into life before stopping again. Eventually the left engine started, blowing out clouds of white and black smoke. After the left engine was running smoothly the pilot was seen to taxi to the threshold for Runway 08.

The takeoff run sounded normal and the landing gear was seen to retract at a height of approximately 200 ft agl. The climbout was captured on a video recording taken by an individual standing next to the disused runway, approximately 400 m to the south of Runway 08. The aircraft was initially captured while it was making a climbing turn to the right and after 10 seconds the wings levelled, the aircraft descended and disappeared behind a tree line. After a further 5 seconds the aircraft came into view flying west over buildings to the east of the disused runway at a low height, in a slightly nose-high attitude. The right propeller appeared to be rotating slowly, there was some left rudder applied and the aircraft was yawed to the right. The left engine could be heard running at a high rpm and the landing gear was in the extended position. The aircraft appeared to be in a gentle right turn and was last observed flying in a north-west direction. The video then cut away from the aircraft for a further 25 seconds and when it returned there was a plume of smoke coming from buildings to the north of the runway (Figure 1).

The pilot reported that the engine had lost power during a right climbing turn during the departure. He recovered the aircraft to level flight and selected the 'right fuel booster' pump (auxiliary pump) and the engine recovered power. He decided to return to Enstone and when he was abeam the threshold for Runway 08 the right engine stopped. He feathered the propeller on the right engine and noted that the single-engine performance was insufficient to climb or manoeuvre and, therefore, he selected a ploughed field to the north of Enstone for a forced landing. During the approach the pilot noticed that the left engine would only produce "approximately 57%" of maximum power, with the result that he could not make the field and crashed into some farm buildings.

There was an immediate fire following the accident and the pilot and passenger both escaped from the wreckage through the rear cabin door. The pilot sustained minor burns. The passenger, who was taken to the John Radcliffe Hospital in Oxford, sustained burns to his body, a fractured vertebra, impact injuries to his chest and lacerations to his head.

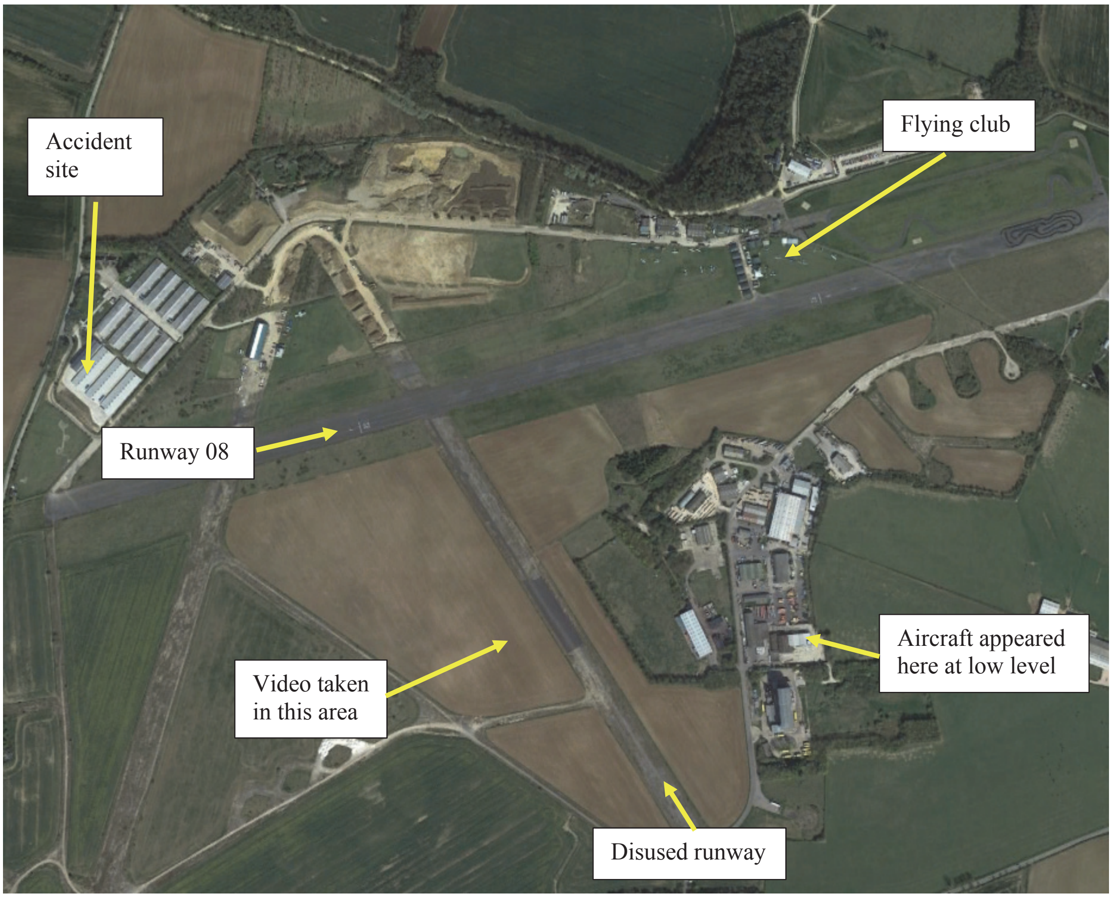

Figure 1

Enstone Airfield

Accident site

The aircraft had crashed into a poultry farm on the edge of the airfield, destroying part of a timber-framed building that was partially lined with asbestos. The resulting fire caused a substantial loss of poultry, from the effect of the fire and asbestos contamination. The aircraft was destroyed in the intense fire (Figure 2).

While liquid petroleum gas (LPG) was present at the accident site, the General Manager responsible for the farm advised that it had not been compromised in the accident and that the intense fire was caused by the fuel on the aircraft.

Figure 2
Remains of aircraft and engines at the accident site

Weather

The Met Office provided an aftercast based on the weather conditions at the time of the accident at RAF Brize Norton, RAF Benson and Oxford Kidlington Airport. With stable atmospheric conditions it was assessed that the weather at these locations would have been very similar to the conditions at Enstone Airfield. The aftercast concluded:

> *'The weather conditions at the time of interest would have been benign, with light easterly winds, visibility in excess of 10 Km, with no significant weather and no significant cloud below 5,000 feet. The most likely QNH pressure 1025 hPa, air temperature 27 degrees Celsius, wind speed and direction for 1,000 ft (agl) 090 degrees 05 knots …'*

Pilots qualifications and experience

The pilot's logbook and licence show that he undertook his check flight for his Multi Engine Piston (MEP) rating on 10 March 2016 and last renewed it on 21 March 2018. On the morning of the accident he had accumulated 120.4 hours as pilot-in-command on MEP aircraft, of which 8.5 hours and 10 flights had been flown in N414FZ. The pilot had not flown any other Cessna 414 aircraft. Although there was no requirement for him to have done so, there was no record of the pilot having had a formal conversion flight on this aircraft type.

Aircraft history

Much of the aircraft documentation, including the Pilot's Operating Handbook (POH), was destroyed in the fire. The current registration document for N414FZ was issued on 4 April 2018 when the aircraft was purchased by the pilot who was a joint owner.

A 50-hour maintenance check was completed on 2 November 2017 at 5,274.7 airframe hours during which Teledyne Continental Service Bulletin 95-7 was carried out on both engines. This Service Bulletin requires a check of the engine manifold valve for evidence of a fuel leak. The maintenance documents record that the fuel pressure tests were carried out satisfactorily on both engines. The owner had reported that the cylinder head temperature (CHT) on the right engine was not working. The fault was traced to a wiring defect and rectified. No significant defects were identified during the maintenance check.

Approximately 20 flying hours later, on 22 March 2018, the aircraft was taken to another maintenance organisation for a survey and clean. Wear was discovered in both propellers, which were replaced. No other significant faults were identified, and the engine ground runs were found to be satisfactory. The aircraft was collected on 14 June 2018 and the accident occurred 5 flying hours later.

The pilot reported that he had experienced no technical problems with the aircraft prior to the accident flight.

Aircraft fuel system

General

In the Cessna 414, the aircraft fuel system consists of the main wingtip fuel tanks (50 US gal each) and an auxiliary fuel tank (20 US gal each) in each wing. Two electrically-operated fuel pumps, the auxiliary pump and the fuel transfer pump, are mounted in each main fuel tank. The auxiliary fuel pump is mounted on the bottom of the main fuel tanks and provides fuel pressure for priming during engine starting and supplies fuel to the engine in an emergency. The transfer fuel pump is mounted on the main tank rear bulkhead and transfers fuel from the nose section of the main tank to the centre baffle area, where it is picked up and routed to the engine by either the engine-driven or auxiliary fuel pump. The fuel transfer pump prevents the possibility of fuel starvation to the engine during steep angles of descent and when fuel is low. The fuel auxiliary pump provides fuel to the engine-driven fuel injection pump via the fuel selector valve. A fuel vapour return line is installed between the engine-driven pump and the main fuel tanks.

Auxiliary fuel pump ('booster pump')

N414FZ had been fitted with a three-position auxiliary fuel pump switch and circuitry which was compliant with Cessna Service Bulletin MEB88-3. This modification allows the pilot to have direct control of the output pressure of the two auxiliary fuel pumps. The two switches are labelled AUX PUMP L and AUX PUMP, R. The positions on each switch are LOW, OFF and HIGH. The LOW position operates the auxiliary pumps at low speed and can be used, when required, to provide supplementary fuel pressure for all normal operations.

The HIGH position is reserved for emergency operations and operates the pump at a high speed which can provide sufficient fuel flow to sustain partial engine power in the event of an engine-driven fuel pump failure.

The Airplane Flight Manual Supplement for the auxiliary fuel pump switch system states:

> *'On rare occasions, such as during engine starting in cold weather, the HIGH position (instead of LOW) may be needed for a few seconds to ensure a good ground start or restart in flight.*
>
> ***CAUTION***
>
> ***If the auxiliary fuel pump switches are placed in the HIGH position with the engine-driven fuel pump(s) operating normally, total loss of engine power may occur.'***

Fuel distribution

The fuel distribution system allows either engine to be fed from the main fuel tanks in either wing or the auxiliary fuel tanks. Two fuel selector handles, one for each engine, are located between the front seats on the cabin floor that are marked with the following position:

Left engine fuel selector handle	*Right engine fuel selector handle*
- LEFT MAIN	*- RIGHT MAIN*
- right main	*- LEFT MAIN*
- LEFT AUXILIARY	*- RIGHT AUXILIARY*
- off	*- OFF*

The main and auxiliary fuel tanks are fitted with a capacitance fuel quantity indicating system. The fuel quantity gauge is a dual-indicator fuel gauge for the left and right main fuel tanks as well as the left and right auxiliary fuel tanks. When the fuel selector handle is in the MAIN TANK position, the gauge will indicate the quantity of fuel in the main tanks. When the fuel selector handle is placed in the AUXILIARY position an indicator light under the gauge will illuminate, indicating that the selector handle is in the auxiliary position and the fuel quantity gauge is indicating the content of the auxiliary tank.

Last refuel

N414FZ was last refuelled with 185 ltr (48 US gal) of Avgas 100LL at Dunkeswell Airfield on the morning of the accident. The aircraft then flew for approximately 0.8 hour before departing on the accident flight when the pilot reported that there was 390 ltr (103 US gal) of fuel on board. There have been no reports of any other aircraft experiencing problems with fuel uplifted from Dunkeswell Airfield.

Aircraft performance

Engines

The engines fitted to N414FZ were Continental TSIO-520-NB that had been modified by RAM Aircraft in 1996 by a Supplementary Type Certificate (STC) to increase the horsepower by approximately 25 hp. This modification would increase the climb and single-engine takeoff performance.

Regarding this modification, the FAA mandated for Part 135[1] aircraft the Time Between Overhaul as 1,600 hours or 12 years, this requirement did not apply to Part 91[2] aircraft such as N414FZ. At the time of the accident, the engines had operated for 5,827 and 4,447 hours since new and 1,764 and 1,774 hours since overhaul. However, RAM Aircraft had no record of the engines having been overhauled and considered it unlikely that the aircraft would still be able to achieve the increased performance from the modification that had been embodied in 1996.

Aircraft weight

The aircraft had last been weighed on 7 October 2013 when the basic weight was 4,875 lb and the centre of gravity was established as 156.97 inches aft of the datum.

During the accident flight there was approximately 140 lb of equipment in the cabin.

Performance graphs used on the accident flight

The pilot reported that he would have calculated the aircraft's performance during the accident flight using the aircraft's POH, which he believed were based on the engines being equipped with the RAM modification.

Calculation of aircraft performance by AAIB

As RAM aircraft advised the AAIB that the performance curves for the RAM modification were unlikely to be achieved, the AAIB estimated the single-engine climb performance using a POH for unmodified engines. The performance was calculated on:

Pilot and passenger	448 lb
Basic weight	4,875 lb
Other equipment	140 lb
Fuel	618 lb
	Total weight 6,066 lbs
Temperature	27°C (81°F)
Airfield height	550 ft (amsl)

Footnote

1 Part 135 is regulations defined by the US Federal Aviation Administration (FAA) for operations of small commercial aircraft.

2 Part 91 is regulations defined by the US Federal Aviation Administration (FAA) for operations of small non-commercial aircraft.

These parameters gave a single-engine climb performance of 173 ft/min at maximum takeoff weight (6,350 lb) and a single-engine climb performance for the accident flight (6,066 lb) of 250 ft/min. This climb performance assumed:

Max continuous power on the operating engine.

The propeller was feathered on the inoperative engine.

The flaps and landing gear were in the retracted position.

The engine cowl flaps were closed on the inoperative engine and open on the operating engine.

For the accident flight, the aircraft was flown at an airspeed of 101 kt

AAIB comment

Engine failure

The pilot and the passengers reported that both engines operated satisfactory on the two flights prior to the accident flight. No problems were identified with the engines during the maintenance activity carried out 25 and 5 flying hours prior to the accident and the engine power checks carried out at the start of the flight were also satisfactory. It is therefore unlikely that there was a fault on both engines which would have caused the left engine to stop during the aborted takeoff and the right engine to stop during the initial climb.

Fuel

The aircraft was last refuelled at Dunkeswell Airfield and had successfully undertaken two flights prior to the accident flight. There had been no reports to indicate that the fuel at Dunkeswell had been contaminated; therefore, fuel contamination was unlikely to have been the cause.

The pilot reported that there was sufficient fuel onboard the aircraft to complete the flight, which was evident by the intense fire in the poultry farm, most probably caused by the fuel from the ruptured aircraft fuel tanks.

With sufficient fuel onboard for the aircraft to complete the flight, the most likely cause of the left engine stopping during the aborted takeoff, and the right engine stopping during the accident flight, was a disruption in the fuel supply between the fuel tanks and engine fuel control units. The reason for this disruption could not be established but it is noted that the fuel system in this design is more complex than in many light twin-engine aircraft.

Aircraft performance

The AAIB calculated the single-engine climb performance during the accident flight using the performance curves[3] for engines not equipped with the RAM modification. It was a hot day and the aircraft was operating at 280 lb below its maximum takeoff weight. Assuming

Footnote

[3] Cessna Model 414 FAA Flight Manual applicable for serials numbers 414-0001 thru 414-0350, Revision 12, dated 29 August 1996.

the landing gear and flaps were retracted, the engine cowls on the right engine were closed and the aircraft was flown at 101 kt, then the single-engine climb performance would have been 250 ft/min. However, the circumstances of the loss of power at low altitude would have been challenging and, shortly before the accident, the aircraft was seen flying with the landing gear extended and the right engine still windmilling. These factors would have adversely affected the single-engine performance and might explain why the pilot was no longer able to maintain height.

Bulletin Correction

The AAIB report published in Bulletin 4/2019 reported in the Synopsis: '*The pilot and passenger both sustained minor injuries*.' This was based on early information. It was later established that the passenger had sustained multiple injuries, including a fractured vertebra. The passenger's injuries are therefore properly classified as 'Serious'.

The Bulletin header information should, therefore, read:

Injuries:	Crew - 1 (Minor)	Passengers - 1 (Serious)

The online version of this report was amended on the 14 November 2019 and a correction will appear in the December 2019 Bulletin.

SERIOUS INCIDENT

Aircraft Type and Registration:	Pioneer 300, G-CEAR
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2007 (Serial no: PFA 330-14511)
Date & Time (UTC):	29 September 2018 at 1400 hrs
Location:	Near New Alresford, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Heat distress to engine cowling and components on firewall; hairline cracking on wing skin and deformed landing gear brackets
Commander's Licence:	Light Aircraft Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	885 hours (of which 135 were on type) Last 90 days - 38 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

During the takeoff roll from Sandown Airfield, the aircraft hit a ridge in the runway causing it to become airborne before it had reached flying speed. Unable to sustain flight, it descended onto the runway before hitting a second ridge, causing it to become airborne again. It contacted the runway a second time with a "very heavy bump" and bounced. After a third bounce it then climbed away and routed towards its home airfield.

After 15 minutes of flight, approximately overhead New Arlesford, Hampshire, the cockpit filled with smoke. The pilot made a PAN call and was guided to land at Popham Airfield. He landed there successfully with fire crew in attendance and the aircraft was shut down.

Subsequent inspection of the engine compartment identified that the exhaust tailpipe had dislodged, allowing exhaust gases to impinge onto the engine cowling and firewall, causing significant damage. The heating of the fibreglass engine cowling had generated smoke which was then entrained into the cockpit ventilation system. Inspection of the airframe found cracks on the leading edge of the wing skin and deformed landing gear brackets.

SERIOUS INCIDENT

Aircraft Type and Registration:	Piper PA-34-200T Seneca II, G-IFLP
No & Type of Engines:	2 Continental Motors Corp TSIO-360-EB piston engines
Year of Manufacture:	1980 (Serial no: 34-8070029)
Date & Time (UTC):	16 December 2018 at 1820 hrs
Location:	Approx 30 miles west of Leeds
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	1,500 hours (of which 90 were on type) Last 90 days - 60 hours Last 28 days - 30 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

G-IFLP encountered control difficulties due to airframe icing resulting in a descent below the cleared level. The pilot requested clearance to descend but was not able to convey the seriousness of the request whilst also manually flying the aircraft and operating the de-icing system. The controller did not detect the urgency of the situation and instructed the aircraft to maintain altitude. This resulted in a brief loss of separation with another aircraft.

History of the flight

The pilot was flying at night from Leeds Bradford Airport to Oxford Airport with one passenger. During the climb the aircraft was experiencing intermittent IMC. After reaching FL90 the pilot observed freezing rain and a rapid ice build-up on the windscreen and wings. The pilot reported that he then started to have difficulty controlling the aircraft, particularly in pitch. He switched on the aircraft de-icing system and requested descent. ATC advised him to maintain altitude due to other traffic. The pilot continued to use the aircraft's de-icing system to clear the ice whilst attempting to maintain altitude. He recalled advising ATC that he had control problems due to icing but descent clearance was not given. He also recalled that another pilot relayed a message that G-IFLP was having control difficulties. After approximately four minutes the de-icing system cleared the ice and the aircraft was able to continue its flight to Oxford without further incident.

Air traffic control report

After the incident, the air traffic service provider reviewed the radar and radio recordings and provided a report which is summarised in Table 1.

TIME	EVENT
18:19:00	An Airbus 319 was inbound to Manchester Airport maintaining FL80. G-IFLP was level at FL90. The Airbus was transferred to Manchester Approach Control. G-IFLP mode C was observed to fluctuate between FL90 – FL93
18:19:15	G-IFLP was instructed to route to the Manchester (MCT) VOR.
18:20:05	G-IFLP turned to the west away from MCT VOR.
18:20:24	G-IFLP was at FL88 and 5.5 nm away from the Airbus which was maintaining FL80.
18:20:37	G-IFLP was at FL86 and 4.8 nm away from the Airbus (minimum required separation 1,000 ft or 5 nm).
18:20:42	G-IFLP was at FL87 and 4.5 nm away from the Airbus.
18:20:44	A "fast and broken" transmission was heard from G-IFLP requesting descent and mentioning icing. The controller responded with "maintain FL90". The controller contacted the Manchester Approach controller and advised them of G-IFLP descent. The Approach controller turned the Airbus to the right to re-establish lateral separation.
18:20:51	Separation was re-established with G-IFLP at FL90 and the Airbus descending through FL79.
18:21:08	The controller instructed G-IFLP to maintain FL90.
18:21:20	G-IFLP transmitted fast again but not as broken "losing control". This appears to have been missed by the controller who instructed G-IFLP to "maintain at least FL80"
18:21:24	G-IFLP turned to the south-east now at FL86. The Airbus passed 3.6 nm behind at FL76.
18:21:48	An unknown pilot transmitted "sir he said he's losing control"
18:21:51	G-IFLP returned to FL90 tracking to MCT VOR.
18:22:18	G-IFLP reported "stabilising"

Table 1

Timeline from radar and radio recordings

The radar recording showed the minimum recorded separation between the Airbus and G-IFLP was 4.5 nm and 600 ft. The minimum required separation is 5 nm or 1,000 ft. However, this can be reduced to 3 nm or 1,000 ft if both aircraft are with the same controller or if prior agreement is reached between two controllers (this did not occur in this case)[1].

Footnote

[1] The minimum separation standards and the conditions on their use are specified in Manual of Air Traffic Services Part 1 and the local Part 2.

Aircraft information

The Seneca II is an all metal aircraft with retractable landing gear, two turbocharged piston engines and seating for up to seven occupants. It is approved for IFR flight by day and night. G-IFLP was not fitted with an autopilot.

The aircraft is approved for flight in icing conditions. It is fitted with an ice protection system consisting of wing and empennage pneumatic boots, wing ice detection lights, electrothermal propeller deice pads and an electrically heated windshield panel. The pneumatic wing and empennage boots are installed on the leading edge of the wings, the vertical stabilizer and the horizontal stabilator. Once ice has accumulated on the wings, it may be cleared by pressing the SURFACE DE-ICE switch on the instrument panel. The boots are inflated for six seconds via an engine driven pressure pump. They work by fracturing ice that has built up over the boots. The Pilot's Operating Handbook (POH) recommends that 'boots should be cycled when ice has built to between ¼ and ½ inch thickness on the leading edge'. The system may not be able to shed light ice accumulations as the ice may not break when the boots inflate. Similarly, it may not work if ice has accumulated to the extent that the boots cannot break the ice or if ice forms whilst the boots are inflated causing the boots to cycle beneath the layer of ice.

The POH provides the following guidelines for operating in known icing conditions;

> *'The following guidelines should be observed:*
>
> *a) Flight into severe icing is prohibited.*
>
> *b) Moderate icing conditions above 10,000 ft should be avoided whenever possible; if moderate icing conditions are encountered above 10,000ft, a descent to a lower altitude should be initiated if practical.*
>
> *c) Operation in light icing is approved at all altitudes.'*

The following warning is contained in the limitations section;

> *'Severe icing may result from environmental conditions outside of those for which the airplane is certificated. Flight in freezing rain, freezing drizzle, or mixed icing conditions may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. This ice may not be shed using the ice protection systems and may seriously degrade the performance and controllability of the airplane.'*

Meteorology

The Met Office forecast for the date and time of the incident is shown in Figure 1. Moderate icing was forecast from between 4,000 ft and 5,000 ft to the upper limit of the chart (10,000 ft). Severe icing was forecast within isolated cumulonimbus cloud embedded within the occluded front.

Met Office forecasts will predict moderate icing in high humidity environments (ie in cloud, where the air temperature is between 0°C and -20°C) and severe icing within cumulonimbus, alto cumulus castellanus or nimbostratus clouds. However, this does not relate directly to the amount of ice accumulation an aircraft may experience in flight. Ice accumulation is dependent on aircraft type, length of time in the icing environment and the aircraft ice protection systems.

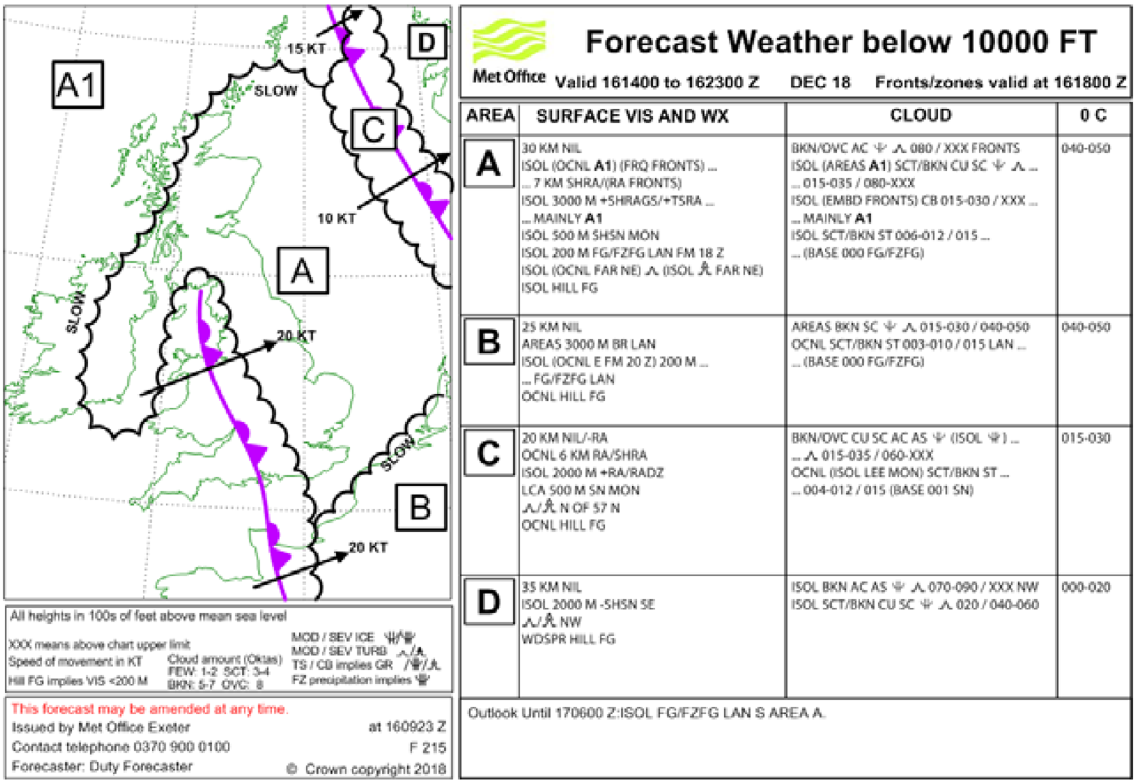

Figure 1

Met Office forecast for 16 December 2018

Personnel

The pilot held a commercial pilot's licence with a valid single-pilot multi-engine rating and instrument rating (MEP/IR rating). The pilot also held a flight instructor rating.

Analysis

G-IFLP descended below its cleared level due to control difficulties associated with ice accumulation on the airframe. Moderate icing was forecast on the planned route with severe icing forecast within embedded cumulonimbus cloud associated with the occluded front to the west. This descent resulted in a loss of separation with another aircraft.

The separation between the two aircraft reduced to a minimum of 4.5 nm and 600 ft. This would have been acceptable if both aircraft were being controlled by the same controller or if prior co-ordination had been agreed. However, as this had not occurred the minimum required separation was 5 nm or 1,000 ft.

The pilot reported that when the icing event occurred his focus was on controlling the aircraft using the maxim 'Aviate, Navigate, Communicate'. Flying the single-pilot aircraft, without an autopilot, in instrument conditions whilst operating the de-icing system left the pilot limited capacity to communicate with air traffic control. The pilot attempted to request descent but, was not able to convey to the controller the seriousness of situation. The controller did not detect the urgency in the request for descent and instructed the aircraft to maintain altitude. The controller contacted the approach controller, who was controlling the other aircraft, to advise of G-IFLP's descent, so they could re-establish separation. Another pilot on the frequency realised the problem and tried to assist by advising the controller that G-IFLP was "losing control". However, by this time the ice had cleared and the aircraft was able to resume FL90.

With the benefit of hindsight, the pilot thought he could have transmitted a PAN or MAYDAY call to ensure the controller was aware of the severity of the control difficulties. However, at the time, he was not sure how quickly the ice would clear and his primary focus was on flying the aircraft.

This incident highlights the hazard of icing conditions particularly to light aircraft. The CAA Safety Sense Leaflet – '*Winter Flying*'[2] provides guidance for flying in potential icing conditions.

Conclusion

The aircraft descended below its cleared level due to control difficulties caused by ice accumulation on the airframe. This resulted in a loss of separation with another aircraft.

Footnote

2 http://publicapps.caa.co.uk/docs/33/20130121SSL03.pdf (assessed on 21 January 2019).

ACCIDENT

Aircraft Type and Registration:	Pulsar, G-LUED	
No & Type of Engines:	1 Rotax 582 piston engine	
Year of Manufacture:	1996 (Serial no: PFA 202-12122)	
Date & Time (UTC):	31 August 2018 at 1800 hrs	
Location:	Sturgate Airfield, Lincolnshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 1 (Minor)	Passengers - None
Nature of Damage:	Broken canopy, nose and propeller	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	76 years	
Commander's Flying Experience:	475 hours (of which 375 were on type) Last 90 days - 4 hours Last 28 days - 2 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further AAIB enquiries	

Synopsis

After landing at Sturgate Airfield, G-LUED overran the runway and crossed a bare patch of earth before its mainwheels dropped into a ditch. The aircraft then flipped over and came to rest inverted heading back towards the runway. The occupants of a passing car helped the pilot and his passenger vacate the aircraft.

History of flight

As he took off, the pilot assessed that the weather was fair, with a 5 kt breeze from the south west. On checking the windsock before landing, he judged that the wind was more southerly in direction, but still suitable for a landing on the westerly runway. The pilot did not report the actual threshold speed achieved but stated that the aircraft failed to decelerate as anticipated after it touched down at the start of Runway 27. The aircraft overran the 820 m landing distance available and crossed an un-prepared surface before its mainwheels dropped into a ditch. The aircraft then nosed over, coming to rest inverted heading approximately 100°M with its tail adjacent to a public road bounding the airfield. The pilot considered that the wind had swung round towards the south east during his approach and he believed that an unexpected tailwind was the cause of the runway overrun.

Figure 1

G-LUED inverted after the accident (image ©Lincolnshire Police)

Other information

G-LUED's approach and landing was witnessed by a second pilot who had recently landed and was standing to the south of the main runway. He judged that the touchdown point was significantly inset into the runway (Figure 2) and he heard G-LUED's engine note rise as if the pilot was attempting an aborted-landing go-around. He did not see the aircraft enter the ditch but ran over to it as soon as he realised there had been an accident. On arriving at the scene, he found two passers-by, who had been driving on Common Lane, helping the occupants of G-LUED.

Figure 2

Overview of Sturgate Airfield

The witness noted that there was no evidence of the aircraft's tailwheel having been on the ground during the overrun. This was corroborated by photographic evidence[1] which showed distinct witness marks from the aircraft's mainwheels leading from the runway, but revealed no evidence of a tailwheel track.

The accident pilot stated that he did not attempt to abort the landing. He expressed the belief that once on the ground he was committed to stopping because the two-stroke engine would not accelerate sufficiently quickly for a successful go-around.

Aircraft information

The Pulsar is a two-seat, low-wing, amateur-built aircraft with fixed undercarriage in either the tailwheel or tricycle configuration. G-LUED was a tailwheel variant powered by a Rotax 582, two-stroke engine. After prolonged periods at low power, such as in descents, two-stroke engines can be prone to spark plug fouling. When discussing such descents, the Pulsar 582 Operating Handbook (POH) recommends that pilots:

> *'Clear the engine* [by increasing RPM to prove the engine and burn off deposits] *every few minutes during descents to make sure you still have it.'*

Being a light, low drag aircraft, the Pulsar gains speed easily on final approach, but it is difficult to reduce it. A senior Light Aircraft Association (LAA) engineer and pilot who had test-flown this type of aircraft reported that they handle well on landing but can be prone to floating in ground effect at threshold speeds higher than the 65 to 70 mph recommended in the POH[2]. To increase drag and help with glidepath control, the trailing edge wing flaps can be lowered. Evidence from Figure 3 indicates that G-LUED's flaps were in the landing position when the it overran the runway.

In relation to engine performance, the LAA pilot stated that, if the engine is "cleared" prior to landing to ensure there is no spark plug fouling or carburettor icing, there is no reason why it could not reasonably be relied upon to perform a go-around from ground level.

The aircraft kit manufacturer had ceased trading and it was not possible to obtain definitive figures for the landing distance required in the conditions prevailing at the time of the accident. The AAIB report into a previous Pulsar accident[3] stated:

> *'The landing ground roll was estimated by* [the design] *organisation to be approximately 800 ft (243 m), but the conditions in which this could be achieved were not stated.'*

Footnote

1 This photograph was made available to the investigation, but the copyright holder's permission for publication was withheld.
2 60 mph is recommended for short-field landings.
3 G-BULM, 17 April 2207, (https://www.gov.uk/aaib-reports/pulsar-g-bulm-17-april-2007) accessed 18 October 2018.

Figure 3

G-LUED inverted with trailing edge flaps extended (image ©Lincolnshire Police)

CAA Safety Sense Leaflet 01, *Good Airmanship Guide*

In Safety Sense Leaflet 01 (Version E)[4], the CAA reinforces the point that a good landing is a result of a good approach and that pilots should be prepared to go-around when circumstances dictate it. They specifically recommend that pilots should:

> *'Go-around if not solidly 'on'* [the ground] *in the first third of the runway, or the first quarter if the runway is wet grass.'*

Analysis

Even considering the possibility of a small tailwind component, it appeared likely that, with a nominal landing ground run of 243 m, the aircraft should have been able to stop within the 820 m landing distance available. The lack of tailwheel witness marks in the overrun area indicated that aircraft was travelling fast enough for the tail to be flying when it left the prepared surface[5]. On balance, the evidence suggested that the aircraft touched down further along the runway than the pilot estimated, as observed by the witness standing south of the runway.

It was not possible to determine the exact cause, but it is possible that wind effects, coupled with a tendency for the aircraft to float in ground effect, contributed to a deep landing and consequential overrun.

The pilot's lack of confidence in the accelerative capability of the engine may explain why he did not believe that he had sufficient time to go around in the circumstances at the time.

Footnote

4 http://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=detail&id=1156 accessed 3 Dec 2018.

5 The investigation did not establish the minimum airspeed at which it was possible to hold the tailwheel off the ground.

Conclusion

This accident occurred because the aircraft was not stopped in the landing distance available. Light, slippery aircraft pose an energy management challenge and their pilots need to be alert to the threat of deep landings.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna F152, G-OLEE
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1980 (Serial no: 1797)
Date & Time (UTC):	22 January 2019 at 1129 hrs
Location:	Fairoaks Airport, Surrey
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Tailfin, rudder, engine, propeller, nose landing gear, and right wingtip damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	136 hours (of which 118 were on type) Last 90 days - 3 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot and subseqeunt enquiries

Synopsis

The aircraft bounced twice on landing and deviated to the left side of the runway, becoming inverted when the nosewheel entered soft ground.

History of the flight

The pilot had hired the aircraft with the intention of conducting circuit practice at Fairoaks Airport. He reported that the weather was CAVOK and the wind was calm. Following the first circuit, the pilot flew an approach to Runway 24 intending to carry out a touch-and-go. After the landing flare, he stated that the main wheels touched down as normal, but the aircraft bounced and briefly became airborne again. A second, more severe bounce followed, during which he reported that the aircraft was lifted by a gust of wind, causing it to come down on the left side of the runway. The aircraft landed heavily on its nose gear, causing it to partially collapse. It then slid towards the runway edge and became inverted when the nosewheel entered soft ground at the side of the runway (Figures 1 and 2). The pilot sustained only minor injuries and exited the aircraft with the assistance of the airport fire and rescue service.

Figure 1
Witness marks on the runway from G-OLEE's nose gear

Figure 2
G-OLEE after coming to rest

Discussion

Witnesses in the airport tower reported that no attempt to initiate a go-around was observed after either bounce. The pilot considered that he could have selected full throttle for a go-around but he was unsure how effective this action would have been, as the airspeed had reduced substantially during the second bounce.

ACCIDENT

Aircraft Type and Registration:	Dyn'Aéro MCR-01 UL, OO-D51	
No & Type of Engines:	1 Rotax 912 ULS piston engine	
Year of Manufacture:	2001	
Date & Time (UTC):	14 March 2018 at 1225 hrs	
Location:	Winsford, Cheshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Canopy, nose landing gear and wheel, right wing, propeller and lower engine support damaged	
Commander's Licence:	ULM (Belgium)	
Commander's Age:	59 years	
Commander's Flying Experience:	185 hours (of which 150 were on type) Last 90 days - 10 hours Last 28 days - 5 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

The pilot had taken off from Calais, France with the destination of Lymm Dam airfield, which is located 7 nm west of Manchester Airport. At approximately 1219 hrs, the pilot contacted Manchester Radar and reported that he was at Stoke-on-Trent and descending to enter the low-level route between the Manchester and Liverpool CTRs. As the aircraft approached the town of Winsford at an altitude of about 1,000 ft, a large section of the canopy detached (Figure 1), following which the pilot decided to make a forced landing in a nearby grass field. The nose gear collapsed during the landing, and the right wing, propeller and engine support were damaged. The pilot was uninjured.

The pilot was uncertain as to why the section of canopy broke away, but he stated that it may have been due to a collision with a drone.

No evidence of a drone or the missing section of canopy has been located and no injuries to persons or damage to property have been reported on the ground.

Figure 1

OO-D51 damage to canopy and aircraft after forced landing

ACCIDENT

Aircraft Type and Registration:	Grob G109A, G-CINK
No & Type of Engines:	1 Limbach L 2400-EB1AA piston engine
Year of Manufacture:	1982 (Serial no: 6103)
Date & Time (UTC):	19 October 2018 at 1340 hrs
Location:	Deenethorpe Airfield, Northamptonshire
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Broken propeller, nose cowling and canopy
Commander's Licence:	British Gliding Association Full Rating with Instructor endorsement
Commander's Age:	55 years
Commander's Flying Experience:	1,740 hours (of which 490 were on type) Last 90 days - 12 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The Grob G109A is a tailwheel motor glider with dual-function airbrake levers which, when pulled, deploy the airbrakes and, when pulled further, apply the mainwheel brakes. The aircraft has a 'car-type' ratchet parking brake. After landing, pilots hold the control column fully back, to keep the tail from lifting, and pull the airbrake lever firmly aft to actuate the wheelbrakes. On this occasion the student pilot did not deflect the airbrake lever sufficiently to generate effective wheel-braking. The instructor called "more brake" three times to prompt him to apply greater force to the lever. The student mis-interpreted these calls and applied the parking brake instead, which resulted in "hard, uncontrolled braking". Despite rapid intervention by the instructor, the aircraft tipped forward damaging the nose cowling and propeller (Figures 1 and 2).

The instructor had considered taking control of the braking sooner but had not wanted to dent the student's confidence after a good landing. He never envisaged that the student would apply the parking brake. The instructor reflected that, in future, he would be more explicit in his use of terminology. Later models of the G109 have been redesigned with toe-brakes instead of the G109A's lever-controlled system.

Figure 1
Damage to nose fairing and spinner

Figure 2
Damage to propeller

ACCIDENT

Aircraft Type and Registration:	RAF 2000 GTX-SE, G-HEKK
No & Type of Engines:	1 Subaru EJ22 piston engine
Year of Manufacture:	1997 (Serial no: PFA G/13-1285)
Date & Time (UTC):	27 October 2018 at 1344 hrs
Location:	Great Heck, North Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Damage to landing gear, rotor blades, propeller and airframe
Commander's Licence:	Private Pilot's Licence
Commander's Age:	72 years
Commander's Flying Experience:	1,939 hours (of which 625 were on type) Last 90 days - 16 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further inquiries by the AAIB

Prior to takeoff, the pilot assessed the wind direction from his windsock as from 290°. He took off from Great Heck's grass strip in a southerly direction but, at 80 ft, after passing above a tree line, he encountered "unexpected severe turbulence and down draft". This caused the aircraft to descend to approximately 40 ft, after which the pilot reported cutting engine power and lowering the nose. The effect of this was an immediate descent to the ground resulting in significant damage to the aircraft.

The pilot was wearing a full harness and suffered minor injuries. He stated that he was familiar with this airfield but had been startled by the unexpected turbulent conditions at 80 ft which may have explained his decision to lower the nose and reduce power.

The pilot held a PPL with a single-engine gyroplane rating. This rating had expired just over two weeks prior to the accident, on 11 October 2018. The pilot also stated that he believed his license revalidation was required in November, not October which was why it was not valid at the time of the accident. The licence was revalidated on 12 December 2018.

ACCIDENT

Aircraft Type and Registration:	DJI Matrice 210 (Serial No 0GODF8F0240020)
No & Type of Engines:	4 electric motors
Year of Manufacture:	Unknown
Date & Time (UTC):	29 January 2019 at 1633 hrs
Location:	Old Lane, Little Hulton, Manchester
Type of Flight:	Aerial Work
Persons on Board:	Crew - N/A Passengers - N/A
Injuries:	Crew - N/A Passengers - N/A
Nature of Damage:	Destroyed
Commander's Licence:	Other
Commander's Age:	33 years
Commander's Flying Experience:	37 hours (of which 15 were on type) Last 90 days - 11 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The unmanned air system (UAS) had been used to carry out an aerial search during a police operation. On completion, it was being flown back to the launch point, when, without warning, it rapidly spiralled to the ground. It crashed into a small stream and was extensively damaged. An examination of the UAS data after the accident found the cause was a propulsion error in one of its four motors.

History of the flight

The UAS was being flown on an aerial search during a police 'missing persons' operation over a built-up area on the outskirts of Manchester. The weather at the time was overcast with light sporadic snow and an estimated wind speed at the search area of 8 to 10 mph. The UAS was launched at about 1518 hrs with a 100% battery charge and spent approximately 23 minutes airborne. On landing the operator checked the UAS and dried a small amount of moisture from its surfaces and ensured there was no ice on the propeller blades. A second flight of 10 minutes was carried out after which the UAS was landed to remove droplets that had formed on the camera lens. After a further 15 minute flight the batteries were changed for a fully charged set.

The UAS was relaunched and flew another 19 minutes to complete the search. The UAS was at approximately 250 to 300 ft agl and 1,000 ft from the operator. The UAS was then turned to fly back to the operator at the launch point. As it got to within 400 ft of the operator, without warning, it entered a tight spiral descent and plummeted to the ground. Whilst the UAS was in descent the operator quickly checked the control screen for warnings and found no error messages and noted the battery reserve at 40%. He described hearing the propulsion motors being louder and turning faster than he had ever heard them before. The UAS crashed upside down into a small stream and was extensively damaged. Both batteries had detached, the landing gear legs had broken and although all the propeller 'stubs' were present, all but one of the propeller blades were missing.

Cause

The data from the UAS system was examined after the accident by the manufacturer. It indicated that there had been a propulsion error in one of its four motors whilst the UAS was at a height of 68.5 m (223 ft).

Miscellaneous

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

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

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

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

Published June 2014.

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

Published September 2014.

1/2015 Airbus A319-131, G-EUOE London Heathrow Airport on 24 May 2013.

Published July 2015.

2/2015 Boeing B787-8, ET-AOP London Heathrow Airport on 12 July 2013.

Published August 2015.

3/2015 Eurocopter (Deutschland) EC135 T2+, G-SPAO Glasgow City Centre, Scotland on 29 November 2013.

Published October 2015.

1/2016 AS332 L2 Super Puma, G-WNSB on approach to Sumburgh Airport on 23 August 2013.

Published March 2016.

2/2016 Saab 2000, G-LGNO approximately 7 nm east of Sumburgh Airport, Shetland on 15 December 2014.

Published September 2016.

1/2017 Hawker Hunter T7, G-BXFI near Shoreham Airport on 22 August 2015.

Published March 2017.

1/2018 Sikorsky S-92A, G-WNSR West Franklin wellhead platform, North Sea on 28 December 2016.

Published March 2018.

2/2018 Boeing 737-86J, C-FWGH Belfast International Airport on 21 July 2017.

Published November 2018.

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

http://www.aaib.gov.uk

GLOSSARY OF ABBREVIATIONS

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

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