CONTENTS

SPECIAL BULLETINS

COMMERCIAL AIR TRANSPORT

FIXED WING

ROTORCRAFT

GENERAL AVIATION

FIXED WING

ROTORCRAFT

None

SPORT AVIATION / BALLOONS

CONTENTS (Continued)

ADDENDA and CORRECTIONS

(ALL TIMES IN THIS BULLETIN ARE UTC)

SERIOUS INCIDENT

Aircraft Type and Registration:	Cessna Citation 680 Sovereign, G-CJCC
No & Type of Engines:	2 Pratt and Whitney Canada PW306C turbofan engines
Year of Manufacture:	2008
Location:	During climb after departure from London Luton Airport
Date & Time (UTC):	30 September 2010 at 0825 hrs UTC
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 3 Passengers - 5
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	6,500 hrs of which 350 hrs were on type
Information Source:	AAIB Field Investigation

The investigation

The Air Accidents Investigation Branch (AAIB) was informed of the serious incident involving this aircraft at 1130 hrs on 1 October 2010 and an investigation was commenced immediately under the provisions of the *Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996.* In accordance with established international arrangements, the National Transportation Safety Board (NTSB) of the USA, representing the State of Design and Manufacture of the aircraft, appointed an Accredited Representative to participate in the investigation. The investigation is also being fully supported by all parties involved.

History of the flight

The aircraft was operating a commercial passenger flight from London Luton Airport, United Kingdom, to Milas-Bodrum Airport, Turkey. It departed with a full fuel load of approximately 11,000 lbs. As it passed FL300 for FL320 in the climb, the DC EMER BUS L amber Crew Alerting System (CAS) message appeared. The crew referred to the Emergency/Abnormal Procedures checklist and, from the observed indications, concluded that there was a fault on the left main electrical bus. They completed the required action items, which included selecting the left generator to OFF. They elected to return to Luton as the weather there was favourable and it was only 20 minutes flying time.

When the left generator was selected OFF, a number of systems lost power, including the flaps, the left fuel quantity indication and the commander's Primary Flight Display (PFD). The commander handed control to the co-pilot, who remained the handling pilot for the rest of the flight. As the flight progressed, the co-pilot became aware that an increasing amount of right aileron control input was required to maintain a wings-level attitude. A flapless landing was completed at Luton Airport without further incident.

When the aircraft was powered up again, all systems appeared to operate normally, including the left fuel quantity indication. The left tank fuel quantity indication was approximately 5,500 lbs (corresponding to full) and the right tank indication was approximately 3,300 lbs. The crew confirmed that they had not selected the fuel cross-feed during the flight.

Fuel system

Two separate integral wing fuel tanks, each with a capacity of 5,500 lbs, provide fuel for the engines and auxiliary power unit. Each engine is normally supplied from its on-side fuel tank. An electrically-driven boost pump supplies fuel pressure for engine starting. A motive-flow pump provides fuel to the engine once it is running and the boost pump is then switched off. The engine-driven fuel pump provides excess fuel flow capacity, with the excess fuel being returned to the on-side tank. The excess flow is used to operate the motive-flow pump.

A selectable fuel cross-feed facility allows either fuel tank to supply the opposite engine. When selected, the cross-feed valve is commanded open and the electric boost pump in the selected tank operates. A signal is sent to the cross-fed engine to close the motive-flow shutoff valve to the tank not in use, so that any excess fuel flow is returned to the selected tank.

The maximum permissible lateral fuel imbalance is 400 lbs, but this can be increased to a maximum of 800 lbs in an emergency.

Post-incident testing

During ground testing under AAIB supervision, it was established that removing power from the left main electrical bus caused the fuel cross-feed valve to open and the right fuel boost pump to operate, with the cross-feed selector switch in the OFF position. FUEL CROSS FEED and R BOOST PUMP messages were also displayed on the CAS. Tests on another, similar aircraft produced the same result.

Recorded data indicate that the motive-flow shutoff valves on both engines did not move during the incident.

Discussion

This incident and subsequent ground testing showed that removal of power from the left main bus will cause the fuel cross-feed valve to open and the right boost pump to operate without any crew selection, and the motive-flow shutoff valves will remain open. This allows motive-flow fuel to be returned to both tanks, resulting in uncommanded fuel transfer from the right to the left tank. During the 20 minutes that elapsed between selecting the left generator OFF and landing at Luton, sufficient fuel was transferred from the right to the left tank, via the left engine motive-flow system, to create a fuel imbalance of 2,200 lbs. The crew were not aware that this was occurring, as only the right fuel quantity indication was available.

It is apparent that if the left main bus is not powered during aircraft operation, uncommanded fuel transfer from the right to the left tank will occur. This will cause an increasing lateral fuel imbalance, with associated roll control difficulties. For this reason, the following Safety Recommendations are made:

Safety Recommendation 2010-090

It is recommended that the Cessna Aircraft Company immediately informs all operators of Cessna Citation 680 Sovereign aircraft that uncommanded fuel transfer will occur during aircraft operation if the left main electrical bus is not powered.

Safety Recommendation 2010-091

It is recommended that the Federal Aviation Administration (FAA) require the Cessna Aircraft Company to take suitable actions for the Cessna Citation 680 Sovereign, to prevent uncommanded fuel transfer during aircraft operation when the left main electrical bus is not powered.

Published 8 October 2010

ACCIDENT

Aircraft Type and Registration:	Boeing 747-41R, G-VROC
No & Type of Engines:	4 General Electric CF6-80C2B1F turbofan engines
Year of Manufacture:	2003
Date & Time (UTC):	28 October 2009 at 1956 hrs
Location:	Johannesburg International Airport, South Africa
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 18 Passengers - 228
Injuries:	Crew - None Passengers - None
Nature of Damage:	No 14 tyre burst, part of a landing gear door detached, impact damage to flap and flap fairing
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	16,073 hours (of which 8,630 were on type) Last 90 days - 182 hours Last 28 days - 53 hours
Information Source:	AAIB Field Investigation

Synopsis

During the takeoff roll, after passing V_1 decision speed, the flight crew heard a "large thud", which was followed by moderate lateral vibrations and vibrations felt through the control column and rudder pedals. The flight crew continued the takeoff and landed safely at their destination. An investigation revealed that the No 14 tyre had burst during the takeoff ground roll at approximately 160 kt. The evidence indicated that the tyre probably burst when it ran over a foreign object. However, no foreign object was found and due to some missing tyre material, the nature of this object could not be determined.

History of the flight

The aircraft was operating a scheduled passenger service from Johannesburg International Airport (JNB) to London Heathrow Airport. Prestwick was selected as the primary alternate for operational reasons and fuel uplifted accordingly. The resulting takeoff weight was approximately 351,000 kg. The cockpit crew comprised the commander, the co-pilot, who was the pilot flying for takeoff, and a third pilot who would assist the operation at other times during the flight.

The departure and takeoff from Runway 03L was uneventful until shortly after the aircraft passed V_1[1]

Footnote

[1] V_1 is the takeoff/abort decision speed.

speed, when a "large thud" was heard. This was followed by moderate lateral vibrations and accompanied by vibrations felt through the control column and rudder pedals. Upon the commander's call "rotate", the co-pilot pitched the aircraft nose-up and, when a positive rate of climb had been established, called for the landing gear to be retracted. The landing gear was selected up and retracted normally, at which point all unusual airframe vibrations stopped.

The three pilots discussed the thud and vibrations and initially concluded that the nosewheel had hit a runway centreline light, which on previous occasions had caused some vibration. However, on this occasion the vibration was of greater amplitude, and the crew considered the possibility that a tyre had burst during the takeoff. The co-pilot asked the commander to inspect the EICAS[2] 'GEAR' page, which presented no abnormal indications, although tyre pressures were not monitored. He then continued to hand fly the aircraft and judged that it "flew very well" with "no abnormal vibrations or buffeting". The flaps were retracted normally, the autopilot was engaged and the remainder of the departure was flown without incident.

The commander contacted the JNB Tower controller to advise that the aircraft may have suffered a tyre failure and requested a runway inspection. Later, when in contact with a subsequent ATC agency, the commander was advised that a piece of rubber, some honeycomb material and a piece of metal had been found.

Most of the cabin crew reported feeling a thud and vibrations during the takeoff. One stated that at the time of the thud she was nudged sideways in her seat and that the noise came from the left side of the aircraft.

Footnote

[2] Engine Indication and Crew Alerting System.

The third pilot went into the cabin to speak to a company pilot travelling as a passenger who he judged might be able to offer an informed opinion. The positioning pilot indicated he had felt the thud and vibrations but was not aware of any abnormalities after retraction of the nosewheel, close to which he was seated.

Later in the flight the pilots contacted the operator's engineering support organisation (known as Maintrol), who suggested that, in the absence of buffeting or abnormal tyre pressure, there was no undue cause for concern. However, this aircraft was not equipped with tyre pressure sensors. The pilots also contacted the company engineer in JNB to request that he attempt to identify the debris.

In a further attempt to identify the debris found at JNB the co-pilot broadcast to the crews of aircraft that had departed JNB earlier, asking if they had received any abnormal indications. None reported that they had. In a subsequent transmission, Maintrol informed the pilots that the rubber debris was a piece of tyre of a type used on the B747-400.

After a discussion involving cockpit and cabin crew, considering the continued normal behaviour of the aircraft in flight and having consulted the *Flight Crew Training Manual* (FCTM) produced by the aircraft manufacturer, the pilots decided to continue to London.

Maintrol said it would advise London Heathrow of a possible landing gear problem and engineering support would be available upon landing. After a period of in-flight crew rest, the commander assumed the duties of pilot flying. The pilots reviewed the landing procedure from the FCTM and elected to use the lowest autobrake setting, reverse thrust, as required to assist deceleration and to extend the landing gear early to provide an opportunity to identify and address any subsequent abnormalities. The commander commented in his announcement to the passengers that, with reference to the vibrations on departure, the aircraft would be stopping after landing in order that engineers could inspect the aircraft prior to taxiing to its parking stand.

On first contact with the Heathrow Radar controller the co-pilot discovered that this ATC unit was not aware of any problems. The co-pilot therefore explained the situation briefly, suggesting that aircraft following G-VROC on approach be accorded greater separation. ATC coordinated the following aircraft to approach 10 nm behind G-VROC and commented later that the lack of forewarning had no other operational impact. When transferred to the Heathrow Tower frequency the co-pilot was informed that the aerodrome fire and rescue service (AFRS) would be in attendance and that a runway inspection would be carried out after the landing. On-board G-VROC there were no abnormal vibrations, EICAS annunciations, or other indications when the landing gear was extended. The landing itself appeared normal but the crew subsequently noted that the aircraft was leaning slightly to the right.

The co-pilot contacted the AFRS after the aircraft vacated the runway, to request an inspection of the landing gear. This revealed damage to the outboard front tyre on the right wing landing gear (WLG). Accordingly, the aircraft stayed on the parallel taxiway until after discussion with the operator's attending engineers, who confirmed damage to the tyre. The engines were then shut down and the aircraft was towed to a stand chosen to minimise the distance that it would have to be moved.

Aircraft examination

Examination of the aircraft revealed that the tyre on the No 14 wheel had burst. The Boeing 747 main landing gear consists of four four-wheeled main landing gear legs, and the No 14 wheel is the outboard front wheel on the right WLG. A large chunk of tyre carcass of almost half the tyre's circumference was missing (Figure 1). Part of the right WLG shock strut inboard door had separated and was found near taxiway A9 adjacent to Heathrow's Runway 27R. This door sits directly above the No 14 wheel and there were black tyre marks on its underside (Figure 2). The aircraft had also suffered impact damage to its right wing inboard flap fairing and to the leading edge and underside of the right inboard aft flap. A wishbone-shaped support bracket (p/n 65B13644-6) which forms part of the connection between the right WLG shock strut and the right WLG outboard door had failed at its lower forward lug. A rod (p/n 65B12747-1) connected to the forward hinge of the right WLG door had also failed. There was also some damage to clamps on the shock strut and drag strut of the right WLG.

Figure 1

Damaged No 14 tyre on G-VROC after landing at Heathrow

Figure 2

Separated section of the right WLG shock strut inboard door
(left: held in position against the rest of the door; right: black tyre marks visible on its underside)

Aircraft parts recovered from Johannesburg Airport

During a runway inspection after the aircraft's departure from Johannesburg, two large sections of tyre, one about 0.8 m long and one about 0.3 m long, were found, as well as a number of smaller fragments of tyre, some pieces of aluminium honeycomb material, and a metal part. These parts were found on Runway 03L-21R between Taxiway H and Taxiway N, but the relative locations of the parts was not documented. The metal part was later determined to be part of one of the failed lugs on the wishbone-shaped support bracket (p/n 65B13644-6). The small pieces of honeycomb material could not be positively identified, but were probably from the WLG shock strut inboard door. When the No 14 tyre was reconstructed with the recovered tyre parts from Johannesburg, it revealed that a section of tyre carcass approximately 0.7 m long was still missing. An additional inspection of the runway environment was carried out by the Johannesburg Airport authority on 10 January 2010, but no further tyre parts were found.

Flight recorder data

In accordance with regulatory requirements, the aircraft was equipped with a 25 hour duration Flight Data Recorder (FDR) and a 120 minute Cockpit Voice Recorder (CVR). The aircraft was also equipped with a Quick Access Recorder (QAR). These were all successfully replayed. The CVR record of the takeoff had been overwritten due to the flight duration between Johannesburg and Heathrow. The FDR and QAR contained records of the entire flight.

Of significance during the takeoff was the record of the lateral, longitudinal and normal acceleration. FDR and QAR acceleration information was provided by a triaxial accelerometer attached to the inboard side of the right outboard landing gear bay.

The takeoff appeared normal until shortly after passing V_{1}, which was 149 kt (Figure 3). As the aircraft accelerated through 160 kt (177 kt groundspeed), there was a series of rapid fluctuations in lateral, longitudinal and normal acceleration. For a period of one eighth of a second, a normal acceleration change from 1 g to -2.9 g occurred, coincident with a deceleration of 0.3 g and a lateral acceleration of 0.75 g. This rapid excitation of the accelerometer is believed to have been the result of either tyre debris or a shockwave striking the accelerometer as the tyre failed. The longitudinal acceleration returned to its previously normal indication, but the aircraft then commenced a series of four cyclic lateral oscillations, which was accompanied by an increase in normal axis vibration. Rotation occurred approximately two seconds later, at 165 kt. As the aircraft took off, the lateral oscillations and normal axis vibration stopped. The maximum recorded groundspeed with the main gear in contact with the runway surface was 189 kt. The aircraft climbed without further incident.

Examination of recorded data for tyre speed and landing gear exceedences

Under certain circumstances, rated tyre speeds may be inadvertently exceeded during takeoff. The risk of such an exceedence is increased at airports that experience warm temperatures and are at high elevations above mean sea level, such as Johannesburg in South Africa and Las Vegas in the USA. In addition to monitoring of speeds by the flight crew, the operator used its Flight Data Monitoring (FDM) system to verify maximum groundspeeds during each takeoff. For G-VROC, the rated tyre speed was 204.2 kt, with the FDM system providing an automatic notification at 202 kt.

G-VROC had flown 57 times since the No 14 tyre was fitted on 18 September 2009. FDM records were available for 46 of these flights, from which the maximum takeoff groundspeed was found to have occurred during the incident flight, which was 189 kt, some 15.2 kt below the rated tyre speed. Of the records that were not available, none of the flights were from airports considered to pose a risk of nearing rated tyre speeds and no flight crew reports of an exceedence were made.

The operator's FDM records for G-VROC were also checked for airspeed exceedences of the landing gear and reports of hard landings during the duration of the tyre fitment. None was found.

History of the No 14 tyre

The No 14 tyre was a Michelin bias-ply H49x19.0-22[3] tyre, rated to 204 kt. It was installed as new (no retreads) on G-VROC on 18 September 2009, and had completed 57 flight cycles at the time of the failure. The tyre pressures were required to be checked during every Daily Check, but there was no requirement to record the tyre pressures unless they were below limits. There were no aircraft technical log entries for the No 14 tyre pressure having been below limits or having required reinflation since its installation. The operator noted that it was possible that small 'top-ups' were not being recorded and that they would reiterate to their staff the requirement to record any reinflations in the aircraft technical log. The last Daily Check had been performed on the aircraft at Johannesburg sometime between its arrival at 0455 UTC and its departure at 1942 UTC. The tyre pressure of the adjacent tyre (No 13) was measured at 210 psi after the aircraft landed at Heathrow following the incident; this was within the limits of 194 psi to 213 psi (for maximum takeoff weight).

Footnote

[3] The designation 'H49x19.0-22' denotes 49 inch outside diameter, 19 inch width and 22 inch inside diameter.

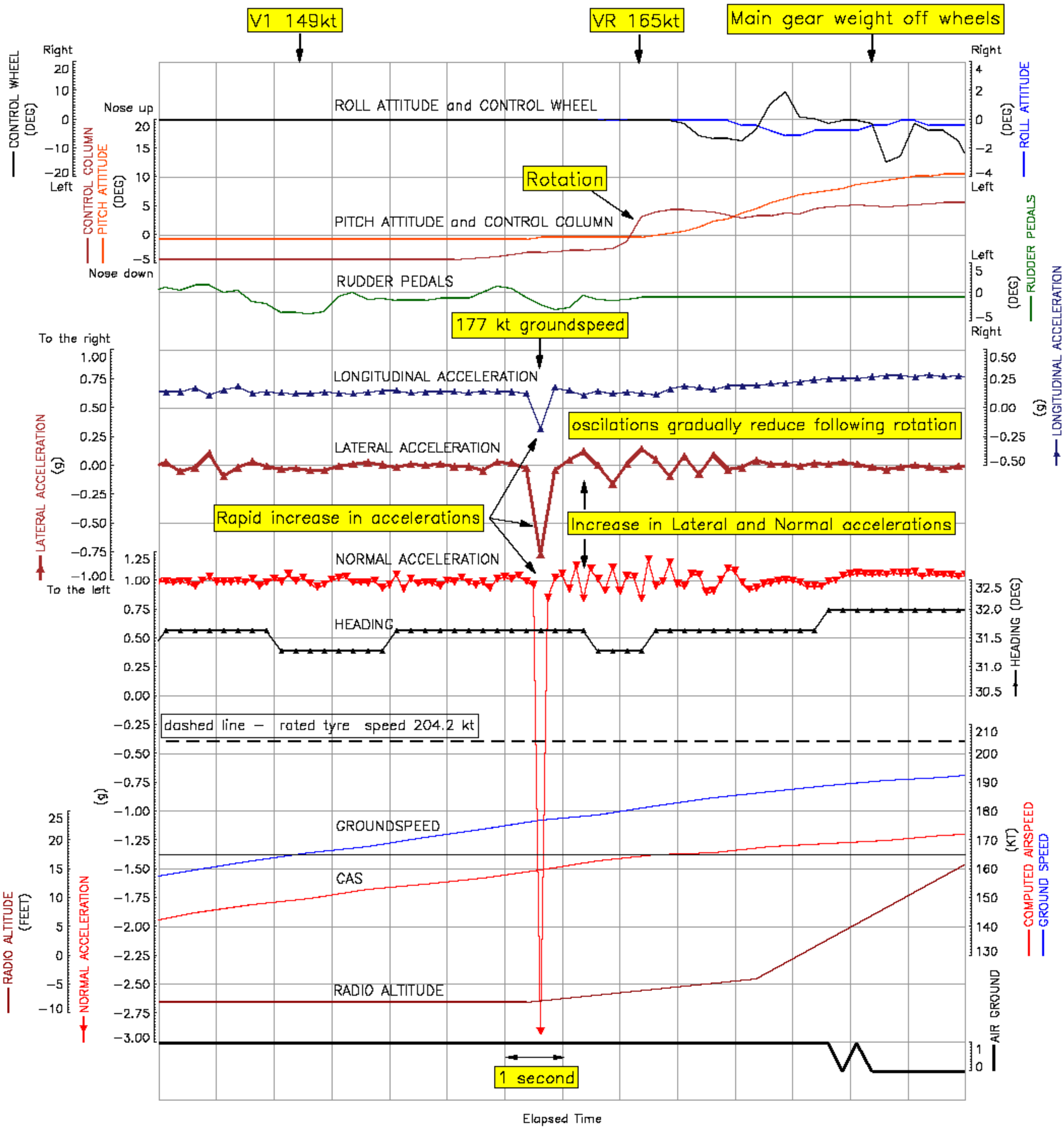

Figure 3

G-VROC – Recorded data for takeoff from Johannesburg Airport

Detailed examination of the No 14 tyre

The failed tyre was removed from the No 14 wheel at the overhaul facility used by the operator. The wheel was leak checked with a new tyre; no leaks were found. An initial examination of the tyre was carried out onsite and it was then sent to the tyre manufacturer's production facility for a more detailed examination. When the tyre was reconstructed with the two separated pieces from Johannesburg, a classic X-type burst pattern was revealed (Figure 4). An X-type rupture indicates a high pressure blowout, and therefore the tyre had not burst in a low pressure 'run-flat' condition. On one of the separated sections there was an area in the centre of the crown where there was a straight break between almost all the casing plies (Figure 5), as if they had been cut. The area surrounding this straight 'cut' exhibited plies that had the appearance of having failed in tensile overload.

Figure 4

No 14 tyre reconstructed with the two large sections found on runway at Johannesburg.
Right: classic X-type burst pattern and 'cut' in upper section

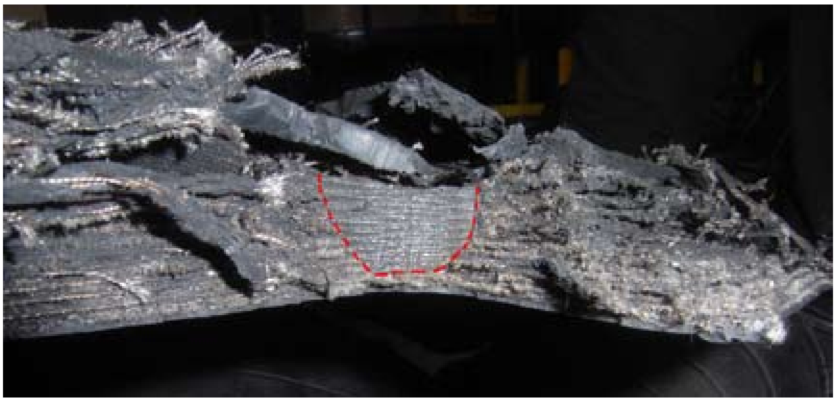

Figure 5

Close-up of 'cut' area highlighted in top right section of Figure 4

The manufacturer determined that there were no defects in the construction of the tyre and there was no evidence of internal heat or inner liner wrinkling. Because there were missing pieces in the area of the X-type rupture, the manufacturer could not determine a definitive cause, but they considered that impact from a foreign object was the most probable cause of the tyre burst. They considered that the section of tyre with the straight 'cut' was probably caused by a sharp object, but because the 'cut' was not located near the centre of the X, it is probable that this cut occurred after the initial tyre burst.

Metallurgical examination of failed lug and rod

The failed lug on the wishbone-shaped support bracket (p/n 65B13644-6) and the failed rod (p/n 65B12747-1) were examined by a metallurgist. The fracture surfaces were examined under both optical and scanning-electron microscopes. The examinations revealed that both the support bracket and the rod had failed as a result of static tensile overload. There was no evidence of any progressive crack growth on any of the fracture surfaces.

Runway inspections at Johannesburg Airport

Three runway inspections are carried out each day at Johannesburg Airport[4]. On the day of the incident, 28 October 2009, the 'dawn' runway inspection was carried out at 0348 hrs on Runway 03L and 0425 hrs on Runway 03R. The 'day' runway inspection was carried out at 1307 hrs on Runway 03R and 1316 hours on Runway 03L. The 'dusk' runway inspection was completed on Runway 03R at 1953 hrs, and Runway 03L was about to be inspected when the G-VROC incident occurred on that runway.

Footnote

4 Annex 14 to the Convention on International Civil Aviation, volume 1 – *'Aerodrome design and operations'*, published by ICAO, recommends a minimum of two such inspections daily.

Guidance in the Flight Crew Training Manual (FCTM)

The version of the FCTM consulted by the pilots during the flight contained the following advice:

> *'If the crew suspects a tire failure during takeoff, the Air Traffic Service facility serving the departing airport should be advised of the potential for tire pieces remaining on the runway. The crew should consider continuing to the destination unless there is an indication that other damage has occurred (non-normal engine indications, engine vibrations, hydraulic system failures or leaks, etc.).*
>
> *Continuing to the destination will allow the airplane weight to be reduced normally, and provide the crew an opportunity to plan and coordinate their arrival and landing when the workload is low.'*

Analysis

The No 14 tyre burst during the takeoff ground roll at approximately 160 kt, which was well below the 204 kt rated tyre speed. The X-type burst pattern of the tyre indicated that it had ruptured at high pressure. Such ruptures can occur during a heavy landing, but this event occurred during the takeoff roll and the FDM data revealed no exceedences during the previous 57 landings. The adjacent tyre to the No 14 tyre was in satisfactory condition and its pressure was within limits, which meant that the No 14 tyre would not have been carrying excessive load. There was no evidence of a manufacturing defect in the tyre or overheat within the liner, and therefore the most probable cause of the tyre burst was penetration by a foreign object. The missing tyre material in the vicinity of the X made it impossible to determine what type or shape of object caused the rupture. The cut in one of the separated tyre sections was probably caused after rupture, as it was not located in the centre of the X. Despite a repeat inspection of the runway area environment by the airport authority, no foreign objects or the missing tyre sections were found.

The possibility that the small piece of failed lug caused the tyre to burst was considered, but this lug had failed in overload with no evidence of progressive cracking; it was therefore more likely that the lug had failed when ruptured sections of tyre carcass struck the WLG outboard door.

The decision of the flight crew to continue to the original planned destination was in accordance with the guidance provided in the FCTM.

Conclusion

The No 14 tyre burst during the takeoff ground roll at approximately 160 kt. The evidence indicated that the tyre probably burst when it ran over a foreign object. Due to the missing tyre material, the nature of this object could not be determined.

SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 757-2Y0, G-FCLK
No & Type of Engines:	2 Rolls-Royce RB211-535E4-37 turbofan engines
Year of Manufacture:	1994
Date & Time (UTC):	19 June 2010 at 0208 hrs
Location:	Dalaman Airport, Turkey
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 7 Passengers - 231
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose landing gear lamp cracked and housing damaged, numerous dents in engine intake cowlings
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	12,000 hours (of which 3,000 were on type) Last 90 days - 200 hours Last 28 days - 60 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

During takeoff from Runway 01R, coincident with the V_1 speed of 156 kt, the aircraft struck a flock of seagulls. The flight crew heard several impacts and were aware that a significant bird strike had occurred. Rotation and initial climb out were normal with no unusual indications. The crew informed Air Traffic Control about the bird strike and also contacted their company operations, who subsequently confirmed that multiple bird remains had been found on the runway at Dalaman.

During the climb the crew noticed that vibration levels on the right engine had increased but other engine indications were normal. The aircraft continued to Manchester Airport, its planned destination, where the extent of the damage was discovered. In addition to a cracked nose landing gear light, the light housing was damaged and there were multiple dents on both engine air intake lips; birds had evidently passed through both engines. Significant bird remains were found still adhering to the nose and main landing gear assemblies.

INCIDENT

Aircraft Type and Registration:	Boeing 777-236, G-YMMI
No & Type of Engines:	2 Rolls-Royce RB211 Trent 895-17 turbofan engines
Year of Manufacture:	2000
Date & Time (UTC):	2 August 2010 at 2110 hrs
Location:	Stand 330, London Heathrow Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 16 Passengers - 236
Injuries:	Crew - None Passengers - None
Nature of Damage:	Upper surface of left engine cowling
Commander's Licence:	Airline Transport Pilot's Lice nce
Commander's Age:	46 years
Commander's Flying Experience:	16,000 hours (of which 7,500 were on type) Last 90 days - 120 hours Last 28 days - 67 hours
Information Source:	Information from the airport operator and airline.

Synopsis

As the airbridge was being removed from the aircraft, it struck the left engine nose cowling. The aircraft was taken out of service as a result of the damage.

Description of the incident

G-YMMI was on Stand 330 at London Heathrow Airport and ready to depart for a commercial air transport flight to Singapore. The airbridge operator moved the airbridge slowly back from the aircraft and adjusted its alignment relative to the aircraft fuselage. She believed from looking at the CCTV monitor installed at the driving position that the airbridge wheels were aligned with the lines drawn on the manoeuvring area, designed to help operators guide the wheels to the yellow parking circle. As she moved the airbridge back further, however, the airbridge auto-leveller contacted the aircraft's left engine nose cowling puncturing the outer skin over a length of approximately 20 cm. The aircraft was taken out of service as a result of the damage.

Previous incident

In June 2002, the AAIB carried out a field investigation into an incident at the same stand during which the airbridge punctured the pressure hull of a parked aircraft (see AAIB Bulletin 5/2003). The airbridge had an apron surveillance CCTV camera located under the airbridge which was approximately 25 m from the wheels when the bridge head was extended to the side of an aircraft. The report commented that:

> *'when the airbridge is considerably extended, the image of the drive axle is small and indistinct.'*

The report noted that one of the reasons for the incident was:

> *'the airbridge controller's inability to properly assess the orientation of the driving axle.'*

The airbridge controller was unfamiliar with the type of airbridge at the stand.

The investigation made a number of recommendations, which included:

> **Safety Recommendation No 2003-23**
>
> Heathrow Airport Limited, in consultation with Thyssen, the airbridge manufacturer, should improve the ease of use and accuracy of the means by which airbridge controllers can assess the orientation of the drive axles of the type of airbridge installed at Stand M 30 of Heathrow Terminal 3.

The recommendation was accepted and the airbridge was fitted with an axle position indicator in the driving position.

Information from the airport operator

The airport operator reported that the axle position indicator in the airbridge driving position had been vandalised and was unusable.

The airline's report into the incident

Managers who attended the scene stated that the image on the CCTV screen of the orientation of the wheel axle was poor. One commented that lighting conditions under the airbridge were also poor. The report noted that training for airbridge operators stressed the requirement to check axle orientation visually and to maintain a lookout while manoeuvring the airbridge. The CCTV and the axle position indicator were to be used in support of these activities. The report concluded that it was most likely that the axle was not parallel to the aircraft when the operator, who was not familiar with Stand 330, began to withdraw the airbridge.

As a result of the incident, and following expressions of concern from other operators using Stands 330 to 336, the airport operator agreed to carry out a trial of the airbridges to limit their turning ability and to reduce their speed. It would also conduct a comprehensive review of all airbridges at the airport.

ACCIDENT

Aircraft Type and Registration:	De Havilland Canada DHC-6 300 Twin Otter, C-FAKB
No & Type of Engines:	2 Pratt & Whitney PT6A-27 turboprop engines
Year of Manufacture:	1969 (serial number 273)
Date & Time (UTC):	24 February 2010 at 0057 hrs
Location:	London Gatwick Airport
Type of Flight:	Ferry flight
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Electrical fire in cabin
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	38 years
Commander's Flying Experience:	10,018 hours (of which 8,560 hours were on type) Last 90 days - 95 hours Last 28 days - 23 hours
Information Source:	AAIB Field Investigation

Synopsis

During a ferry flight from Calgary, Canada to the Maldives, an electrical fire started in the power distribution and generator control box located in the roof of the passenger cabin. The crew isolated the electrical systems and successfully diverted to London Gatwick Airport. The source of the fire was traced to the left generator reverse current relay, which was found to have a different part number to the relays authorised for use on the DHC-6 series of aircraft.

Five Safety Recommendations were made.

Background information

C-FAKB was going to make a series of positioning flights starting from Calgary, Canada, finishing in the Maldives. The passenger seats were removed from the aircraft to create space for two 925 litre fuel tanks, which were attached to the floor rails in the cabin and connected to the main fuel system. Two 45 gallon drums were secured to the rear bulkhead in the cabin and one was secured to the floor points behind the forward bulkhead. The drums were filled with fuel, which was to be manually transferred to the 925 litre tanks if unfavourable headwinds were experienced during any of the long over-water legs. Immediately behind the flight deck, on the right side, was an oxygen cylinder, which provided supplementary oxygen to the crew through two constant-flow nasal cannula hoses. This allowed the un-pressurised aircraft to operate at higher flight levels than would otherwise have been the case.

The first leg, from Calgary to Iqualuit, was planned for 20 February 2010. After starting the right engine, the crew noticed that the right GENERATOR caution light failed to illuminate after the start switch was released and so the engine was shut down in accordance with the Emergency Checklist. Following work by engineers to diagnose the problem, it was decided to replace the right engine reverse current relay (RCR) and, when the rectification work was complete, the generator functioned correctly.

The aircraft flew three flights, during which the crew experienced no further problems, and at the end of the third flight it landed at Birmingham Airport.

History of the flight

On 23 February 2010, C-FAKB departed from Birmingham Airport at 2336 hrs and climbed to FL170 for a flight to Dubrovnik, Croatia. A few minutes after levelling off for the cruise, the captain noticed "two brief flickers" of the left GENERATOR caution light. After discussion with the co-pilot, the commander opened the DC bus tie in order to separate the two DC generator busbars electrically. This action was known to enable continued operation of both generators in circumstances where they were not properly balanced.

Approximately five minutes later, the commander noticed a faint smell, but he and the co-pilot saw nothing abnormal. The crew discussed the symptoms they had observed but decided not to reset the left generator because there had been no steady GENERATOR caution light. A few minutes later, they noticed a "dim orange flickering glow" between two ceiling panels on the right side of the cabin close to the location of both RCRs. The commander declared an emergency and asked for assistance from ATC to land at the nearest suitable airport. The aircraft was at FL170 overhead the River Thames estuary near Manston, but Manston Airport was closed, as was Lydd Airport. Ostend Airport, Belgium, was 58 nautical miles away but the crew did not wish to fly for that distance over the sea. Southend Airport was open but there was broken cloud at 200 ft aal and the crew decided the weather was not suitable to make an approach. After further discussion with ATC, the crew decided to make an approach to Runway 26L at London Gatwick Airport.

While trying to identify the fault, the crew saw that the left generator load meter was showing a full scale deflection to the left, and that the right generator load meter was deflected to the right although not to full scale. The nature of the problem was not obvious to the crew and there was no applicable procedure in the Emergency Checklist. Nevertheless, the pilots decided to shut down the right generator because it was the RCR associated with the right generator that had caused the problem they experienced in Calgary. After shutting down the generator, the right GENERATOR caution light remained off. During the descent, the crew switched off unnecessary electrical items as well as equipment that the pilots believed had wiring that ran close to the RCRs. The commander also went into the cabin to turn off the supplementary oxygen. There was no obvious improvement in the symptoms they could see in the cabin and so the crew decided to switch off the left generator, leaving the battery as the only source of electrical power. The left GENERATOR caution light also remained off although the captain considered that this might have been because he had tripped a large number of circuit breakers.

During the final approach to Gatwick Airport, the crew thought that the glow behind the ceiling panels had reduced, but a heat blister had developed on the cabin side of the panels and it was smoking slightly. The aircraft landed, taxied clear of the runway and the crew attempted to shut down the engines. The left engine shut down correctly but, after shutting off the fuel to the right engine it continued to run at between 12% to 15% N_g. The captain thought that the starter motor was probably engaged and stopped the engine by selecting the battery Master Switch to OFF.

The airport fire crew attended the aircraft and determined that the temperature in the vicinity of the RCRs was slowly increasing. Therefore, they disconnected the aircraft battery from the electrical system and remained with the aircraft until they were satisfied that there was no longer a risk of a fire.

Description of the aircraft DC electrical system

General

The aircraft is equipped with a 28VDC electrical system. Each engine is fitted with a starter-generator, which supplies electrical power to its respective DC busbar through a reverse current relay (RCR), see Figure 1. A secondary source of DC power is a 24V battery, which feeds the left DC busbar through the battery bus and reverse current circuit breaker. During normal operation the left and right DC busbars are connected by the bus tie, which allows both systems to operate in parallel. The left and right DC electrical systems can operate as separate systems by opening the DC bus tie. A load meter allows the crew to determine the current flowing into or out of the starter generator, its scale indicates between +1 and –1, which corresponds to +200 amps and -200 amps. Movement of the pointer to the instrument stops corresponds to approximately 400 amps.

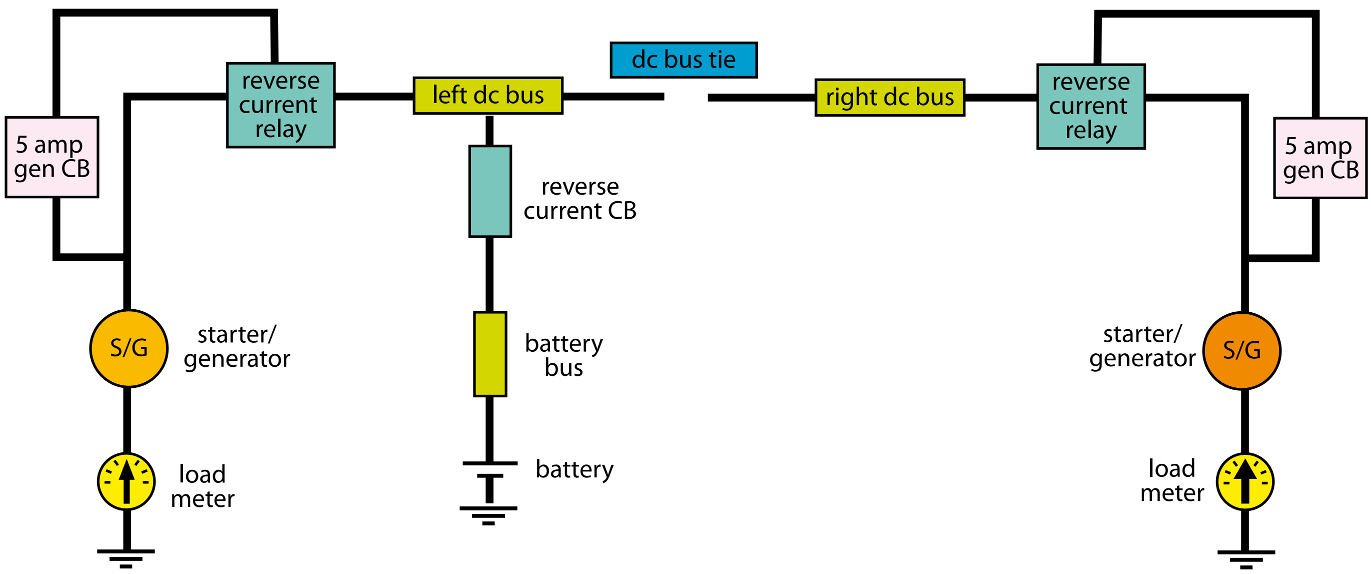

Figure 1

Simplified diagram of aircraft DC electrical generation

Reverse current relays

The purpose of the RCR is to provide a connection between the generator and the bus, or battery, and to provide reverse current protection in the event of a generator failure or a loss of generator voltage. The RCRs are located within the power distribution and generator control box, which is mounted in the roof on the right side of the cabin. Each RCR contains three relays (Figure 2). Relay R1 operates when the generator voltage reaches approximately 22V, relay R2 is a polarized differential relay which senses the direction of the current flow and relay R3 operates the main contacts. A GENERATOR caution light, located on the instrument panel in the cockpit, illuminates when the main contact is open and the engine start switch is at the OFF position.

The sequence of operation of the RCR is as follows. When the generator voltage reaches approximately 22V, relay R1 closes. This energises relay R2, which is connected across the open main contacts. The voltage on the 'Diff Volt coil' of relay R2 is now the difference between the generator voltage and the battery / bus voltage. When this difference reaches between 0.35V and 0.65V (generator must be the highest voltage) relay R2 will close. This applies a voltage to the 'Main Relay coil' R3, which immediately closes and connects the generator to the bus. If the generator voltage decreases below the battery / bus voltage, a current will flow from the bus to the generator. The 'Rev Current coil' in Relay R2 senses the change in direction of the current and the contact opens. The 'Main Relay' coil in Relay R3 is then de-energised, the main contacts open and the generator is disconnected from the bus.

The drawing for the power distribution and generator control (No C6NF1171) lists the part numbers for RCRs approved for use on the DHC-6 as A-700AP and A-700AAP, rated at 300 amps, and A-701D, rated at 400 amps.

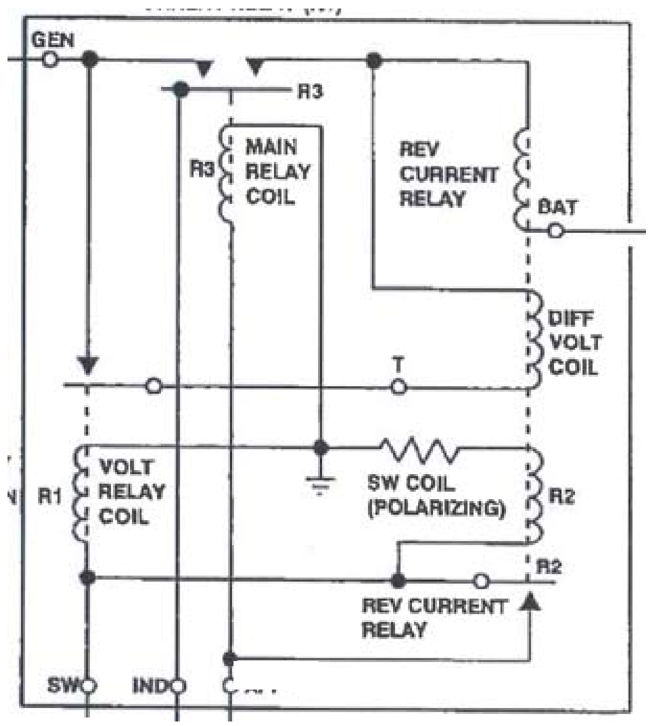

Figure 2

Schematic diagram of reverse current relay

Voltage regulator

A voltage regulator is fitted in each generator circuit and controls the generator output at a nominal 28.5V over the full range of generator speed, load and operating temperature. An equalizer circuit in each voltage regulator ensures equal loading (within 20 amps) when the generators are operating in parallel.

Examination of the aircraft

Examination of the aircraft revealed that there had been an electrical fire, which had almost consumed the left RCR, Figure 3. The fire had burnt through the cover of the power distribution and generator control box and, whilst the heat had caused the trim in the cabin to blister,

Figure 3

Damage to power distribution box and generator control box

the trim remained intact and there was no evidence of any smoke damage in the cabin. The trail of the combustion products shows that the smoke remained trapped between the fuselage and cabin trim and was drawn out of the cabin vent mounted in the roof of the aircraft. The heat had also damaged the wiring for the entertainment system and the aerial for a redundant ADF system; there was no other damage to any of the aircraft wiring. Although the adjacent structure and components were covered with combustion products there was no evidence of heat damage outside of the power distribution and generator control box, except to the adjacent cabin trim, .

Both generators were visually examined and the brushes were found to be in good condition. The 5 amp circuit breaker for the right generator, mounted near the generator relay in the engine nacelle, had tripped. The aircraft battery appeared, from a visual inspection, to be in good condition and had a voltage of 25.7v.

The power distribution and generator control box was replaced and the aircraft was flown to a maintenance organisation in Switzerland where a detailed inspection of the complete aircraft electrical system was carried out. The maintenance organisation advised the AAIB that whilst the wiring in the aircraft was *'in a bad general condition..... they could not find any obvious cause for the electrical fire'*. The complete aircraft wiring was replaced and engine ground runs were carried out to test the electrical generation and distribution system. All the systems operated satisfactorily and the aircraft was flown to the Maldives.

Previous occurrences

The Type Certificate Holder provided the AAIB with copies of their Service Difficulty Reports detailing 18 failures of the RCR since 1974. Of the 18 occurrences, 15 reports recorded that either the contacts were welded closed or there were signs of overheating, smoke or sparks. Eleven of the RCR were rated at 300 amps and five at 400 amps. There was insufficient information to establish the current rating of the remaining two RCRs.

Significant airworthiness directives, modifications and service bulletins

Airworthiness directives (AD)

AD CF-75-11 was issued by Transport Canada and became effective on 1 December 1975. The AD is applicable to DHC-6 series of aircraft and requires the inspection of the contact points on A-700AAP and A-700AP relays.

AD CF-77-08 was issued by Transport Canada and became effective on 30 September 1977. The AD is applicable to DHC-6 aircraft serial numbers 1 through 530. The AD states:

> *'To preclude the possibility of total electrical failure due to contact welding of reverse current relays Hartman A700AP or A7000AAP and subsequent burning through of relay covers and adjacent wiring, install de Havilland Modification 6/1598 in accordance with de Havilland Service Bulletin No 6/353.'*

AD 78-01-05 was issued by the Federal Aviation Administration and became effective on 9 February 1978. The AD required the De Havilland modification 6/1598 and SB 6/353 to be incorporated on DHC-6 series aircraft.

De Havilland Service Bulletins

SB 6/338 was issued on 24 October 1975 and revised on 29 October 1982. This SB requires RCRs rated at 300 amps (A-700AP and AAP) to be removed from the aircraft and inspected at intervals of not more than 1,200 hours. The inspection requirement is to look for signs of overheating and pitting or corrosion of the contact points.

SB 6/353 was issued on 13 May 1977 and revised on 28 February 1978. This SB introduces heat shielding around the RCR and the rerouting of critical wiring away from the RCRs.

De Havilland Modifications

Modification 6/1585 introduced a new RCR, part number A-701D, rated at 400 amps.

Modification 6/1598 was approved in 1977 and reroutes the electrical wiring adjacent to the RCRs and introduces fire resistant panels in the power distribution and generator control box.

Modification state of aircraft wiring

An entry in the aircraft technical log, dated 7/12/09, stated:

> *'U.S AWD 78-01-05 main distribution box rewiring complied with as per modification No. 6/1598 And S.B 6/353.'*

Examination of right RCR removed at Calgary

The right RCR (s/n A98995), which was removed at Calgary before the start of the ferry flight, was examined by the AAIB and tested by a specialist organisation. The RCR was fitted with a data plate identifying it as Part Number A-700A, rated at 300 amps. With the exception of the test for the volt relay coil (R1), and the resistance check across the generator and battery terminals, the RCR met all the requirements in the specification.

The tests established that relay R1 closed at 15V and opened at 3v. These values were outside the specified limits of 20V to 24V for closing and more than 18V for opening. The RCR was removed from its container and the relay was operated by hand before being retested. During the second test the relay closing and opening voltages were found to be 22.7V and 18.7V respectively, which is within the acceptable limits.

The resistance across the generator and battery terminals was established by measuring the voltage drop when a load bank and standard resistor were connected in series with the RCR. The measured voltage drop was 39.2 mV at 50 amps, which gave a resistance across the contacts of 0.748 mΩ. The specification states that for a maximum voltage drop of 100 mV at 300 amps, the resistance should not exceed 0.333 mΩ. Therefore the contact resistance was higher than the maximum permitted value.

The RCR appeared, from a visual inspection, to be old and the covering of the voltage relay coil (R1) had the appearance of having being degraded by heat. There was light pitting on the contacts of the main relay coil (R3) and it was noted that a fine braid, forming a connection at the differential voltage contacts, was passed around the spindle of the moving part of the differential relay R2.

Examination of power distribution and generator control box

The damage indicates that the left RCR was the source of the fire and the temperature was sufficiently high to destroy the majority of the cover and the container in which the components for the RCR are located, Figure 4.

One of the two contact faces in the main relay (R3) had welded closed and the face on the second contact had light pitting. This pitting was similar to that seen on the faces of the main contact in the right RCR which had been removed at Calgary. While the data plate had been destroyed, the components in the left RCR, and the design of the main contacts (R3), were found to be identical to the components in the right RCR that had been replaced at Calgary; the right RCR had a data plate identifying it as an A-700A relay. The documentation for the left RCR also identified it as an A-700A relay rated at 300 amps.

Four holes had been burnt through the stainless steel heat shield positioned around the left RCR, Figure 5. The holes were the result of arcing between the metal components in the left RCR and the heat shields; three of the holes were approximately 10 mm high and 20 mm long, the fourth was slightly smaller. The sides of the DC bus tie and the right RCR, which were mounted adjacent to the left RCR, had also been damaged by heat. The insulation on all the electrical control wires to the left RCR had melted and there was evidence of arcing having occurred between some of the wires

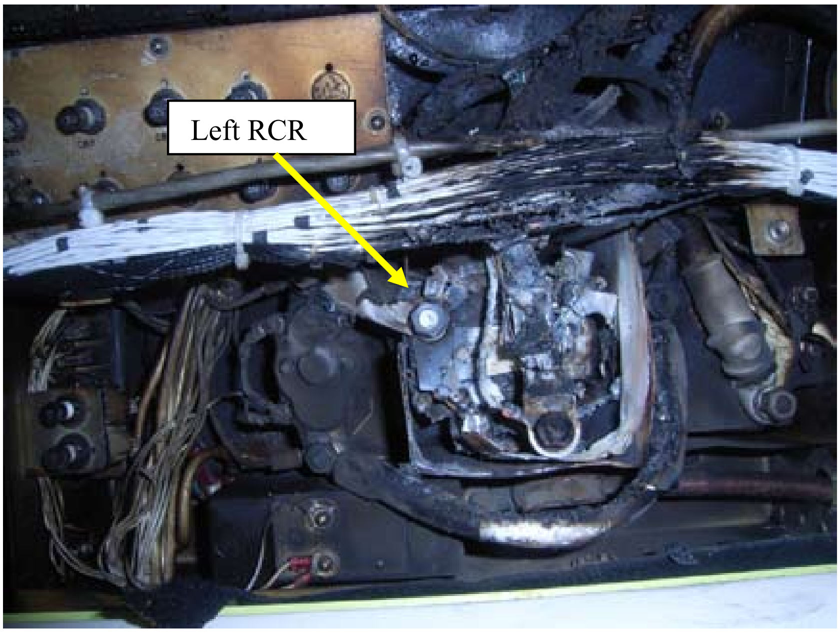

Figure 4

Damage to left RCR

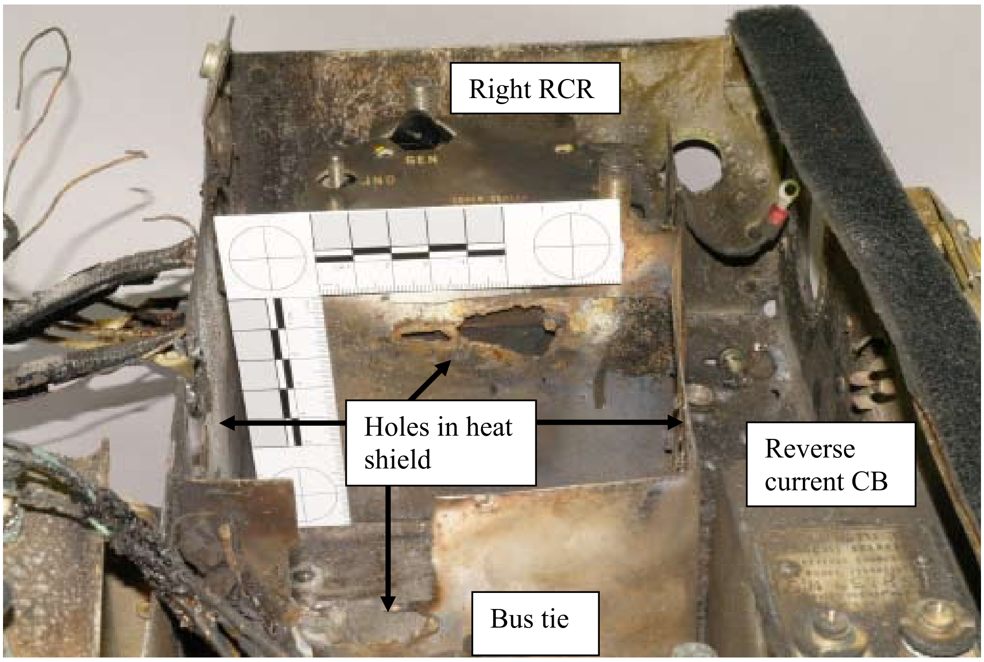

Figure 5

Damage to heat shield

and adjacent metal components. The insulation on the electrical control wires for the right RCR had also melted where they passed through the access hole in the side of the power distribution box. The damage was such that all these wires would have shorted on the side of the power distribution box.

The routing of the wiring in the power distribution and generator control box is dependent on the modification state of the aircraft. However, the routing of the wiring did not appear to conform to any of the four drawings in SB 6/353: the installation was closest to the configuration detailed at *'A/S 136-310 Pre Mod 6/1274 & Pre Mod 6/1389'*. This was not considered to be a factor in this accident.

Examination by the Original Equipment Manufacturer

The Original Equipment Manufacturer (OEM) examined the right RCR (part number A-700A) removed at Calgary prior to the ferry flight.

The OEM was of the opinion that the RCR might have been manufactured between 1944 and 1966 when the part number A-700A became obsolete and was replaced with part number A-700AP. The OEM no longer held any drawings for the A-700A units and had no production information for either of the RCR's (part number A-700A) fitted to C-FAKB. They were, therefore, unable to determine if the RCRs were authentic components.

The OEM was not aware of any overhaul manuals having been produced for the A-700A relays. They also had no production test documentation or any other documents that contained adjustment or repair instructions. Their advice was that the relays should be discarded if they are removed from the aircraft.

History of the reverse current relays

The documentation for the RCRs fitted to the aircraft at the time of the accident and the right RCR removed at Calgary indicated that they had all been recently overhauled and had flown relatively few hours prior to the accident.

Left RCR

The left RCR (A-700A, s/n 50747) was rated at 300 amps and had been fitted to the aircraft in December 2009, 35 flying hours prior to the accident. The Authorized Release Certificate, which was dated *'10/8/2009'*, recorded that the unit had been *'overhauled I.A.W. Hartman Manual A-700A'*. The following comment was recorded in the teardown report:

> *'Found all contacts are pitted'*

and in the work accomplished section of the report the following action was recorded:

> *'Overhaul the unit I.A.W Hartman Manual No. A-700A reqd (Polish and repair the contacts, carried out current drop test as per reqd).'*

Right RCR

The right RCR (A-701D, s/n CON318) was fitted at Calgary on 21 February 2010 and was rated at 400 amps. The Authorized Release Certificate, which was dated *'12/17/2009'*, recorded that the unit had been *'repaired and tested I.A.W. Hartman Manual No A-700D. Rev. M Apr/1996'*.

Right RCR removed at Calgary

The right RCR (A-700A, s/n A98995) removed at Calgary on 21 February 2010 was rated at 300 amps and had been fitted to the aircraft on 29 November 2009. It had flown 13 flying hours before it was removed from the aircraft on 21 February 2010. The Authorized Release Certificate, which was dated *'10/7/2009'*, recorded that the unit had been *'overhauled I.A.W. Hartman Manual A-700A'*. The following comment was recorded in the teardown report:

> *'Found all contacts are pitted'*

and in the work accomplished section of the report the following action was recorded:

> *'Overhaul the unit I.A.W Hartman Manual No. A-700A reqd (Polish and repair the contacts, carried out current drop test as per reqd).'*

The maintenance organisation that overhauled and repaired the RCR provided the investigation with a copy of the 'Hartman Manual' referenced in the Authorized Release Certificate. The cover sheet of this document had the title '*Donallco aircraft accessories and component parts*'. The remainder of the document was annotated '*Hartman*' and had the title '*Installation Instructions for Switch, Generator Control relay (Differential) .... Manufacturer's Part No A-700A)*'. However, this document only provided information on the testing of the relay and did not contain any information as to how to overhaul or repair the component.

Inspection requirements for reverse current relays

The DHC-6 is on a 3,000 hour inspection schedule with a 'C' check required every 500 hours. The inspection Requirements Manual (PSM 1-6-7) calls for the contacts on relays A-700AP and A-700AAP to be examined in accordance with SB 6/338 every 1,200 hours. It also calls for the relay to be removed and bench tested every 3,000 hrs during the 'C6' check. There is no requirement for the relays to be overhauled.

Analysis

Cause of fire

The damage to the aircraft indicates that the electrical fire started in the left RCR and the fire, and associated heat damage, did not spread outside the power distribution and generator control box.

The first indication to the crew was the 'two brief flickers' on the left GENERATOR caution caption. It is likely that this was caused by the rapid opening and closing of the main contacts (R3) in the left RCR. With the left generator on-line, it is likely that this action would have resulted in arcing between the moving and fixed contact plates, which may have been sufficient to weld one of the two contacts in the closed position. When the crew checked the DC load meter they noticed that on the left system the needle was fully deflected to the left, and on the right system was partially deflected to the right. This indicates that while the right generator was providing power to the right DC bus, current of at least 400 amps was flowing into the left starter/generator. It is this current flow which most probably caused, and sustained, the electrical fire.

Although the crew had turned both generators OFF, and disconnected the DC bus tie, the right engine continued to turn at 12% to 15% N_g after both engines had been shut down. This shows that at the end of the flight the aircraft battery was providing electrical power to the right starter/generator, and the DC bus tie and the main contacts in the right RCR must have been in the closed position. It is, therefore, probable that the damage to the left RCR and the electrical control wires in the electrical power distribution box had already occurred before the crew attempted to disconnect the generators.

The investigation was unable to determine the reason why the main contacts (R3) in the left RCR might have started to open and close during the flight. No faults were found in the electrical wiring outside the power distribution and generator control box. After the aircraft had been rewired, and the damaged components replaced, the DC electrical generator system was found to operate satisfactorily indicating that there were no faults in the generators or voltage regulators.

The left RCR and the wiring in the power distribution and generator control box were extensively damaged and consequently it was not possible to determine if the fire had been the result of a fault in the RCR or a damaged wire that controlled the RCR.

Heat shield

As a result of previous occurrences of RCRs overheating and damaging adjacent components, Transport Canada issued an AD in 1977 that resulted in the introduction of fire resistance panels in the power distribution and generator control box. While the required modification (6/1598) had been embodied on C-FAKB, the heat shields were breached in four places as a result of arcing between the metal components in the RCR and the heat shields. Consequently the DC bus tie, right RCR, battery power cable and several electrical control cables all sustained some damage. The following Safety Recommendation is therefore made to Transport Canada:

Safety Recommendation 2010-083

It is recommended that Transport Canada reviews the design and efficacy of the heat shields fitted around the Reverse Current Relays on De Havilland DHC-6 aircraft that were introduced as a result of Airworthiness Directive CF-77-08.

Reverse current relays

The investigation established that the left RCR that failed during the accident flight and the right relay removed prior to the start of the ferry flight were both identified as A-700A relays, which is an obsolete part that has not been approved for use on the De Havilland

DHC-6. The following safety recommendation is therefore made to Transport Canada:

Safety Recommendation 2010-084

It is recommended that Transport Canada takes appropriate action to ensure that only approved Reverse Current Relays are fitted to De Havilland DHC-6 aircraft.

A review of previous occurrences of overheating of the RCRs indicates that failures generally occurred due to arcing, and welding, of the main contacts and was most likely to occur on the relays rated at 300 amps (A-700AP and A-700AAP). While modification 6/1585 introduced relay A-701D, rated at 400 amps with an improved contact design, there was no requirement to replace the existing 300 amps relays providing their contacts were examined every 1,200 hours. Given that most of the occurrences of overheating appear to have occurred with the relays rated at 300 amps, the following Safety Recommendation is made to Transport Canada:

Safety Recommendation 2010-085

It is recommended that Transport Canada require the replacement of existing Reverse Current Relays (part number A-700AP and A-700AAP) fitted to De Havilland DHC-6 aircraft with relays of a higher current rating and improved design of the electrical contacts.

While the Authorised Release Certificates recorded that both A-700A relays had been overhauled, the maintenance organisation responsible confirmed that they had not undergone a full overhaul, but instead had been electrically tested in accordance with what they believed was the OEM manual. The normal practice was that if the relay failed any part of the test then the relevant component would be replaced and the relay retested. This approach was entirely consistent with the DHC-6 Inspection Requirements Manual, which only required the relays to be bench tested every 3,000 flying hours. However, the left RCR which caught fire had only flown for approximately 35 flying hours since it was last tested and the right RCR (serial number A98995) removed prior to the start of the ferry flight, had only flown approximately 13 flying hours.

While the subsequent internal visual examination of the right RCR (serial number A98995) established that one of the coils appeared to have been degraded by heat due to normal aging, there would have been no requirement to replace this coil providing the RCR passed the required electrical test. The contact pressure is a factor in preventing arcing across the contacts and is normally established by measuring the relay over-travel, but this parameter is only checked during overhaul of the relay and cannot be established during electrical tests. It is, therefore, possible that an RCR with a degraded coil and insufficient contact pressure could pass all the required tests and be authorised to fly for a further 3,000 hours. The following Safety Recommendation is, therefore, made to Transport Canada:

Safety Recommendation 2010-086

It is recommended that Transport Canada reviews the maintenance requirements for the Reverse Current Relay fitted to De Havilland DHC-6 aircraft and considers requiring the relay to be overhauled on a regular basis.

The Authorized Release Certificate for RCRs serial numbers 33284 and 33283 stated that the relays had been '*overhauled I.A.W Hartman Manual A-700A*'.

While the document which the overhaul agency referred to was annotated with the OEM's name, the OEM has advised the investigation that they have not produced an overhaul manual for the A-700A RCRs. Moreover, the title of the document is '*Installation Instructions*' and only contained information on the testing of the relay. The following Safety Recommendation is, therefore, made to the overhaul agency:

Safety Recommendation 2010-087

It is recommended that Transport Canada conduct an audit of Condor Aircraft Accessories Inc's internal processes to ensure that work recorded on the Authorized Release Certificate accurately reflects the work carried out on the component.

SERIOUS INCIDENT

Aircraft Type and Registration:	1) DHC-8-402, Dash 8, G-JECL 2) Boeing 737-5H6, G-PJPJ
No & Type of Engines:	1) 2 Pratt & Whitney Canada PW150A turboprop engines 2) 2 CFM56-3C1 turbofan engines
Year of Manufacture:	1) 2005 2) 1994
Date & Time (UTC):	30 October 2009 at 1900 hrs
Location:	Exeter Airport, Devon
Type of Flight:	1) Commercial Air Transport (Passenger) 2) Commercial Air Transport (Passenger)
Persons on Board:	1) Crew - 4 Passengers - 58 2) Crew - 2 Passengers - 0
Injuries:	1) Crew - None Passengers - None 2) Crew - None Passengers - None
Nature of Damage:	1) None 2) None
Commander's Licence:	1) Airline Transport Pilot's Licence 2) Airline Transport Pilot's Licence
Commander's Age:	1) 30 years 2) n/k years
Commander's Flying Experience:	1) 6,259 hours (of which 639 were on type) Last 90 days - 143 hours Last 28 days - 50 hours 2) n/k hours (of which n/k were on type) Last 90 days - n/k hours Last 28 days - n/k hours
Information Source:	AAIB Field Investigation

Synopsis

G-JECL was scheduled to operate from Exeter Airport, Devon, to Edinburgh Airport, Midlothian. After an uneventful pushback and start, taxi clearance was received from ATC to Holding Point Alpha One for Runway 08. This was read back correctly. The crew subsequently crossed Alpha One and lined up on Runway 08; as they did so, a Boeing 737 landed on Runway 26.

History of the flight

The crew of G-JECL were rostered to operate five sectors: Exeter to Jersey, Jersey to Guernsey, Guernsey to Exeter, Exeter to Edinburgh and return; the incident occurred on the fourth sector.

The first sector departed on time, however all subsequent sectors departed at least 15 minutes late. All the sectors, apart from the first, were conducted in the dark. At the time of the incident the visibility was 7,000 m and the surface wind was from 150° at 9 kt.

The fourth sector commenced with an uneventful pushback and start. Taxi clearance was received from ATC to Holding Point Alpha One for Runway 08. This was read back correctly. During the pushback an empty Boeing 737 (G-PJPJ) came onto the Tower frequency when it was at 8 nm finals and was cleared to land on Runway 26. There were no further transmissions to, or from, the B737 and there was no other traffic on frequency. During the B737's final approach the Tower controller's attention was focussed towards the threshold of Runway 26, watching the B737's landing

At the start of the taxi phase the commander of G-JECL, who was taxiing the aircraft, requested the co-pilot to complete the Taxi Checks, which he did. During this time, however, the co-pilot was predominately "heads in". When the co-pilot challenged the commander with the last item on the Taxi checklist, 'CLEARANCES' (ATC departure clearance), the commander responded "to come". The commander then instructed the co-pilot to continue with the next checklist, the Line Up checklist. At this point the commander commented on their previous departure from Exeter, for which they had to wait "a long period of time" on the runway for their departure clearance, having already been given line-up clearance by ATC. The commander later commented that he had, by mistake, reverted to the previous clearance.

As G-JECL approached the entry point for Runway 08 the co-pilot commented, to the commander, on some moving lights on the runway. The commander said that he believed it was a car. Disagreeing, the co-pilot said it looked like an aircraft. It was at this point the commander realised that they had only been cleared to Holding Point Alpha One. Having turned to monitor the B737's landing roll, and to anticipate where it might vacate the runway, the Tower controller saw the lights of G-JECL moving on the runway. At that moment he asked G-JECL "CONFIRM YOU'VE LINED UP" to which the commander replied "AFFIRM". The controller replied "YOUR CLEARANCE WAS TO ALPHA ONE THERE'S TRAFFIC JUST LANDED ON 26 THRESHOLD." The B737's crew only noticed G-JECL was on the runway when their aircraft's speed was approaching taxi speed, shortly before they vacated Runway 26 at Intersection Bravo.

When the Boeing 737 had cleared the runway, G-JECL received its clearance and departed.

The commander notified the operator's operations department of the incident after the fifth sector and filed an Air Safety Report electronically the following day.

CAP 168, Licensing of Aerodromes

Chapter 6 of CAP 168 states the following:

> *'6.3* ***Stop-Bars***
> *6.3.1 Stop-bars are intended to help protect the runway against inadvertent incursions. A stop-bar consists of a single row of flush or semi-flush inset lights installed laterally across*

> *a taxiway showing red towards the intended direction of approach.*
>
> *6.3.2 Stop-bars should be provided at all Runway Taxi-Holding Positions and Intermediate Taxi-Holding Positions intended for use in RVR conditions less than 800 m, unless procedures have been agreed with the CAA to limit the number of aircraft either on the manoeuvring area or on final approach within 5 nm to one at any given time.'*

Exeter Airport does not have red stop bars and, as it complies with 6.3.2, they are not required. There are flashing ('wig wag') amber lights at Holding Point Alpha Two.

Additional information

The commander was based in Guernsey, Channel Islands and the co-pilot had recently been relocated to Exeter from Manchester.

Examination of the ATC tapes showed that G-JECL waited on the runway, prior to departure on the first sector, for 3 min 20 sec before its clearance was issued.

Operations manual

Part A, Section 11, paragraph 11.1.11 of the operator's operations manual states the following:

> *'A serious incident means an incident involving circumstances indicating that an accident nearly occurred.'*

The commander stated that at the time he did not realise this incident would be categorised as a serious incident. Hence he operated the sectors to Edinburgh and back.

Crew's comments

Both the commander and co-pilot stated that while they had both had a broken night's sleep the night before, they both felt fit to report for duty.

The commander was Guernsey based and mainly operated at airports with red stop bars at runway holding points. He stated that he expected to see a red stop bar at all relevant holding points and had he seen one he would not have crossed it. He added that he was trying to get the flight back onto schedule. The operator commented that at this point the aircraft was some 15 minutes behind schedule.

This was the first time that the co-pilot had operated from Exeter at night, with a commander who was not based there.

Flight recorders

The Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR) from G-JECL were downloaded. Whilst the 25 hour FDR recording covered the incident period, the 2 hour CVR recording did not as the CVR was left running for the two sectors flown after the event. The 737 operator provided data gathered for its Flight Data Monitoring programme. The ATC recordings provided the relevant radio communications and enabled the data from the aircraft to be aligned.

The relevant radio communications are given in the history of the flight. The relative aircraft positions during the incident are shown in Figure 1. G-JECL proceeded along Taxiway Alpha without stopping at Holding Point Alpha One and while taxiing along Taxiway Alpha, the crew would have not had the landing B737 in their view. The B737 touched down shortly after G-JECL passed Holding Point Alpha One. As the B737 decelerated through a ground speed of

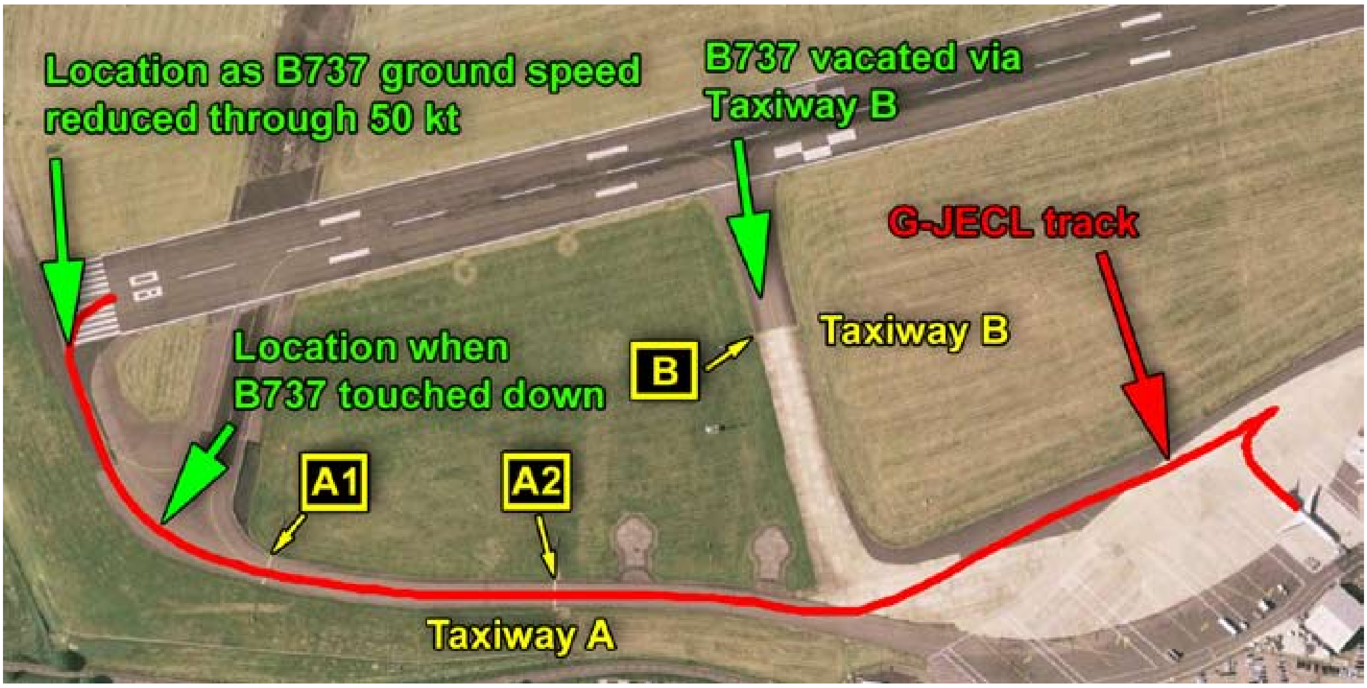

Figure 1

G-JECL track and G-PJPJ positional information
(Google Earth ™ mapping service/Infoterra Ltd & Bluesky)

50 kt, G-JECL started turning onto the runway. The B737 vacated the runway via Taxiway Bravo.

Comment

The crew did not realise that Runway 26 was in use, as they did not register the B737's landing clearance while they were concentrating on their pushback. Had they heard the landing clearance they may have been alerted that Runway 26 was in use at the time.

The crew of G-JECL taxied onto Runway 08 contrary to their ATC clearance. Both crew members were likely to have been tired after a broken night's sleep and a busy day trying to regain the schedule. The co-pilot was not adequately monitoring the commander, who was unfamiliar with this airport, while he completed the Taxi checklist. Additionally, as the crew had been discussing their first sector at the time of the incident, it is likely to have conditioned them to expect the same clearance from ATC on this sector. The commander also asked for the Line Up check list despite the Taxi checklist not being completed. All of these factors led the crew to become distracted enough to cross Alpha One and line up on Runway 08 contrary to their ATC clearance.

The crew operated two sectors after the incident, contrary to the operations manual and, as a result, the incident portion of the CVR was overwritten. The operator's Operations Manual states, in '*Part A Section 11.2, Accident Reporting*':

> *'Following an accident or incident in which it is necessary to contact the Chief Inspector of Accidents, the crew are immediately grounded. No allocation of blame is attached to this automatic procedure which can only be lifted by the Chief Pilot, or in his absence the Fleet General Manager.'*

Safety actions

The operator of G-JECL stated that it will publish a report on this incident in its flight safety magazine, highlighting the salient points. Additionally, the Dash 8 Fleet Manager for this operator would be examining the remote bases culture and operating standards, including the importance of normal checklist procedures on all occasions, by arranging a series of base visits to reaffirm the company safety culture.

INCIDENT

Aircraft Type and Registration:	DHC-8-402 Dash 8, G-JEDK
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2002
Date & Time (UTC):	19 August 2010 at 1445 hrs
Location:	Manchester Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 31
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	6,311 hours (of which 2,751 were on type) Last 90 days - 106 hours Last 28 days - 15 hours
Information Source:	Aircraft Accident Report Form submitted by the aircraft commander

Synopsis

Smoke entered the cabin and flight deck soon after takeoff. The aircraft returned to Manchester Airport and a successful evacuation was carried out on the runway after landing. There were no injuries. The source of the smoke was a failed internal oil seal in the left engine.

History of the flight

Shortly after takeoff the senior cabin crew member contacted the commander to say there was mist or smoke in the cabin, together with a strange smell. Shortly afterwards the flight deck also began to fill with smoke and the flight crew carried out the smoke vital actions. A 'PAN' call was transmitted and the decision made to return to land back at Manchester.

When the flight crew had completed all appropriate checklist items, they contacted the cabin crew to brief them for the arrival. By this time the smoke in the cabin had worsened, so the crew upgraded their status to 'MAYDAY'. The cabin crew were briefed to expect a normal landing, followed by an emergency evacuation on the commander's order.

As the smoke in the cabin thickened, a toilet fire alarm activated. The two cabin crew prepared to fight a toilet fire but none was found. They then checked overhead lockers for signs of fire but again none was found. Circuit breakers for cabin and galley equipment were pulled as a precaution. The cabin crew then briefed passengers seated by the self-help exits.

After about 14 minutes airborne, the aircraft landed without further incident and was bought to a stop on the runway. Once the appropriate drills had been completed and the propellers had stopped rotating, the commander ordered the evacuation. It was successful and without injury. Emergency services estimated that the evacuation was complete in about 15 seconds.

An engineering inspection revealed that an internal oil seal in the left engine had failed, leading to oil contamination of the engine bleed air and thus of the conditioned air supply to the cabin.

SERIOUS INCIDENT

Aircraft Type and Registration:	Aerospatiale SA365N Dauphin, G-HEMS
No & Type of Engines:	2 Turbomeca Arriel 1C turboshaft engines
Year of Manufacture:	1982
Date & Time (UTC):	17 June 2010 at 1840 hrs
Location:	En-route to Durham Tees Valley Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 1 Passengers - 3
Injuries:	Crew - None Passengers - None Others - 1 (Minor)
Nature of Damage:	Right rear cabin door damaged
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	33 years
Commander's Flying Experience:	3,213 hours (of which 155 were on type) Last 90 days - 48 hours Last 28 days - 20 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional information provided by the operator

Synopsis

Shortly after takeoff the helicopter's right rear cabin quarter-door opened. A number of articles fell out, including a stationery folder that hit a person on the ground, rendering him unconscious. The operator stated that all crew members will be re-trained on the closing, locking and opening of all doors.

History of the flight

After delivering a patient to hospital in Middlesbrough the pilot observed the doctor return to the helicopter and close the right rear cabin quarter-door, secure the upper and lower locks and close the passenger door. The pilot then made a visual inspection of the aircraft and pulled on each of the right door handles to confirm that they were closed and locked. During the Pre-Take Off checks the three crew members responded "all secure" to a challenge from the pilot. No captions were displayed on the central warning panel to indicate that a door might be unlocked.

Approximately 3 min after takeoff at approximately 700 ft amsl, while en-route to the helicopter's base at Durham Tees Valley Airport, a loud bang was heard and the paramedic seated in the rear of the aircraft remarked that the right rear cabin quarter-door had opened. A number of objects were seen to fall from the aircraft but the door, though fully open, remained attached. The pilot reduced speed to 70 kt and advised ATC of the problem, and the flight continued the short distance to its destination without further incident.

Later it was reported that a plastic A4 stationary folder that had fallen from the helicopter hit a person on the ground, rendering him unconscious. He was assisted by paramedics.

Engineering inspection

The operator's engineers inspected the door and its locking mechanism and found some deformation of the door and other minor damage consistent with it having opened in flight. The locks, however, were serviceable. The engineers commented that as the pilot had checked the door was shut by pulling on it, it was likely that the bolts were at least partially engaged. They added that the quarter-door pins could not be seen from outside the helicopter and were difficult to see from inside the cabin when a stretcher was installed, as on this flight.

Safety actions

It is likely that the door was not secure before takeoff and that the door pins were either not located or only partially located. As a result the operator issued a Safety Bulletin, *'Security of Helicopter Emergency Medical Service's (HEMS) Dauphin Doors'*, which states, in part:

'1. As soon as possible all HEMS Crewmembers will be re-trained on the closing/locking/opening of all the doors. Unqualified passengers are not to close/lock aircraft doors.

2. The first item on the Before Taxi Checklist is:

Doors…….Closed and locked

Pilots are to ensure that either they check all doors are locked themselves or get confirmation from a HEMS Crewmember that this is so before continuing with the checklist.

The use of the question "All secure?" before take-off is ambiguous. The question "Are all seat belts fastened?" removes this ambiguity and ensures compliance with the ANO and OM obligations.'

ACCIDENT

Aircraft Type and Registration:	Beech 200 Super Kingair, G-BGRE
No & Type of Engines:	2 Pratt & Whitney Canada PT6A-61 turboprop engines
Year of Manufacture:	1979
Date & Time (UTC):	23 November 2009 at 1308 hrs
Location:	Chalgrove Airfield, Oxfordshire
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Aircraft nose and propellers damaged
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	7,000 hours (of which 600 were on type) Last 90 days - 60 hours Last 28 days - 22 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, operator's investigation report and metallurgy report

Synopsis

Following retraction of the landing gear after takeoff, the red gear unsafe warning light remained ON. When attempting to extend the gear again at the end of the flight, the nose landing gear did not fully deploy. When the aircraft landed the nose gear collapsed, causing damage to the aircraft nose and propellers, but no injuries to the occupants. The nose gear drive chain was subsequently found to have failed in overload.

History of the flight

The aircraft was returning to Chalgrove from Langford Lodge in Northern Ireland. Following retraction of the gear after takeoff, the red gear unsafe warning light remained ON. The crew flew the remainder of the flight at less than 181 KIAS as a precaution. During the final stages of the flight, the crew selected the landing gear lever to the DOWN position. This resulted in both main landing gear legs extending, with their associated green lights indicating they had locked in place. However, the green light for the nose gear remained OFF and the red gear unsafe warning light illuminated, indicating that the nose landing gear had not locked down.

The pilot flew a low pass over the airfield and observers on the ground confirmed that the nose landing gear had not fully extended. The pilot decided to continue with the landing, anticipating that the nose gear might collapse as it started to support the aircraft's weight. He then conducted a normal approach, but shut down both engines just prior to touchdown of the nose gear. During the landing roll the nose gear leg collapsed, causing both propellers to strike the ground. The aircraft eventually came to a stop resting on its nose, just off the runway centreline. Both occupants were uninjured and vacated the aircraft through the main passenger door.

Landing gear system description

The landing gear system has a gearbox located below the cabin floor, in the centre of the fuselage. The gearbox is operated by an electric motor which is controlled by the landing gear lever position. There are three outputs from the gearbox: spine drives attached to torque tubes which turn each main gear leg actuator, and a sprocket that drives a duplex chain turning the nose gear leg actuator. The electric motor has a dynamic brake system which is triggered by microswitches to prevent over-travel of the gear legs. The emergency extension system consists of a manually operated handle in the cockpit, turning a separate chain attached to the gearbox to drive all three gear legs down together.

Investigation findings

After removing the cabin floor to access the gearbox, it became evident that the nose gear chain had separated. The point of separation was a connecting master link used to remove the chain for maintenance. The pins, plates and the spring clip which made up this link had detached, but the parts were recovered from the aircraft. The chain was visually inspected in accordance with the manufacturer's Aircraft Maintenance Manual (AMM) and the general condition was considered to be within limits. Detailed inspection of the detached parts showed that one of the pins had fractured at its mid point and two of the connecting plates were distorted upwards, with a third plate distorted outwards (Figure 1).

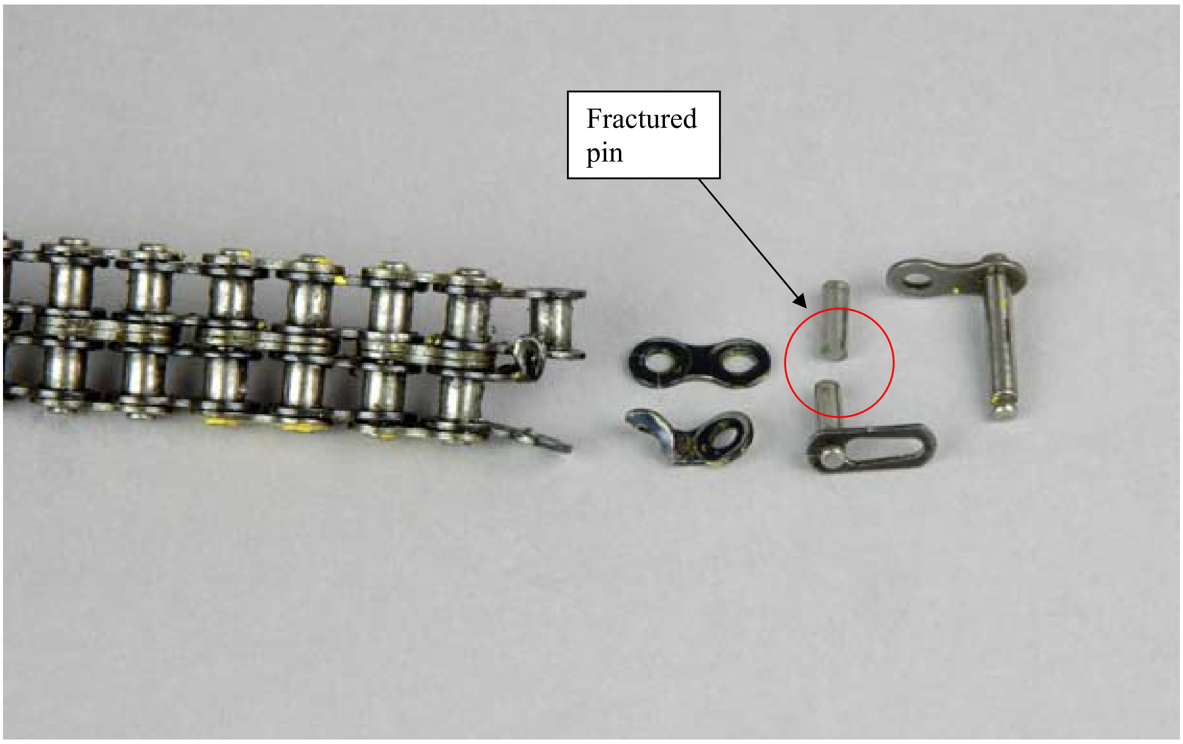

Figure 1

Failed chain link

The failed pin was sent for metallurgical analysis. Inspection of the pin, under a scanning electron microscope, showed evidence on the fracture surface that the failure was due to overload. No evidence of fatigue was identified. Several other cracks, which had not propagated to failure, were also identified when the pin was sectioned. The pin material composition and hardness were also tested and met the required specification.

Manufacturer's information

The chain manufacturer's website provides advice in the form of 'frequently asked questions' and contains the following:

> *'11. Roller Chain failure - Broken, Bent, or Turned Pins*
>
> ***Chain failed in service. Inspection of failure revealed a bent or broken pin, or pins that appear to be turned within the outer (pin) link plates.***
>
> *ANSWER: Shock loads that are greater than the components yield strength, approximately 55-60% of the chains tensile [sic], are the cause of this problem. Changing to High Strength series chain, increasing the chain size (i.e. #80 up to #100), or working to eliminate the shock load on the drive system are some of the ways the chain's performance may be improved.'*

Maintenance requirements

The approved maintenance schedule for the aircraft requires four inspections of the chain to be carried out over a period of 800 flying hours or 2 years, with 200 flying hours between each inspection. The first inspection in the cycle checks for wear and condition, the remainder ensure the chain is free from obstruction and correctly tensioned. The chain is an 'on condition' item and is only replaced when wear limits are exceeded, but the gearbox and motor undergo overhaul every 8000 cycles or 6 years. Checking for wear in the chain consists of measuring the length of a number of links whilst the chain is under a specified tensional load. Limits for the amount of increase in the length of the chain from new are prescribed in the AMM. This test was carried out on the chain during the investigation and it was found to be within manual limits.

Service history

The landing gear was last overhauled on 15 November 2005, 935.5 hrs and 885 cycles previously. The operator's maintenance organisation stated that during this overhaul the chain had been refitted in accordance with the instructions contained in the AMM.

No further removals of the chain were carried out prior to the accident.

Maintenance documentation

Model Communiqué No 16, dated 13 January 1978 was issued by the aircraft manufacturer advising replacement of a 'slip-fit' plate on the master link, with a 'press-fit' plate to retain the master link in the event of the spring lock becoming detached. This communiqué was applicable to aircraft serial numbers prior to BB-306. The accident aircraft serial number was BB-568, suggesting that the chain master link should be the same as the arrangement shown in Figure 2. Examination of the recovered parts of the chain indicated that the pins may not have been pressed through the rear cover plate to the full extent; as such there was insufficient gap remaining for the front 'press-fit' cover plate to be fitted underneath the spring clip. A front cover plate was not recovered from the aircraft following the accident (Figures 1 and 2).

Landing Gear Chain Press-Fit Cover Plate

Super King Airs prior to BB-306 should be checked at the next scheduled inspection to determine if a slip-fit, rather than a press-fit, cover plate is installed on the nose gear chain master links. If the spring lock were to become dislodged or break away from the master link, a slip-fit cover plate would be more likely to slip off the master link than a press-fit cover plate. For this reason we recommend that only press-fit cover plates be used.

If a cover plate is required, we recommend a complete new master link (P/N 131378-25-2-CL) be installed. The press-fit plate can be pressed in place with the modified tool shown.

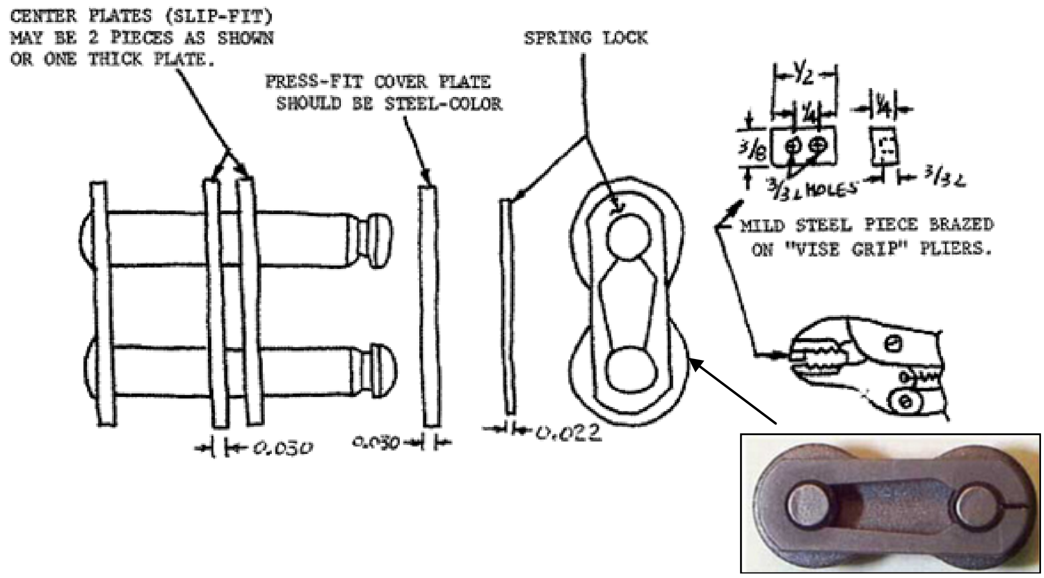

Figure 2

Master link modification

The operator's maintenance staff were unaware that a 'press-fit' cover plate should have been fitted in this position on the chain. They reported that as the AMM did not provide any detail regarding the assembly/disassembly of the master link during removal/installation of the gearbox and did not refer to Model Communiqué No 16, it is possible that a 'press-fit' cover plate may not have been fitted to the chain for some time.

Other events

The aircraft manufacturer advised that their records showed one similar nose gear failure event in March 2001 which was caused by a detached nose gear drive chain. This chain had the same part number as the chain from G-BGRE. The subsequent investigation attributed the failure to incorrect reassembly of the chain following removal of the gearbox for overhaul.

The manufacturer also searched the FAA Accident/Incident Data System (AIDS) which listed the following event involving the nose gear chain:

> *'Data Source: Accident and Incident Database*
> *Report Number: 20070712012309C*
> ***NARRATIVE***
>
> *On July 12, 2007 at approximately 1700 CDT, while on a local CFR Part 91 maintenance flight, a Beechcraft model BE-200, landed on Runway 17R at Lubbock International Airport*

(klbb) with the nose gear in the retracted position. The aircraft sustained damage to both propellers, both nose gear doors and radome. There were no injuries to the pilot or the mechanic onboard. Examination of the aircraft revealed failure of the aft nose gear actuating chain located underneath the cabin floor, between the main gear actuator gearbox and the forward bulkhead. Failure of the chain rendered emergency gear extension ineffective.'

Information from the aircraft manufacturer indicated that the chain master spring link had detached and that the link had a 'slip-fit' type cover plate.

Analysis

Forensic analysis of the fractured pin showed that the failure of the chain occurred in a single overload event. Advice from the chain manufacturer suggests that this may have been due to shock-loading of the chain. Given the design of the landing gear system when the motor brake activates, it can result in shock loads being transferred through the gear chain. This type of load could have occurred during gear retraction after takeoff, which is consistent with the warning indications observed during the accident flight and the subsequent failure of the nose gear to extend fully when selected. The damage identified to the chain plates is likely to have been caused by the sprocket teeth as the failed link travelled around the gearbox sprocket.

It was not possible to determine whether the lack of a 'press-fit' front cover plate may have contributed to the failure of the pin. However, fully inserting the pins into the rear cover plate and fitting a front 'press-fit' cover plate as defined in Model Communiqué No 16 would most likely have prevented the failed link becoming completely detached after the pin fractured. This may have allowed the gear system to continue to operate until the nose gear had fully extended. With a failure of the drive chain in this manner, the emergency extension system is rendered ineffective as it requires the nose gear drive chain to be serviceable to lower the nose gear leg.

Only two previous nose gear failure events, associated with a separation of the landing gear drive chain, could be identified in the extensive service history of the aircraft. Of these, one was caused by maintenance issues and the other failure mode was due to the detachment of the spring lock on a chain fitted with a 'slip-fit' cover plate. The aircraft manufacturer has introduced a hydraulic landing gear system on more recent versions of this aircraft type.

ACCIDENT

Aircraft Type and Registration:	Cessna 150M, G-NWFA
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	1975
Date & Time (UTC):	19 August 2010 at 1048 hrs
Location:	Andrewsfield, Essex
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nose landing gear and propeller
Commander's Licence:	Student
Commander's Age:	20 years
Commander's Flying Experience:	18 hours (of which 18 were on type) Last 90 days - 6 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB enquiries

Synopsis

The aircraft bounced on landing and during the second touchdown the nosewheel broke away and the aircraft then bounced into the air for a second time. The student pilot was able to fly a go-around and after being briefed by his instructor, over the radio, diverted to North Weald where he landed safely.

History of the flight

G-NWFA was based at North Weald, which is an unlicensed airfield, and when used for flying training the aircraft would normally be flown to, and operated out of, Andrewsfield, which is a licensed airfield. The student involved in this accident was familiar with operating out of North Weald.

This was the student's fifth solo flight and he was returning to Andrewsfield after having completed his first solo navigation flight. The student reported that the weather was fine and the approach was normal. As he started to flare the aircraft it suddenly sank and landed on its main wheels before bouncing back into the air. The student maintained the attitude of the aircraft and allowed it to settle back onto the runway. However, the aircraft made a firm touchdown and the student heard a noise as it once again bounced into the air. At this point he commenced a go-around and at the same time heard his instructor, who was monitoring the student on a portable radio, informing him that the nosewheel had separated from the aircraft. The air / ground operator asked the student for his fuel state and enquired if he had any other problems with the aircraft. As the student responded in a calm manner, and stated that he had plenty of fuel and there were no other apparent problems, he was advised to continue flying the circuit pattern while they considered the best course of action.

The airfield manager, student's instructor and an engineer discussed the situation and felt that in landing at Andrewsfield the nose landing gear leg might dig into the grass runway causing the aircraft to turn over. Consideration was given to advising the student to fly to Southend; however the student was unfamiliar with this airfield and the navigation would have placed him under additional pressure. It was, therefore, felt that a safer option would be for the student to fly to North Weald, which had a long asphalt runway and from where he had flown on a number of occasions.

While the airfield manger contacted North Weald and informed them of the situation, the student's instructor departed Andrewsfield in a second aircraft piloted by another instructor. This second aircraft escorted G-NWFA to North Weald and during the transit the student's instructor briefed him on the actions he should take to land the aircraft with the nosewheel missing. The instructor's aircraft landed first while the student was instructed to fly the circuit pattern until the emergency vehicles were in place. The student made a normal approach with full flap selected. Once the main wheels touched the runway he closed the throttle and mixture lever, and held the nose of the aircraft up for as long as possible. The aircraft came safely to a halt on the runway.

Engineering examination

The nose landing gear fork had failed where it attached to the nose oleo and the right hand side of the fork, along with the nosewheel, had separated from the aircraft at Andrewsfield. The left side of the fork remained attached to the oleo and was badly abraded during the subsequent landing at North Weald. The AAIB were advised that there was no visible signs of damage to the nose landing gear supports or the engine firewall and the only other visible damage was to the tips of the propeller blades. A metallurgist inspected the fracture surfaces of the fork and could find no evidence of any pre-existing damage and commented that the failure was consistent with the fork failing as a result of a heavy landing.

ACCIDENT

Aircraft Type and Registration:	Diamond Aircraft Industries DA42 Twin Star, G-SLCT
No & Type of Engines:	2 Thielert TAE 125-01 piston engines
Year of Manufacture:	2005
Date & Time (UTC):	3 June 2010 at 0900 hrs
Location:	Stapleford Airfield, Essex
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Aircraft extensively damaged
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	38 years
Commander's Flying Experience:	2,276 hours (of which 58 were on type) Last 90 days - 107 hours Last 28 days - 40 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB investigation

Synopsis

Despite cycling the landing gear several times, the right main gear remained in the retracted position and the pilot landed the aircraft on the nose and left main landing gear. The pilot and passenger were uninjured, but the aircraft was extensively damaged. The investigation established that the right landing gear jammed in the wheel well as a result of the failure of a trunnion, which connected the landing gear damper to the wheel trailing arm. The failure was caused by stress corrosion cracking. Three Safety Recommendations were made to the aircraft manufacturer.

History of the flight

The pilot reported that on selecting the landing gear down during the approach to Cranfield, the gear unsafe light illuminated and the position indicator for the right main landing gear remained extinguished. The landing gear was cycled several times, but with the gear selected down the indications in the cockpit remained the same. The controller in the Tower confirmed, as the pilot flew down the runway, that the right main landing gear had not extended. The pilot elected to return to his home airfield at Stapleford and during the flight carried out a number of high g manoeuvres in an attempt to dislodge the landing gear. As this was unsuccessful, he undertook a number of touch-and-go landings at Stapleford, but to no avail. A landing was subsequently made on Runway 22R; the pilot held the right wing up for as long as possible during the landing roll, whilst maintaining directional control with the rudder and latterly the brakes. The wing settled on the runway and when directional control was no longer effective, the aircraft yawed to the right before coming to rest in a field of crops, on a heading of approximately 270°. While the pilot and passenger were uninjured the aircraft was extensively damaged.

Damage to the aircraft

The aircraft was recovered and examined by the operator's maintenance organisation who advised the AAIB that the trunnion (Part No D60-3217-23-51) that connected the landing gear damper to the wheel trailing arm on the right landing gear leg had failed, Figure 1. This allowed the trailing arm to hang lower than normal, causing the landing gear to foul on the inside of the wheel well and prevented it from extending.

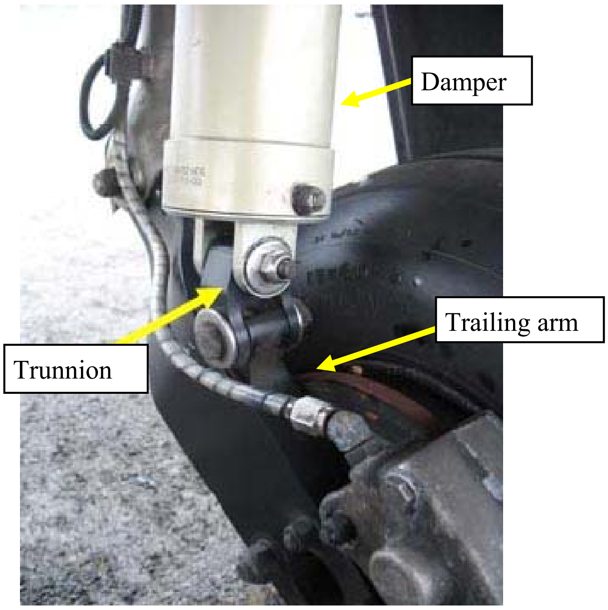

Figure 1

Location of failed trunnion on right landing gear

Stress corrosion cracking

Stress corrosion cracking (SCC) propagates along the grain boundaries in a metal and occurs when it is subjected to a sustained tensile load in a corrosive environment. SCC can be controlled by the use of corrosion prevention measures, minimising stress concentrations and using a combination of materials less susceptible to corrosion and SCC.

Examination of landing gear trunnions

General

The trunnions from the left and right landing gear assemblies were examined by a metallurgist at QinetiQ. The trunnions had been manufactured from aluminium alloy, specification 3.4365.71, which had been anodised to improve wear and corrosion resistance.

Trunnion from right landing gear

Failure of the right trunnion had occurred as a result of a fracture running along the 14 mm bore through which the attachment bolt that connects the trunnion to the damper was fitted. A section from this part of the trunnion, approximately 5 mm wide, had broken away and was not recovered from the accident site, Figure 2.

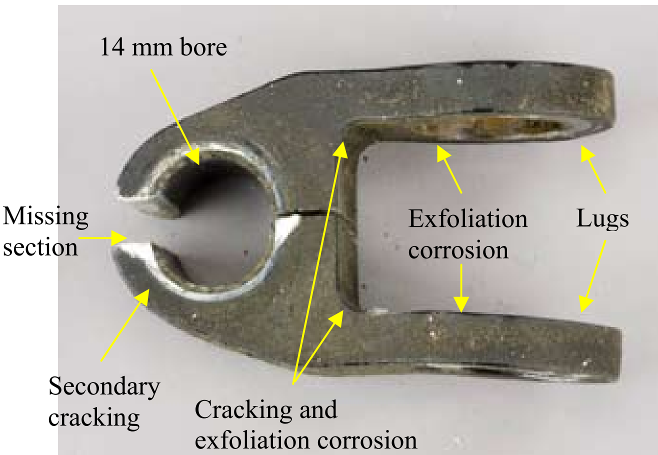

Figure 2

Damage to right trunnion

There was also evidence of secondary cracking and corrosion pits on the inside of the bore, with one corrosion pit located on the fracture face of the bore. The secondary cracking which was associated with damage to the anodised layer, had progressed along the exposed grain boundaries to depths of approximately 2.5 mm and was indicative of SCC.

The trunnion had suffered extensively from exfoliation corrosion on the inner and outer faces of both lugs, Figure 3, to a depth of 4.8 mm. Cracking and exfoliation corrosion to a depth of 1.6 mm was also found along the inner radius at the base of both lugs, Figure 4.

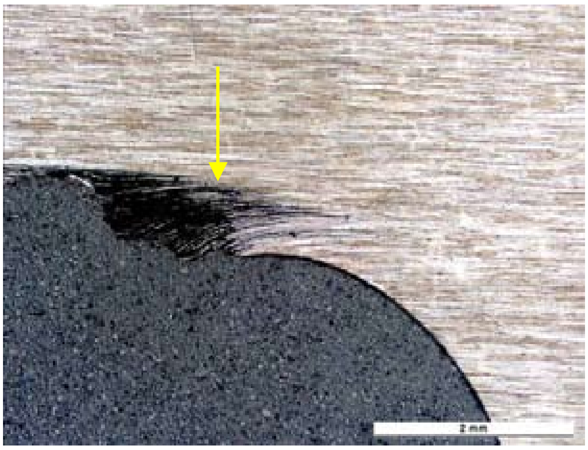

Figure 3

Exfoliation corrosion

Figure 4

Cracking at base of lugs

The bush (Part No BU1-18-10-0342) that fits into the lugs and the fitting on the landing gear trailing arm, Figure 5, had suffered from corrosion damage which appeared to be confined to the surface and did not penetrate the section, or show any evidence of pitting. There was no evidence of wear or gross loss of material. The bolt, which is fitted in the bush, was assessed as being in relatively good condition with no evidence of corrosion or damage.

Figure 5

Condition of bush

The metallurgist concluded that the failure of the right trunnion was as a result of SCC, which started in the 14 mm bore where the protective anodising had been damaged. Movement of the attachment bolt in the bore might have resulted in surface damage which compromised the anodised layer and accelerated the onset of SCC. The metallurgist also commented that the material from which the trunnion was manufactured is known to be susceptible to SSC, particularly when, as in this case, the component has been machined from plate stock or a forging resulting in exposed grain boundaries.

Trunnion from left landing gear

Examination of the left trunnion revealed evidence of exfoliation corrosion around both lugs. There was no evidence of cracking either at the base of the lugs or within the 14 mm bore.

Previous occurrences

The aircraft manufacturer advised the AAIB that they were aware of corrosion occurring on the landing gear assembly and over the previous three years had inspected 550 aircraft and found 13 occurrences of damage to the trunnions. However, this was the first occasion that a failure had occurred in-flight.

As a result of these findings the aircraft manufacturer took the following actions:

- A temporary revision to the Aircraft Maintenance Manual (AMM-TR-MAM-42-368) detailing the anti-corrosion coatings to apply to the aircraft was issued on 14 July 2009.

- A Service Information letter (SI-42-127) was issued on 11 December 2009 advising operators of new anti-corrosion methods that had been incorporated in the AMM.

- A Mandatory Service Bulletin (MSB 42-088) was issued two weeks after this accident, on 23 June 2010, requiring the trunnions that connect the landing gear damper to the wheel trailing arm to be inspected for cracks within the next 20 flight hours and then at every 100 hour maintenance inspection. The MSB only required the joint to be disassembled if there was doubt about its condition.

Analysis

Examination of the trunnion on the right landing gear assembly revealed that it failed as a result of SCC along the inner face of the 14 mm bore. Stress corrosion cracking requires a metal to be subject to a sustained tensile load in a corrosive environment. The trunnions are manufactured from an aluminium alloy that is known to be particularly susceptible to SCC. Moreover the location of the trunnions results in their exposure to moisture and dirt thrown up from the main wheels. While the left and the right trunnion had been damaged by exfoliation corrosion, it is most probable that the SCC in the right trunnion started from a corrosion pit in the 14 mm bore caused by galvanic corrosion between the attachment bolt and the sides of the bore where the anodised layer had worn away.

The aircraft manufacturer had taken action to inspect the trunnions for cracking and corrosion, and introduced a number of anti-corrosion methods. However, these measures do not require the trunnion assembly to be dismantled; consequently, the current actions would not have identified any damage in the 14 mm bore, cracking at the base of the lugs or corrosion on the bush. Therefore, the following Safety Recommendations are made to the aircraft manufacturer:

Safety Recommendation 2010-066

It is recommended that Diamond Aircraft Industries consider issuing a Mandatory Service Bulletin for the trunnions (Part No D60-3217-23-51) on the main landing gear fitted to DA42 and DA42M aircraft to be removed, disassembled and inspected for corrosion and cracking.

Safety Recommendation 2010-067

It is recommended that Diamond Aircraft Industries review their instructions for the inspection and lubrication of the trunnions (Part No D60-3217-23-51) on the main landing gear fitted to DA42 and DA42M aircraft with a view to reducing their susceptibility to corrosion and stress corrosion cracking.

Safety Recommendation 2010-068

It is recommended that Diamond Aircraft Industries review the design of the trunnions (Part No D60-3217-23-51) on the main landing gear fitted to DA42 and DA42M aircraft with a view to making the components less susceptible to stress corrosion cracking.

ACCIDENT

Aircraft Type and Registration:	Europa XS, G-IRON
No & Type of Engines:	1 Rotax 914-UL piston engine
Year of Manufacture:	2005
Date & Time (UTC):	2 August 2010 at 0930 hrs
Location:	Wildfields Farm, Guildford, Surrey
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller blades, fuselage and wingtip
Commander's Licence:	Private Pilot's Licence
Commander's Age:	64 years
Commander's Flying Experience:	818 hours (of which 148 were on type) Last 90 days - 13 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft touched down further along the strip than planned and the pilot elected to go around. During the climb out a wingtip clipped a tree and the aircraft landed heavily in the next field. Both the pilot and passenger were uninjured. The pilot considered that the wind had dropped, increasing the landing distance required.

ACCIDENT

Aircraft Type and Registration:	GAF Nomad, N5190Y
No & Type of Engines:	2 Allison 250B17 turboprop engines
Year of Manufacture:	1976
Date & Time (UTC):	9 May 2009 at 1345 hrs
Location:	Chatteris Airfield, Cambridgeshire
Type of Flight:	Aerial Work
Persons on Board:	Crew - 1 Passengers - 13
Injuries:	Crew - None Passengers - None
Nature of Damage:	Left main landing gear and left wing tip damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	1,161 hours (of which 328 were on type) Last 90 days - 13 hours Last 28 days - 4 hours
Information Source:	AAIB Field investigation

Synopsis

The aircraft landed heavily in gusty conditions with 13 parachutists on board, causing damage to the landing gear and wing tip. The pilot had not received any formal training on this aircraft type and the British Parachuting Association have subsequently formed a working group to review the training and qualification of pilots flying foreign-registered aircraft for parachute dropping.

History of the flight

The aircraft departed with the pilot and 13 parachutists aboard. During climb to the drop altitude, the ground crew called the pilot by radio to say that the wind was too strong for the planned drop, and the aircraft should return.

The pilot reported that he flew an approach to Runway 19, at 87 kt, with flaps set at 20°[1]. The wind was reported as 220/15 kt gusting to 30 kt, visibility was 10 km or more, and cloud was scattered at 5,000 ft above the airfield. The approach appeared normal until, as he was about to initiate the roundout, the aircraft "suddenly dropped" and landed heavily. The pilot recalled that on his last instrument scan before the flare, the indicated speed was 75 kt. The aircraft came to a halt and the left main landing gear then collapsed. There was no fire and all occupants exited the aircraft without difficulty. Another experienced Nomad pilot, who observed the approach

Footnote

[1] The flaps extend to a maximum of 38°, but their use was restricted to 20° by airworthiness requirements.

and accident, commented that the Nomad had followed a microlight aircraft close ahead of it on the approach. He added that he was surprised that the Nomad pilot had not gone around.

Aircraft performance

The flight manual for the aircraft showed that at a landing weight of 8,500 lbs, the uncorrected approach speed with flaps set at 20° should be 87 kt. The flight manual gave no advice about landing with less than full flap or adjusting the approach speed to take account of wind.

Pilot qualification

The pilot held both CAA and FAA Private Pilot's Licences; the FAA licence had been issued on the basis of the CAA licence. Under CAA rules, the pilot would have been required to undertake a course of training and tests to obtain a type rating on the Nomad aircraft, whereas FAA rules make no such provision. The pilot's training on the type had consisted of one 50 minute flight, which he described in is log book as a 'checkout', although the flying time was recorded in his P1 flying hours column. The name of the pilot who conducted the 'checkout' with him was not recorded.

The AAIB sought an opinion from the CAA as to whether the pilot's licence was valid for this flight with this aircraft. As this N-registered aircraft was being flown under the privileges of an FAA licence, the CAA asked the FAA for clarification but the FAA did not provide a definitive answer.

The pilot had carried out only one landing with parachutists still on board the aircraft since a previous accident in 2007.

Previous accident

The AAIB investigation[2] into a previous accident involving the same pilot and aircraft type in 2007 stated that:

> *'The aircraft, with 13 parachutists on board, inadvertently entered cloud as it climbed through about 8,500 ft. The pilot descended the aircraft and regained VMC at about 4,000 ft; however one of the engines ran down due to icing before the engine anti ice system was selected on. The pilot was unable to restart the engine and returned to his departure airfield, where he flew a faster than normal approach in accordance with training he had received for single-engine landings. The aircraft landed long and the pilot was unable to stop it before the end of the runway. During the subsequent overrun, the nosewheel entered a ditch causing the noseleg to collapse.*
>
> *'The pilot did not hold a type rating for the aircraft, as required under CAA and JAR's, however he was operating under his FAA licence, (based on his CAA licence) and he incorrectly believed he did not require a specific type rating.'*

The aircraft is prohibited from operating in icing conditions. Following the accident, the pilot continued to fly the aircraft regularly under the same licensing arrangement.

Footnote

[2] EW/C2007/08/11.

Foreign-registered aircraft approved for parachute dropping in the UK

The Department for Transport provided a list of non-UK registered aircraft that have been granted permission for parachute operations in the current calendar year in the UK. It included 20 aircraft on eight foreign registers, almost all of them single or twin turboprop aircraft.

Analysis

This accident occurred in good weather, though with a gusty wind. The fact that the parachutists had not disembarked meant that the landing weight was markedly higher than normal. The pilot had only occasionally landed the aircraft at similarly high weights.

The pilot had not received any formal training to fly the aircraft; his FAA licence permitted him to fly the aircraft without a type rating. If the aircraft had been operated on the UK register, he would have been required to undertake training and a test to obtain a type rating. This may have better prepared him to complete a safe heavyweight approach and landing.

Safety action

The accident was discussed with the British Parachuting Association (BPA). BPA officials have formed a working group to review the training and qualification of pilots flying foreign-registered aircraft for parachute dropping.

The aircraft operator now requires pilots converting onto the Nomad aircraft to undertake at least ten hours training in the right seat of the aircraft with a BPA Pilot Examiner, followed by approximately ten hours in the left seat, before being cleared to fly solo.

ACCIDENT

Aircraft Type and Registration:	Jabiru SK, G-JABA
No & Type of Engines:	1 Jabiru Aircraft Pty 2200A piston engine
Year of Manufacture:	2000
Date & Time (UTC):	22 June 2010 at 1920 hrs
Location:	1 mile west of Whiterashes Airstrip, Aberdeenshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose leg, left landing gear, wing and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	188 hours (of which 20 were on type) Last 90 days - 4 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

The aircraft suffered an engine failure following power reduction whilst on the downwind leg of a circuit. The pilot carried out a forced landing in a crop field, during which the aircraft sustained damage but the pilot was uninjured.

History of the flight

The Jabiru SK is a high-wing, single-engine two-seat kit aircraft and G-JABA was operating under a UK Permit to Fly. After completing pre-takeoff checks, the pilot departed from Whiterashes Airstrip with approximately two hours of fuel on board (34 litres), with the intention of practising circuits. On the downwind leg of the initial circuit the pilot reduced engine power to approximately 2,000 rpm. As the pilot was running through the pre-landing checks, but before carburettor heat was applied, the engine hesitated briefly before stopping.

The pilot trimmed the aircraft for best glide speed but assessed that he was too low to land safely back on the airstrip and decided instead to make a forced landing in a crop field approximately 1 nm west of the airstrip. During the approach to the field the pilot attempted to restart the engine by turning the electric fuel pump on and engaging the starter, but the engine did not start. The field the aircraft landed in was rough beneath the crop and the aircraft sustained damage to the nose leg and left main landing gear, propeller and left wingtip.

Meteorology

An aftercast provided by the Met Office for the accident location estimated that the surface conditions were temperature +18ºC, dewpoint +14ºC and the surface wind 340º at 5 kt.

The conditions for 1,000 ft altitude at the accident location were estimated as temperature +18ºC, dewpoint +10ºC and wind 250º at 5 to 10 kt.

From the carburettor icing chart (Figure 1) it can be seen that the conditions at the surface and at 1,000 ft altitude were favourable for 'moderate icing – cruise power' and 'serious icing – descent power'.

Examination of the engine

The day following the accident the engine was examined by the pilot and fuel was observed in the carburettor float chamber. The engine turned freely and the ignition system functioned normally. There had been no fuel leak and sufficient fuel to conduct the flight remained in the main fuel tank.

A subsequent strip inspection of the engine did not reveal any defects that would have contributed to the engine failure.

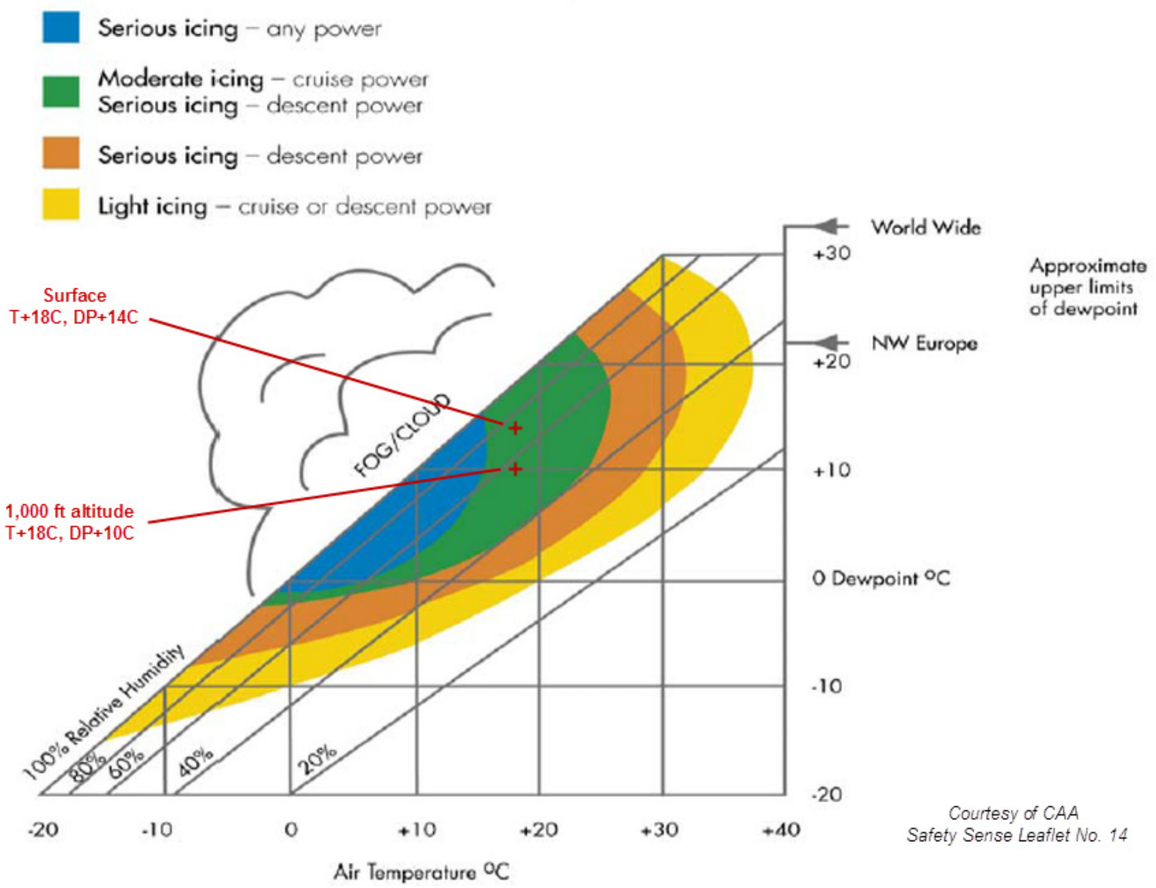

Figure 1

Carburettor icing chart

Piston engine icing

The CAA's Safety Sense Leaflet 14, *'Piston Engine Icing'* (available from www.caa.co.uk/safetysense) provides useful information to pilots on the hazards of piston engine icing. Section 6 'General Practices', subsection (i) states:

> *'Unless necessary, the continuous use of hot air at high power settings should be avoided. However, carburettor heat should be applied early enough before descent to warm the intake, and should remain fully applied during that descent, as the engine is more susceptible to carb icing at low power settings.'*

And in section 7 'Pilot Procedures', subsection (k):

> *'Downwind*
>
> *Ensure that the downwind check includes the cruise carburettor heat check at paragraph 6(i) above. If you select and leave the heat on, speed or altitude will reduce on the downwind leg unless you have added some power beforehand.'*

Discussion

The prevailing meteorological conditions at the time of the accident were favourable for the formation of serious carburettor icing at descent power settings. Lack of application of carburettor heat and subsequent carburettor icing were the most likely causes of the engine failure.

A contributory factor in the accident itself was the presence of crop in the field selected for the subsequent forced landing, which obscured the field's underlying rough surface condition.

ACCIDENT

Aircraft Type and Registration:	Piel CP301A Emeraude, G-AYTR
No & Type of Engines:	1 Continental Motors Corp C90-14F piston engine
Year of Manufacture:	1958
Date & Time (UTC):	3 August 2010 at 1205 hrs
Location:	Defford (Croft Farm) Airfield, Worcestershire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Damage to canopy, propeller, fuselage and elevator
Commander's Licence:	Private Pilot's Licence
Commander's Age:	66 years
Commander's Flying Experience:	320 hours (of which 96 were on type) Last 90 days - 10 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot had conducted a local flight lasting an hour, before returning to land on Runway 27L at the airfield. The weather was good, with the wind from 250° at 8 kt. The aircraft touched down smoothly but during the rollout it gradually turned into the wind. The pilot judged that the aircraft ground speed had reduced sufficiently to use the brakes to steer back onto the centreline. However, when he applied the brakes, the aircraft rapidly pitched nose-down, resulting in it coming to rest inverted. The pilot acknowledged that he had not reduced the power completely to idle or pulled the control stick fully back during the ground roll. He stated that a misjudgement of the ground speed, combined with a tail wheel bounce as he applied the brakes, resulted in the accident.

ACCIDENT

Aircraft Type and Registration:	Piper PA-31P Pressurised Navajo, N95RS
No & Type of Engines:	2 Lycoming TIGO-541 piston engines
Year of Manufacture:	1974
Date & Time (UTC):	15 January 2010 at 1407 hrs
Location:	Bladon, Oxfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed by post-impact fire
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	12,500 hours (hours on type not known) Last 90 days - n/k hours Last 28 days - 10+ hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft took off from Oxford for a planned flight up to FL190. The reported visibility was 2,000 m with a cloudbase of 200 ft. The pilot established two-way radio communication with Brize Radar and was cleared to climb to FL80. The controller observed the aircraft climb to around 1,500 ft then saw that it had started to descend. There were no further communications from the aircraft and two minutes later it crashed into a field. The post-mortem examination showed that the pilot had severe coronary heart disease and there was evidence to suggest that he may have been incapacitated, or died, prior to the collision with the ground. The passenger was a qualified private pilot but was not experienced with either the aircraft or flight in IMC.

History of the flight

The aircraft had recently been purchased in Germany and was flown to the United Kingdom on 11 December 2009 by the pilot of the accident flight. The new owner, who accompanied him for the flight from Germany, was a private pilot himself and was the passenger in the accident. The aircraft landed at Oxford on the evening of 11 December. The pilot reported to a maintenance organisation that there had been a problem with the brakes after landing and the aircraft was left parked outside a hangar.

Minor maintenance was carried out on 20 December 2009 and on 9 January 2010 the aircraft was refuelled, but it was not flown again until the accident flight.

On the morning of 15 January 2010 the pilot and his passenger met at Oxford Airport and prepared the aircraft for flight. The plan was to carry out an air test, although its exact nature was not established. The flight was pre-notified to Royal Air Force (RAF) Brize Norton as an air test with a requested level of FL190.

At 1344 hrs the aircraft taxied out to Holding Point C for Runway 19 at Oxford. The pilot reported 'READY FOR DEPARTURE' at 1400 hrs and was given a clearance for a right turn after takeoff with a climb initially to FL80. The pilot then requested the latest weather information and the tower controller provided the following information: '........TWO THOUSAND METRES IN MIST AND CLOUD IS BROKEN AT 200 FEET.'

At 1403 hrs the takeoff commenced and shortly after liftoff Oxford ATC suggested that the pilot should contact Brize Radar on 124.275 Megahertz (MHz). The pilot made contact with Brize Radar at 1404 hrs, two-way communication was established and the provision of a Deconfliction Service was agreed.

On the radar screen the Brize Norton controller observed the 'Mode C' (altitude) return increase to around 1,500 ft and then noticed it decrease, seeing returns of 1,300 ft and 900 ft, before the secondary return disappeared. At 1406 hrs the Brize Norton controller contacted Oxford ATC to ask if the aircraft had landed back there and was advised that it had not done so, but that it could be heard overhead. The Brize Norton controller told Oxford ATC that they had a continuing contact, but no Secondary Surveillance Radar (SSR). The Oxford controller could still hear an aircraft in the vicinity and agreed with the Brize Norton controller to attempt to make contact. At 1407 hrs Oxford ATC made several calls to the aircraft but there was no reply. The Oxford controller told the Brize Norton controller there was no reply and was informed in return that there was no longer any radar contact either.

The Brize Norton controller also attempted to call the aircraft at 1407 hrs but without success. At 1410 hrs the Oxford controller advised the Brize Norton controller that there was smoke visible to the west of the airfield and they would alert both the airport and local emergency services.

In the meantime several witnesses saw the aircraft crash into a field to the west of Oxford Airport. A severe fire started soon afterwards and bystanders who arrived at the scene were not able to get close to the aircraft. The local emergency services were notified of the accident by witnesses at 1407 hrs.

Meteorological information

The weather during the time the aircraft was parked at Oxford was unusually cold with snow lying on the ground for several weeks. By 15 January 2010 much of the snow had melted and the main movement areas at Oxford Airport were clear.

The weather observation for Oxford Airport at 1330 hrs was: surface wind from 170º at 8 to 12 kt, visibility 2,000 m, cloud broken at 200 ft temperature 3ºC, dewpoint 2ºC and pressure 1015 hPa. Stage one low visibility procedures, principally involving a test of communications, were implemented at Oxford at 1340 hrs.

The 1350 hrs Meteorological Report for RAF Brize Norton was: surface wind from 170º at 4 kt, visibility 2,000 m, cloud overcast at 200 ft, temperature 5ºC, dewpoint 4ºC, and pressure 1015 hPa.

Airport information

Oxford has an Air Traffic Zone extending in a circle of radius 2 nm around the airfield and an Air Traffic Service. The Oxford ILS/DME/NDB RWY 19 procedure minima for this aircraft was 458 ft amsl/200 ft aal. Radar coverage for the local area can be provided by Brize Radar on request.

The airfield elevation is 270 feet. Terrain rises to 400 ft 1nm south west of the airport.

Pilot information

The pilot was an airline transport pilot whose main flying activity was working for an airline as a training captain on Boeing 737-800 aircraft. For the three days prior to the accident the pilot had been conducting aircraft training with pilots new to type. When this training is being conducted a type-qualified safety pilot is seated on the jumpseat. The pilot had returned to his home on the evening of the day before the accident.

The pilot also had various general aviation interests. He was a commercial helicopter pilot with a valid instructor rating and an active fixed-wing pilot. His Multi-engine Piston (MEP) rating was renewed on 2 November 2009. No logbook record of his recent general aviation flying activities was found so it was not possible to know precisely how much of this type of flying he had done in the recent past.

The passenger was a qualified private pilot; no logbook record of his flying experience was found. He obtained his PPL on fixed-wing aircraft in November 2008 and his PPL(H) in March 2009. He was reported to have flown his own Robinson R44 helicopter on a regular basis. He carried out a full-time training course to obtain an MEP rating in November 2009 using a Piper Seneca aircraft. It was recorded on his application form for the rating that he had 93 hours of pilot in command flight time. When he had completed his MEP course he started working towards obtaining an IMC rating; at the time of the accident he had done about 4 hours dual training, also on a Piper Seneca. His instructor gave his opinion that at his stage of training and experience he would be unlikely to have been able to successfully fly a Piper Navajo aircraft in IMC.

Medical and pathological information

Autopsy examinations were carried out on the bodies of both occupants. These examinations showed that both had suffered severe multiple injuries and that the crash was non-survivable. Death would have occurred before the onset of the post-crash fire and no alcohol or drugs were detected in toxicological tests. The autopsy report for the pilot showed that he was suffering from:

> *'a severe degree of coronary artery disease which would be capable of producing a range of cardiac symptoms including arrhythmias, angina, collapse or sudden death.'*

It also commented that there was no convincing evidence that the pilot was alive at the time of sustaining his injuries.

The pilot held a current JAR Class 1 medical certificate. His most recent medical examination took place on 29 September 2009. In September 2008 a minor anomaly was detected on his ECG (electrocardiogram) which was referred to a cardiologist who assessed it as being acceptable for certification. The ECG in September 2009 showed a similar anomaly and was passed as being acceptable without reference to a cardiologist. Following the accident both ECGs were reviewed by an independent cardiologist who concurred that the changes would not necessarily have warranted further investigation.

Aircraft information

Background and aircraft history

The Piper PA-31P Pressurised Navajo has two geared turbocharged piston engines, with three-bladed propellers, and a pressurised cabin, giving a quoted service ceiling of over 24,000 ft. It was not possible to determine precisely the instrumentation and equipment fitted to N95RS at the time of the accident, but interior photos of the aircraft, taken at an unknown date, showed a full set of instruments on the right-hand side. Post-accident examination of this heavily fire-damaged area supported this. Flap operation is electrical, by an 'ungated' switch in front of the right control column, with flap setting indicated on a gauge positioned on the right instrument panel.

The aircraft was manufactured in the USA in 1974, initially registered there and so registered at the time of the accident. The aircraft had been purchased in Germany and ferried to Oxford in December 2009 following the change of ownership; the accident flight of 15 January 2010 was the first to take place after the ferry flight.

Recent records of the aircraft technical and maintenance history were not available and the ferry flight had carried the same pilot and passenger who received fatal injuries in the accident. A witness to the departure of the aircraft from the German base stated that the maintenance documentation relating to the complete history of the aircraft was placed in the main cabin before the departure from Germany. None of this documentation was recovered, but was probably destroyed by the sustained post-crash fire. All maintenance and aircraft information held by the FAA in their records was supplied to the AAIB but did not include recent aircraft maintenance.

The only recent maintenance of which full details were available was the rectification of a brake defect, identified during the landing at Oxford following the delivery flight from Germany, together with replacement of two lights and the aircraft battery. This work was carried out on 20 December 2009. None of these actions involved any physical work on parts of the aircraft relevant to its flight performance or handling characteristics. A work pack covering inspections and maintenance carried out in Germany approximately 11 months before the accident, was recovered by the Bundesstelle für Flugunfalluntersuchung (BFU, the German air safety investigation body) and supplied to AAIB. This appeared to cover those actions necessary to issue an Airworthiness Review Certificate.

The airport operators informed the AAIB that N95RS was refuelled at Oxford on 9 January 2010, six days before the accident. The fuel sample taken on the day the aircraft was refuelled was recovered by the AAIB and subjected to analysis; it was found to conform fully to the required specification.

Wreckage and accident site

The aircraft struck the ground on an approximately level, snow-covered, cultivated field at an elevation of about 300 ft and examination of the wreckage site confirmed that the aircraft had struck the ground whilst structurally complete. It was erect, flying in a slightly nose-down and slightly right-wing-down attitude, with the landing gear retracted. At the time of impact the aircraft had a higher rate of descent than would be accounted for as a direct consequence of the pitch angle. The heading at impact was approximately westerly and the flaps were set at 15º. The aircraft was largely destroyed by a sustained ground fire.

Both propellers showed evidence of having been rotating at similar speeds at impact. However, no direct evidence of blade pitch position was found, so the power setting could not be determined. Strip examination of the engines revealed no evidence of internal failure and the components were in a condition consistent with correct engine operation at the time of impact. Examination of the flying controls revealed no evidence of pre-impact failure. The extent of fire damage, however, precluded a realistic examination of the aircraft instruments.

Air traffic control

RAF Brize Norton provides a Lower Airspace Radar Advisory Service (LARS), Brize Radar, in the accident area. The pilot established two-way RTF contact with Brize Radar and the provision of a Deconfliction Service was agreed. This is a surveillance-based service, which may be in VMC or IMC, whereby the controller issues headings and/or levels aimed at achieving planned deconfliction minima.

The following paragraph regarding identification of aircraft receiving a Deconfliction Service is provided in the Manual of Air Traffic Services (MATS) Part 1:

> *'The controller shall identify the aircraft, inform the pilot that he is identified, and maintain identity. If identity is lost, the pilot shall be informed and the controller shall attempt to re-establish identity as soon as practicable.'*

Recorded information

Radio communication recordings between the aircraft and both Oxford ATC and Brize Radar were available to the investigation.

A limited amount of radar data for the accident flight, covering a period of 48 seconds, was recorded by Clee Hill radar, 58 nm to the northwest. The first contact was at 1405:09 and the last at 1405:57; however, contact with the aircraft was lost during this period for two consecutive sweeps of the radar. The aircraft was fitted with a Mode S transponder that transmitted true track angle, groundspeed and altitude (with 100 foot resolution) information. This information was recorded for all the returns except the first, which contained altitude information only[1]. The radar track is presented in Figure 1 together with the time, groundspeed, altitude (adjusted to 1015 mb QNH) and track information.

The groundspeed and adjusted altitude data are also presented in Figure 2.

During the 24-second period that radar contact was lost, the aircraft turned to the left through 200º (see Figure 1) and gained 700 (±100) feet, as well as losing 48 kt groundspeed in the turn and climb. Radar contact was probably lost because the radar coverage was initially obscured by rising terrain between the radar head at Clee Hill and the aircraft, and in the latter part of the turn the aircraft's antenna was out of sight of the radar as the aircraft was in a bank to the left.

Footnote

[1] Mode S radar has two methods of interrogation: All-Call and Selective. All-call interrogations are transmitted regularly at a steady rate in a similar way to conventional Secondary Surveillance Radar. When a Mode S transponder replies to an all-call interrogation it transmits its unique 24-bit aircraft address together with altitude data (if available). Once the 24-bit aircraft address is known, from the initial interrogation, the Mode S radar can then selectively interrogate the transponder, whose reply then also includes airborne data (if available).

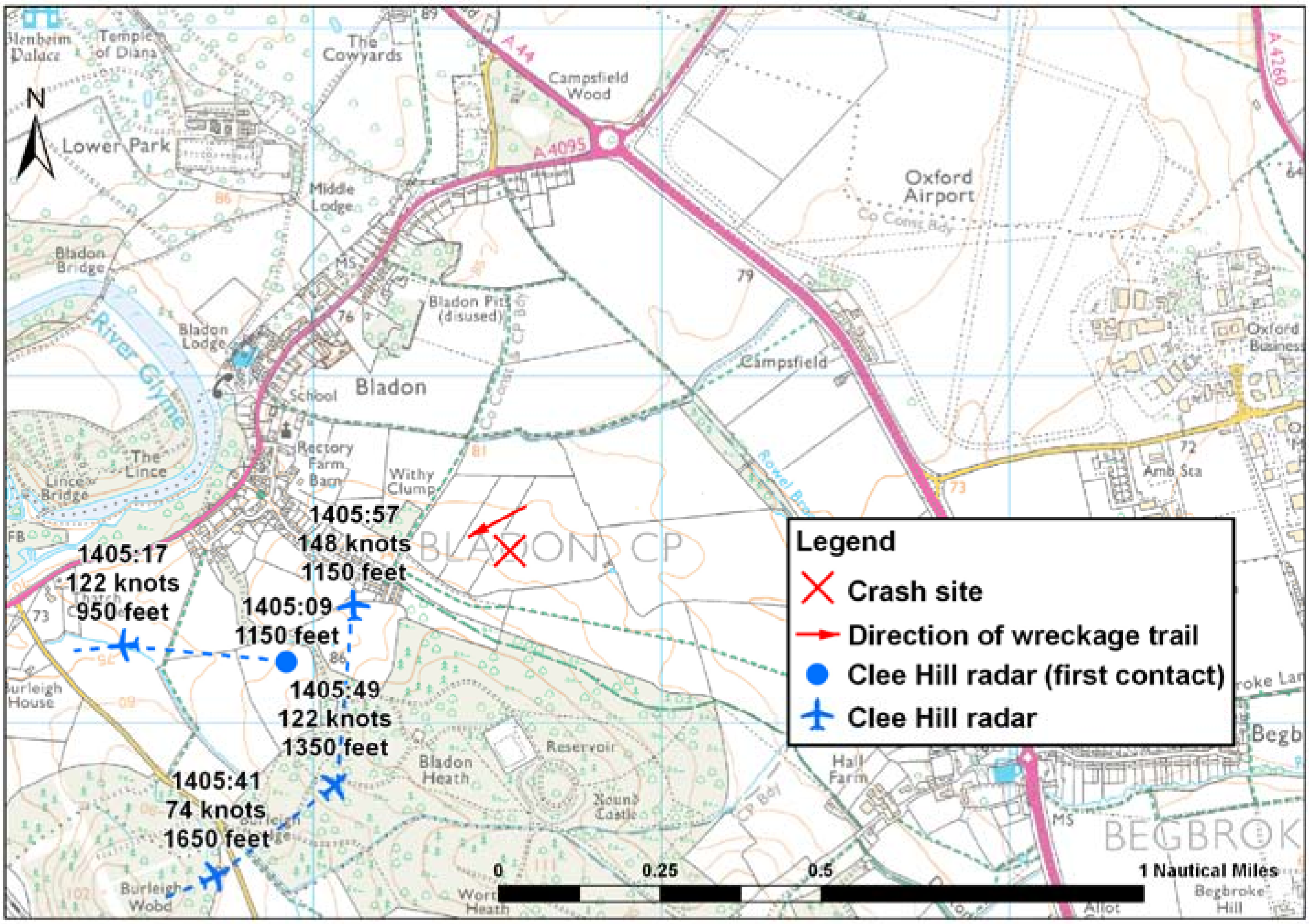

Figure 1

Radar track and accident site location

Radar coverage between the recorded track and the airfield to the northeast was at least to the level of the first and last contacts, which were both 1,148 feet amsl. Therefore, it is likely that the aircraft was between the ground and this altitude from takeoff to the first contact, and from the last contact to the site of the accident.

Witness information

There were a number of witnesses who heard the aircraft during its flight, several of whom also saw the aircraft. Most commented that the aircraft was noisy, apparently running at high power. Several witnesses said that the engine noise varied and described the sound as unusual and, in some cases, as similar to an aircraft doing aerobatics. Some thought that they were hearing a single aircraft engine, others thought it was two engines.

Eyewitnesses caught a brief glimpse of the aircraft descending steeply nose down towards the ground. One of them described seeing the nose coming up just before impact. They reported that a very intense fire started a short while after the impact and that nobody was able to get close to the aircraft.

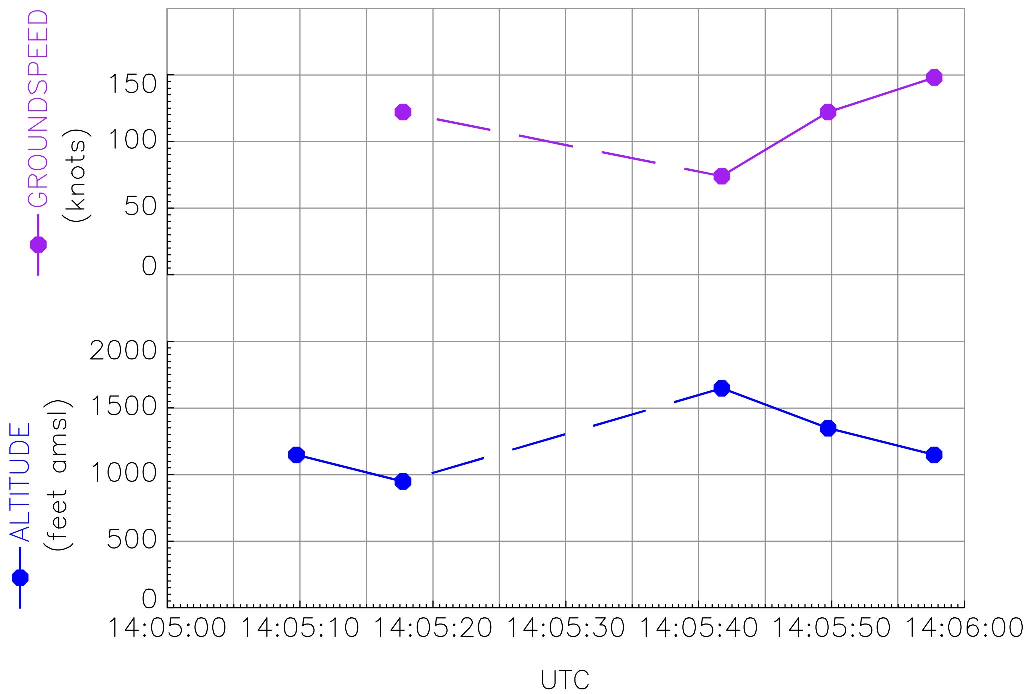

Figure 2

Aircraft groundspeed and altitude

Analysis

Technical

The post-crash fire precluded a full technical examination of the aircraft systems, but those examinations which could be performed revealed no indication of any technical problem with the aircraft before its impact with the ground.

Operational

The weather conditions at takeoff were not suitable for visual flight but were within the capability of the pilot, who was experienced in flight in IMC. An instrument approach would have been required to land back at Oxford.

The total flight was of between three and four minutes duration. By combining the recorded radar data with the witness information it was possible to reconstruct some of the flight path. The aircraft appears to have turned right after takeoff, in accordance with the departure instructions, and the pilot made contact with Brize Radar. The RTF calls were routine and there was no suggestion of any problem. The flight path of the aircraft then became erratic, over the next two minutes it flew an approximate figure-of-eight pattern, initially turning to the left and then turning right (see Figure 1). The height varied, the lowest recorded radar return was at 900 ft amsl, and during the final minute of flight there were no recorded radar returns, indicating that the aircraft was probably below this altitude. At the time of impact with the ground the aircraft was in a right-wing-low, nose-down attitude with both engines running. By the time that Oxford ATC attempted to contact the aircraft at 1407 hrs it had already crashed.

The fact that there was no radio call from the pilot when he deviated from his ATC clearance suggests either that he was not aware of it, or that he was unable to make a call. Electrical failure is unlikely to have been the reason because the transponder continued to operate as the aircraft descended. A pressure instrument failure could have led to an erratic flight path but is unlikely to have led to a loss of control with no radio communication.

The medical evidence from the post-mortem showed that there was a strong possibility that the pilot had become incapacitated at some time before the final impact. The erratic flight path observed during the final part of the flight suggests pilot disorientation, which could either have been as a result of the pilot attempting to fly while incapacitated or an attempt by the passenger to fly in conditions that were beyond his training and experience. It seems likely that the pilot became incapacitated soon after his last radio transmission and that at some time after that the passenger took control and attempted to fly the aircraft. Although there were flight instruments in front of him he had not flown the aircraft before, was unprepared to take over, had very little experience of flight in IMC and was not accustomed to flying in the right seat. These factors, together with the difficulty of dealing with the pilot, whose condition at this time is not known, would have meant that the passenger was presented with a very difficult situation.

One witness suggested that there was an attempt to pull up the nose of the aircraft before it hit the ground but with the low cloudbase and snow-covered surface there would have been very little sight of the ground before impact. If the flight had taken place in VMC the passenger may have been able to take control of the aircraft and make a successful landing.

When the Brize Radar controller noticed the aircraft was deviating from its clearance there was no immediate attempt to call the pilot. Instead Oxford ATC was contacted by landline. It is not clear why this should have occurred, when it would be expected that the pilot would be called directly, but it is unlikely to have affected the outcome. Given the circumstances, it is likely that the passenger's attention was taken up with the condition of the pilot and the management of the aircraft, so that he was unlikely to have had any spare capacity to manage a radio call.

The pilot held a current Class One medical certificate. However, there is evidence that such medical examinations are not necessarily successful at detecting coronary heart disease.

ACCIDENT

Aircraft Type and Registration:	Piper PA-34-200T Seneca II, G-GUYS
No & Type of Engines:	2 Continental Motors Corp LTSIO-360-EB piston engines
Year of Manufacture:	1978
Date & Time (UTC):	16 March 2010 at 1815 hrs
Location:	Sturgate Airfield, Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Both propellers, underside of fuselage and left wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	65 years
Commander's Flying Experience:	1,806 hours (of which 1,300 were on type) Last 90 days - 19 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was taking off on a short flight to Gamston airfield. At about the point of rotation the pilot stated that all three landing gears started to retract and the aircraft settled onto its belly. After coming to a halt, the pilot evacuated the aircraft and noticed a small fire had developed under the left wing trailing edge. This was extinguished by the airfield fire service who rapidly deployed to the scene.

Examination of the aircraft showed that all three landing gears were up and locked, with no scuffing apparent on the doors or tyres. The damage to the propeller tips was consistent with them striking the runway under low power. The pilot stated that he either accidentally caught the landing gear selector or there had been "a mechanical problem". No electrical or mechanical defects were found after investigation.

ACCIDENT

Aircraft Type and Registration:	PZL-104 Wilga 35A, G-BWDF
No & Type of Engines:	1 PZL Kalisz AI-14RA piston engine
Year of Manufacture:	1995
Date & Time (UTC):	6 May 2010 at 0659 hrs
Location:	Hinton-in-the-Hedges Airfield, Northamptonshire
Type of Flight:	Aerial Work
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Serious)
Nature of Damage:	Engine, undercarriage and fuselage damaged
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	602 hours (of which 155 were on type) Last 90 days - 16 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB.

Synopsis

During an attempt to tow a banner the tow line became wrapped around the tailplane, causing a nose down elevator input. The pilot maintained some control of the aircraft but could not prevent it from impacting the ground.

History of the flight

The aircraft took off from Runway 06 at Hinton-in-the-Hedges for the purpose of towing an advertising banner. The pilot was sitting in the left seat and the right seat was occupied by a person intending to receive text messages from colleagues on the ground giving locations where the banner could be shown to maximum effect. The pilot made two attempts to engage the banner during which the grapple hook attached to the aircraft failed to engage the banner tow line. An observer on the ground advised that the grapple hook had deployed correctly but was unsteady in the aircraft's slipstream. The pilot made two more unsuccessful passes before positioning for a further attempt. He reported that during the final pass the aircraft was at the correct height and speed and was aligned correctly between two pick-up poles that held the tow line off the ground for grappling. As the aircraft passed the poles, the pilot initiated a sharp pull-up, applied full power and glanced over his right shoulder to see whether the grapple hook had engaged the tow line. He recalled seeing the tow line "snake" upwards between the trailing edge of the wing and the leading edge of the tailplane and loop over the elevator.

When the slack in the tow line had been taken up and the banner was in the air, the pilot found that the control column was being pulled forward with a force that required both hands to resist. He managed to hold the aircraft level at what he estimated to be approximately 300 ft agl and, as there was nowhere to land straight ahead, decided to fly a circuit and approach the grass north of the main runway. The recommended procedure to be applied in the event that the tow line hooked around the main landing gear or tail wheel was to fly a steep approach so that the aircraft remained below the banner until touchdown. The pilot judged that insufficient nose-up pitch authority remained to attempt a steep approach and decided instead that a shallow flapless approach would be controllable.

When the aircraft was approximately 35 ft agl on final approach, the control column was pulled forward with a force that the pilot could not resist. Then, as the nose dropped, the forward pressure on the control column reduced and he was able to raise the nose to achieve a level attitude, but this did not prevent the aircraft from hitting the ground with a high rate of descent. The impact separated the engine from its mounts and collapsed the landing gear. As the fuselage hit the ground, the front section dug in and the aircraft pivoted forwards, coming to rest inverted. The right seat occupant was able to leave the aircraft after his harness was released by witnesses, but the pilot's foot was trapped until freed by the attending fire service.

Photographic evidence

A photograph of the aircraft on one of the attempts to engage the tow line showed that the grapple hook had not deployed but was still attached to the aircraft beneath the left side of the cockpit. A later photograph showed the hook trailing behind the aircraft but it was not possible to determine when the hook actually deployed.

Other photographs showed that the tow line was wrapped around the left elevator from the trailing edge to the hinge between the elevator horn balance and the tailplane (see Figure 1, which shows the tow line after cutting by personnel on the ground). Marks on the paint in the internal gap between the tailplane and horn balance were consistent with the tow line rubbing against the two surfaces.

Figure 1.

Banner Towing Operations Manual

The operator's Banner Towing Operations Manual recommended that if the tow line became caught on the aircraft's main gear leg, the pilot should land:

> *'preferably on a hard surface to minimise the ground drag of the banner.'*

The manual also stated that a steep approach would:

> *'keep the banner at or above the height of the aircraft.'*

The procedure did not refer specifically to fouling of the elevator.

Pilot's assessment of the cause

The pilot operated the hook release mechanism only once and was unaware that the hook had not deployed immediately. Photographic evidence, along with the report from the observer on the ground, suggested that the hook deployed sometime between the first attempt to engage the tow line and the last. However, the pilot believed throughout that the hook had deployed correctly and did not modify his usual technique for engaging the tow line. He believed, therefore, that subsequent events were unlikely to have been caused by the hook's failure to release immediately.

After the aircraft had picked up the banner, the pilot believed that tension in the tow line combined with its downward angle created a nose down elevator input that he could barely overcome. He considered that on the final approach, the banner made contact with the ground when the aircraft was at approximately 35 ft agl, which increased the tension on the tow line momentarily and pulled the control column forward. Tension in the line was relieved as the aircraft descended, allowing him to raise the nose to a level attitude before impact.

ACCIDENT

Aircraft Type and Registration:	YAK-52, G-IMIC
No & Type of Engines:	1 Ivchenko Vedeneyev M-14P piston engine
Year of Manufacture:	1989
Date & Time (UTC):	1 December 2009 at 1500 hrs
Location:	Seething Airfield, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller, lower cowling, wingstep and tailskid
Commander's Licence:	Private Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	593 hours (of which 72 were on type) Last 90 days - 7 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was making an approach to Seething Airfield, when the pilot's attention was diverted by an aircraft backtracking the runway and he forgot to lower the landing gear. A minor malfunction of the flap operating light distracted him from his final check of the landing gear position and the aircraft landed with the wheels still retracted.

A review of wheels up landings by both YAK-50 and YAK-52 aircraft, compared with other single engine aircraft types with retractable landing gear, revealed that there has been a disproportionate rate of wheels up landings involving YAK aircraft in the UK. No specific reason for this could be identified, so action has been taken by the CAA and YAK operators to make pilots more aware of the hazard.

History of the flight

The aircraft flew uneventfully in the Yarmouth area for approximately 10 minutes before the pilot decided to return to Seething Airfield, Norwich. The weather conditions were good, with a light and variable wind. As the pilot neared the airfield, he could not hear any indications of traffic on the airfield's radio frequency, so he decided to fly a straight-in approach to Runway 24. The aircraft was positioned on long finals and the pilot reduced speed and began to configure the aircraft for landing. The pilot reported that, as he reached for the landing gear lever to lower it, he heard another aircraft report that it was backtracking Runway 24. The pilot lowered the nose of his aircraft to enable him to see the other aircraft and, once it was clear of the runway, he slowed his aircraft to 170 kph and lowered the flaps. The pilot heard the pneumatic flaps operating but noticed that the 'flaps down' light did not illuminate. He considered recycling the flaps but, given the benign weather conditions, the short distance left to go to the runway and that the aircraft was stable at 150 kph, he decided to continue and land. The pilot realised that the landing gear was not extended just before the aircraft touched the runway. It quickly came to a stop and the pilot, who was uninjured, vacated the aircraft normally. There was no fire.

The pilot concluded that the reason he did not lower the landing gear was that he had allowed himself to become distracted by the other aircraft and the minor malfunction with the 'flaps down' light.

Previous YAK-50 and YAK-52 wheels up landings

A search of the CAA database revealed that, in the period between October 1995 and this accident, there had been 9 wheels up landings involving YAK-50s and 13 wheels up landings involving YAK-52s. Of these, five were attributed to system failures, leaving 17 wheels up landings that were probably attributable to human factors. In June 2010 there were 22 YAK-50s and 57 YAK-52s on the UK register.

An analysis of wheels up landing events from the CAA database revealed that there had been a significant number of wheels up landings on YAK 50s and YAK 52s compared with other single engine aircraft with retractable landing gear. Due to the limitations of the data it was not possible to make a direct numerical comparison per flying hour, or per flight.

Further investigation

The CAA hosted a meeting which was attended by the AAIB and several members of the UK YAK flying community. The meeting reviewed the YAK wheels up landings. Accidents occurred to both experienced and inexperienced pilots and no specific reason could be identified as to why the YAK wheels up landing rate was so much higher than for other aircraft.

A large proportion of aircraft that have retractable landing gear are fitted with a 'gear not down' warning device. The device activates a horn or a flashing light when the landing gear is not extended and other parameters (eg flap position, airspeed or throttle settings) indicate that the aircraft may be about to land. While such systems have not totally prevented any wheels up landings, they do appear to have reduced the rate. Modifications for embodying such systems in YAK aircraft are available but, as they are not part of the aircraft standard specification, most UK registered YAKs do not have these systems fitted.

The operators explained that the insurance companies had become aware of the problem and that their premiums were likely to increase. For their part, the insurance companies had indicated that they might give discounts on aircraft that had modifications embodied which helped to alleviate this type of occurrence. However, the operators were concerned that the CAA should not mandate any such modification.

The CAA's analysis concluded that the consequences of a wheels up landing are mitigated by the architecture of the landing gear design, to the extent that these incidents did not represent an unsafe condition (as defined in EASA Part 21, AMC (Acceptable Means of Compliance) 21A.3B(b)). Accordingly, the CAA felt that mandatory Airworthiness Directive action, to restore an acceptable level of safety, was not necessary.

Other ways of trying to reduce the rate of wheels up landings were discussed and it was agreed that raising pilot awareness of the problem was probably the most effective way to begin. Owners would also be made aware of the availability of 'gear not down' warning systems and the insurance benefits of fitting them.

Safety action

It was agreed that, in order to try and reduce the rate of wheels up landings involving UK YAK aircraft, YAK operators would use their forums to increase YAK pilots' awareness of the problem. The CAA also agreed to produce information for all UK YAK owners and publish an article on operations involving General Aviation aircraft with retractable landing gear. The AAIB would continue to monitor the rate of wheels up landings in YAK aircraft.

ACCIDENT

Aircraft Type and Registration:	EV-97 TeamEurostar UK, G-CEAM
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2006
Date & Time (UTC):	29 June 2010 at 1255 hrs
Location:	Sywell Airport, Northamptonshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose leg, bulkhead and propeller tips
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	194 hours (of which 63 were on type) Last 90 days - 3 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Following a local flight the aircraft made an approach to the grass Runway 23 at Sywell. The wind was reported as 10 kt from 270º. The pilot selected two stages of flap and trimmed for 65 mph, a slightly higher speed than normal in order to allow for the crosswind. Once over the threshold he closed the throttle and corrected the drift angle using the rudder. Touchdown was smooth and on the mainwheels. However, the aircraft bounced into the air again and subsequently landed on its nosewheel, causing damage to the propeller, the landing gear leg and the bulkhead to which it was attached.

The pilot stated that, on reflection, the touchdown speed had been too high. He also noted that, following the initial bounce, he should either have held the nose up so that the subsequent landing was on the mainwheels, or applied power and gone around.

Since the occurrence the pilot has undertaken additional instruction prior to flying solo again.

ACCIDENT

Aircraft Type and Registration:	Jabiru UL-450, G-JABZ	
No & Type of Engines:	1 Jabiru Aircraft Pty 2200A piston engine	
Year of Manufacture:	2005	
Date & Time (UTC):	2 June 2010 at 1400 hrs	
Location:	Eshott Airfield, Northumberland	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Damage to wing, fuselage, landing gear, cockpit, engine and propeller	
Commander's Licence:	National Private Pilot's Licence	
Commander's Age:	45 years	
Commander's Flying Experience:	57 hours (of which 18 were on type) Last 90 days - 11 hours Last 28 days - 2 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

The pilot arrived at Eshott airfield at 1330 hrs and checked the actual weather, confirming that it was the same as the forecast he had obtained earlier on the internet, ie sunny/cloudy with the wind westerly at 3 kt. At about 1400 hrs, he and his passenger took off from Runway 26 and flew a local sortie without incident. Preparing to land back at Eshott on Runway 26, the pilot selected second stage flaps on the approach but as he was about to touch down, what he describes as a "severe wind" lifted the right wing and the aircraft yawed to the left; he tried to correct the wing drop, but the aircraft stalled and crashed in a cornfield to the left of the runway, sustaining major damage. Despite the damage, the pilot and passenger exited the aircraft using the doors and were assisted by the farmer and other pilots. Neither, had suffered injury.

ACCIDENT

Aircraft Type and Registration:	P&M Aviation QuikR, G-DALI
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2009
Date & Time (UTC):	18 January 2010 at about 1300 hrs
Location:	English Channel, approximately 20 nm west of Le Touquet, France
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft missing
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	Estimated 700 hours (of which about 500 were on flex-wing microlights)
Information Source:	AAIB Field Investigation

Synopsis

Contact with the microlight was lost whilst it was over the English Channel en-route to Le Touquet Airport in France. The body of the pilot was recovered later the same day, but none of the aircraft or its equipment was found. With no aircraft wreckage to examine, the cause of the accident could not be positively determined, although adverse weather was a probable contributory factor.

Background to the flight

The accident occurred during the first leg of a planned charity flight from Gloucestershire Airport to Sydney, Australia. The whole journey was expected to take between six and twelve weeks and the first intended stop was at Le Touquet Airport. The aircraft was being flown by an experienced microlight pilot who had already completed a number of long distance flights.

History of the flight

The pilot arrived at Gloucestershire Airport at about 0800 hrs for a planned 0930 hrs departure. Although the majority of the pre-flight planning and aircraft preparation had already been completed, the pilot visited the airport briefing unit to check the latest weather information. With considerable media interest in the flight, he spent most of his time before departure dealing with the press.

A flight plan had been filed for the flight to Le Touquet, with Calais Dunkerque as the nominated alternate airport. However, meteorological reports were unavailable for either destination. The forecast for Lille Airport, 57 nm to the east, showed fog (which the pilot remarked upon), with possible temporary improvements in visibility of up to 7 km during the period of the intended flight. The general area forecast gave areas of low cloud with isolated mist and fog at the surface.

The aircraft departed at 1041 hrs for the two hour flight to Le Touquet. It was fully fuelled, with an endurance of five hours listed on the flight plan. As the aircraft approached the London area, the pilot contacted Farnborough ATC who provided him with navigational assistance as he negotiated the airspace around Heathrow Airport. The aircraft then routed to the south of London, between the Heathrow and Gatwick control zones.

At 1215 hrs, when the aircraft was about 15 nm from the south coast, the pilot contacted the London Flight Information Service controller and requested a weather report for Le Touquet. The controller replied that visibility at Le Touquet was 500 m in fog, and that the airfield was not accepting VFR traffic[1]. The pilot responded by asking if the weather was the same at Lille. After a short pause, the controller passed the Lille weather report to the pilot: it gave a visibility of 7 km, with FEW clouds at 600 ft. The pilot acknowledged this information but did not declare any intended change of route or destination.

Communications between the pilot and the London controller then became intermittent. Eventually, at 1232 hrs the pilot contacted Lille ATC. He was allocated a transponder code and the aircraft first appeared on French radar, over the sea, about 6 nm from Dungeness. The Lille controller asked the pilot for his intentions, to which he replied that he was "INTENDING TO DIVERT TO ABBEVILLE". The controller asked the pilot to confirm that he was VFR, which he did. At 1253 hrs the controller asked the pilot to confirm his position, as radar contact was intermittent. The pilot replied to the effect that he was diverting around Le Touquet airspace and was taking up a heading towards Abbeville. The pilot was asked to call again when he was approaching Abbeville, to which he replied "WILCO". At 1314 hrs the Lille controller attempted to contact the pilot, without success. At her request, another aircraft also attempted to make contact with G-DALI, but again without success.

Search and rescue operations (SAROPS)

SAROPS were initiated by the French authorities. Two French surface craft, one a Customs patrol vessel and the other an oceanographic research vessel, were joined in the search by a maritime helicopter from Le Touquet. Poor weather hampered search operations and forced the helicopter to withdraw from the search. The pilot's body was found at 2200 hrs by a Portuguese tug, which had joined the search, and was transferred to the Customs patrol vessel. The reported location was less than half a mile from the last known radar position. No wreckage or any equipment from the aircraft was found.

Pilot information

The pilot first became involved in sport aviation through paragliding. In 1998 he started flying helicopters, and gained a Private Pilot's Licence (Helicopters) in 1999. His last helicopter logbook entry showed that he had accrued 208 hrs in light helicopters. In about 2000, he started training on flex-wing microlights. Although he kept a flying logbook, this was presumed lost in

Footnote

[1] Visual Flight Rules, under which the pilot of G-DALI was operating.

the accident and his total microlight flying time was estimated at 500 hrs.

The pilot had owned or part-owned a number of flex-wing microlights, and had previous experience of long journeys by microlight. It was reported that he had flown to Portugal and had crossed the Channel on numerous occasions, becoming familiar with both Le Touquet and Abbeville Airports. He had also taken part in a round-UK event on several occasions, most recently in 2009. The pilot was described as a regular flyer and in current flying practice. Family and friends of the pilot were of the opinion that his actions on the day would not have been influenced by the status of the flight or the considerable media attention it attracted.

Aircraft information

The QuikR is an advanced flex-wing microlight, of a high-speed touring design, capable of cruising at 90 kt. G-DALI was purchased new by the pilot in 2009: it was supplied in standard form and there had been no recorded modifications. It was equipped with basic flight instruments - an altimeter, a vertical speed indicator, an air speed indicator and an E2 type compass – but no gyro flight instruments. A GPS navigation unit, radio and ATC transponder were also fitted. In preparation for the charity flight, the pilot had an additional fuel tank manufactured and installed in place of the rear seat. The tank had a capacity of 80 litres. A photograph showing the aircraft's trike unit is at Figure 1.

The aircraft had been fitted with a portable satellite tracking system. This was intended to allow the flight's progress to be monitored via an internet web-site, as well as providing position information in the event of an emergency. The system was wired directly into the aircraft's electrical system, so that it was operational any time the electrical system was energised. The system included two aerials secured behind the pilot; one received GPS signals for positional computation and the other transmitted the unit's position to the satellite constellation three times every ten minutes.

The tracking system featured an emergency pushbutton which, when pressed, generated an additional position return. The return so created was indistinguishable from the other returns, except as an additional point in the data stream. The pushbutton had been located on the forward left of the fuselage, near the pilot's left knee, so that inadvertent operation was unlikely. The system operating company advised that a temporary loss of signal could occur if the aircraft was manoeuvring at the moment the unit transmitted its position, so blanking the aerial or interfering with the line of sight to a satellite. Similarly, the signal could be affected by turbulence or an aerial becoming dislodged.

Figure 1

Trike unit of G-DALI, showing auxiliary fuel tank with life-raft secured above

Recorded information

Radio transmissions

At 1231:51 hrs the pilot contacted the Lille ATC Approach controller and shortly afterwards announced his intention to divert to Abbeville. The controller asked for an estimate for Abbeville, to which the pilot replied "FORTY FIVE MINUTES": at this point Abbeville was 50 nm distant. The controller had only intermittent contact on her radar display and asked the pilot for his position. He replied "...ELEVEN MILES TO RUN TO THE FIR[2] BOUNDARY AND AT TWO THOUSAND FEET...". The controller asked the pilot to call approaching Abbeville, which he acknowledged. Cross referencing with the radar data showed that the pilot was actually 11 nm from the Lille Terminal Manoeuvring Area (TMA) at this stage (which protrudes into the London FIR), and not the FIR boundary itself.

At 1252:33 hrs, the controller had again lost radar contact and asked the pilot for his position from Abbeville. He replied "... I'VE JUST DIVERTED AROUND LE TOUQUET AIRSPACE, I'M ON THE SOUTH WESTERN CORNER OF LE TOUQUET AIRSPACE, I'M HEADING INTO ABBEVILLE...". The controller replied "... CALL ME BACK FOR ANY CHANGE OR APPROACHING ABBEVILLE...". The pilot replied with "WILCO GOLF LIMA INDIA". This was his last known transmission and it was timed at 1253:05 hrs.

Radar and satellite data

Figure 2 shows a composite picture of the final stages of the flight, using data from French radar and the satellite system. The aircraft was equipped with a transponder but no Mode C altitude information was observed. However, each satellite position included GPS derived altitude information.

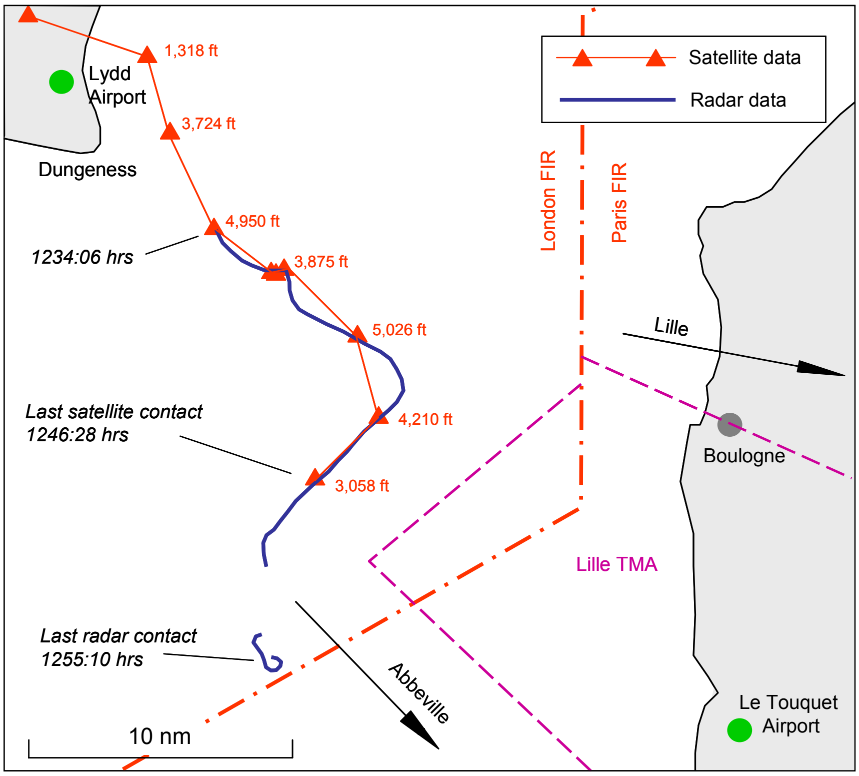

Figure 2

Radar track of G-DALI over the English Channel, with GPS derived position and altitude information

Footnote

[2] Flight Information Region.

Figure 3 shows G-DALI's track immediately after the aircraft appeared on French radar at 1234:14 hrs, commencing about two minutes after the pilot declared his intention to divert to Abbeville. The aircraft was initially tracking along a direct line between Lydd Airport and Le Touquet Airport (the aircraft had diverted around Lydd itself, establishing on this track once it was over the Channel). At 1235:34 hrs, the aircraft turned left and was established, for a short while, on a track, possibly coincidentally, for Lille Airport.

As Figure 3 shows, there was then a block of radar returns, which saw the aircraft slow down, possibly make a left hand orbit, and eventually take up a southerly track. Coincidental with this event, four unscheduled satellite positions were recorded, consistent with the 'emergency button' having been pushed, with time intervals of 7, 5 and 21 seconds respectively. The only other unscheduled satellite position during the flight was recorded as the pilot negotiated the airspace around Heathrow, apparently with some difficulty, requiring Farnborough ATC's assistance.

After these returns, the aircraft resumed the track from Lydd to Le Touquet, before deviating left of it once again. At 1240:28 hrs, for a period of about one minute, the aircraft stabilised on a new direct track to Le Touquet. The aircraft then turned south-westwards, onto a track approximately parallel with the Lille TMA boundary but some three to four miles north of it. At 1249:36 hrs, the aircraft started a gentle left turn and was tracking about 30° right of the required course for Abbeville when radar contact was lost temporarily.

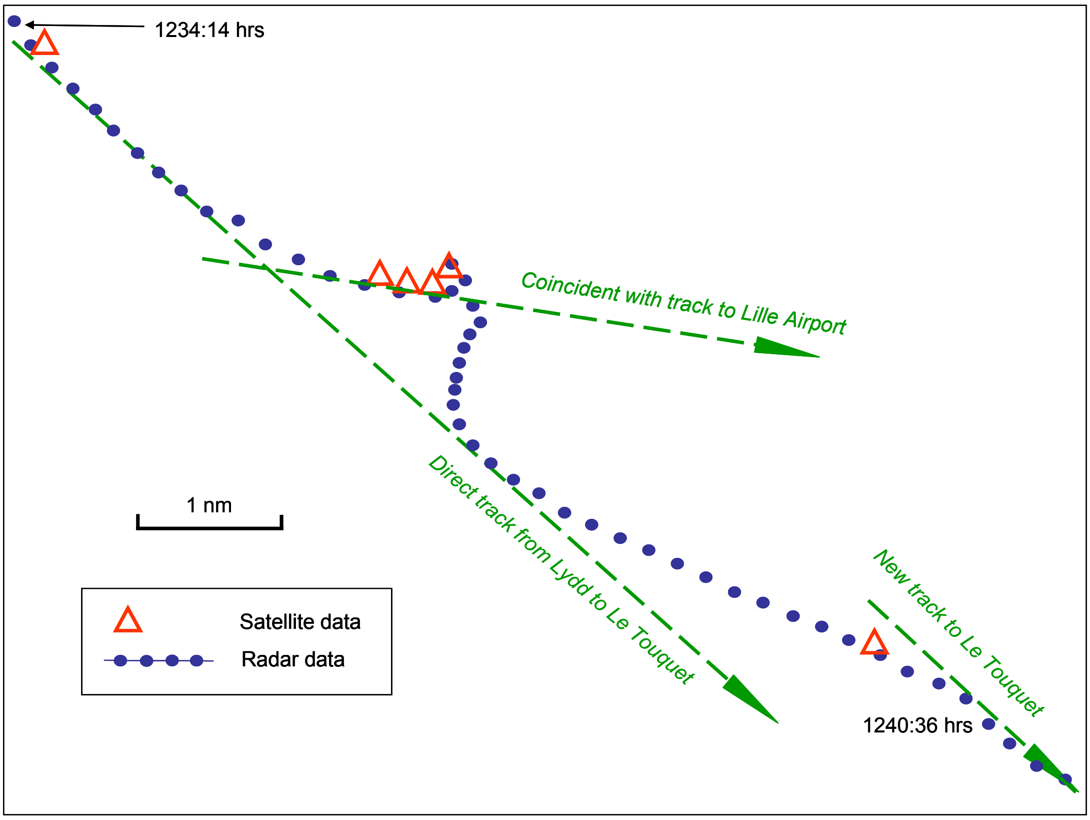

Figure 3

Track of G-DALI shortly after first appearing on French radar

Figure 4 shows the last series of radar returns from G-DALI. Radar contact was regained at 1253:18 hrs, at which point the aircraft appears to have been tracking in a left turn at relatively slow speed, before taking up a track of about 160°(T). The aircraft then made a further turn to the left, during which radar contact was finally lost. The last radar return was timed at 1255:09 hrs.

The GPS derived altitude showed that the aircraft had generally flown between 2,000 and 3,000 ft, until approaching the London area, and about 1,000 to 1,500 ft thereafter. Consistent with his comments to ATC, the data showed an increasing altitude as he climbed to improve communications with London, reaching a maximum of 5,026 ft. At the last recorded satellite position, the GPS altitude was 3058 ft. An oblique view of the recorded satellite track is at Figure 5.

Shipping and tidal information

With the assistance of HM Coastguard at Dover, recorded shipping movements in the accident area were studied. The closest vessel to the last radar position was a commercial vessel of 90 m overall length, which was bearing 040° at 2.3 nm at the time of the last radar return and steaming away from the area in a north-easterly direction.

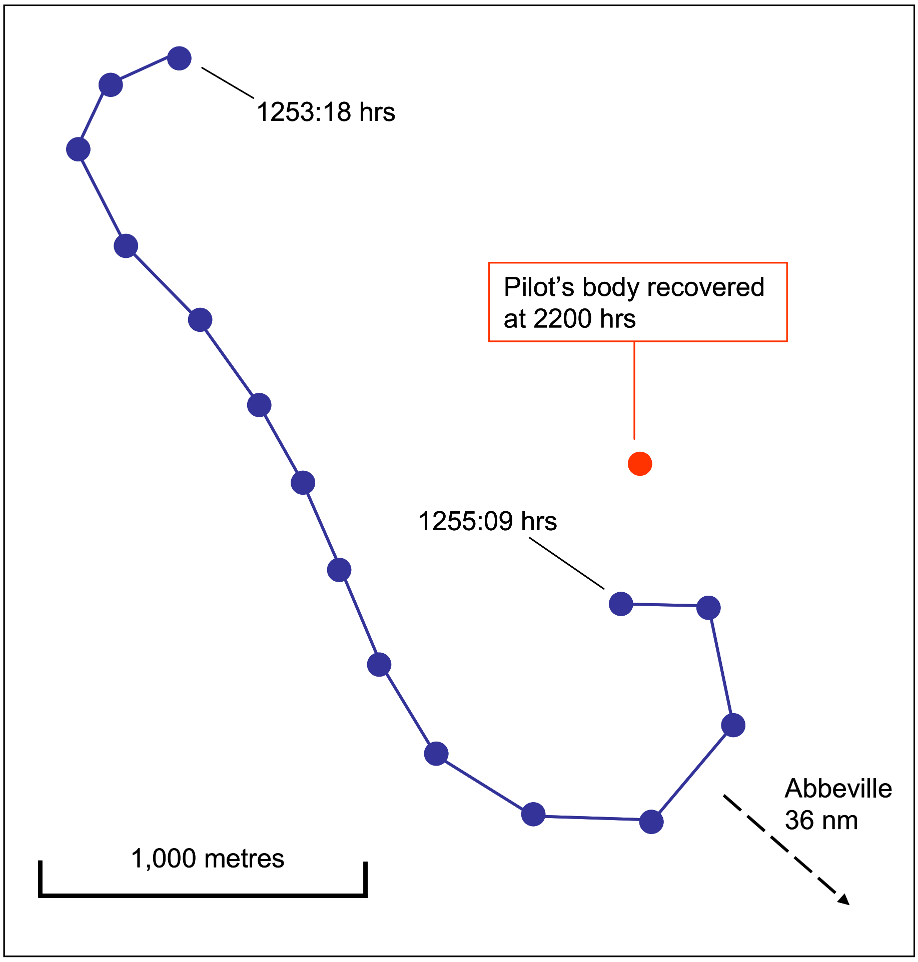

Figure 4

Final radar returns, with the reported location where the pilot was found

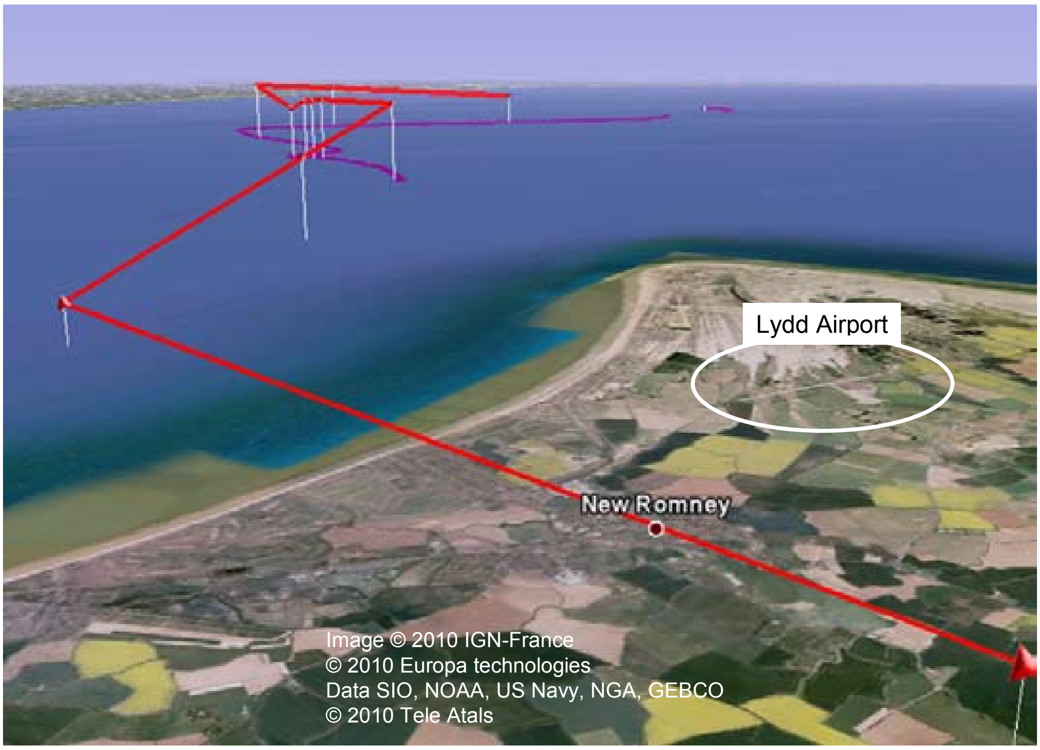

Figure 5

Oblique projection of aircraft satellite track, showing change in GPS derived altitude (radar ground track shown in purple)

A dedicated SAR computer programme was used to study the expected drift, due to tide and wind, of a person in the water in the accident area. Assuming that the drift started at 1255 hrs (the time of the last radar return) and continued until 2200 hrs, when the pilot was found, this produced a start point about 0.5 nm to the north-east of the position where the pilot was found. This calculated start point was less than 1 nm from the last radar position.

Meteorological information

When the pilot met briefing unit staff at Gloucestershire Airport two days before departure, to file a flight plan, he told them that he would only need updated airfield weather information on the morning of the flight. The pilot was known to use his home computer and mobile phone to access on-line aviation meteorological services.

Useful weather information from the nearby continental airfields was limited. There were no available METARs or TAFs[3] for Le Touquet or Calais Dunkerque[4], and the pilot did not request or receive reports for Abbeville, 24 nm south of Le Touquet. The nearest airport to Le Touquet for which a valid TAF was available was Lille, about 57 nm to the east.

According to a Met Office report, high pressure was prevalent across the near continent, with a light moist south-westerly airflow across the area and generally broken or overcast amounts of cloud. It was thought there would have been scattered or broken stratus cloud in the area, with a cloud base between 200 and 500 ft

Footnotes

[3] METARs and TAFs are routine station reports which describe the actual and forecast meteorological conditions.
[4] On-line actual and forecast meteorological reports are not routinely available for these airfields.

above the surface. Above this, there was probably broken or overcast strato-cumulus cloud, between 2,000 and 3,000 ft above the surface, extending upwards to about 4,000 ft. Embedded in this cloud layer were likely to have been isolated cumulus clouds up to about 6,000 ft, with associated moderate turbulence. The general visibility would probably have been between 5,000 m and 10 km in haze, with occasional mist and isolated fog patches reducing visibility to less than 1,000 m. The freezing level was at about 8,000 ft, so there was a risk of light icing in cloud, above about 3,000 ft, although there were no reports of icing being encountered in the area. The wind at 2,000 ft was estimated to have been from 260° at 10 to 15 kt.

The Lille TAF, which the pilot saw before departure, gave a light surface wind and a visibility of 150 m in fog. Temporary improvements to 3,000 m visibility, with cloud at 300 ft, were forecast for the airport and a 30% probability of further temporary improvements to 7 km visibility, with cloud at 700 ft, were also predicted. The 1200 hrs Abbeville METAR gave a visibility of 4,500 m in mist, few clouds at 500 ft and broken cloud at 2,000 ft. By 1300 hrs the visibility had improved to 10 km and the cloud had become overcast at 2,000 ft.

It was noted that the forecast information from the MetForm 215[5] and the TAFs conformed reasonably well with the actual information summarised above, in terms of weather and visibility. However, whereas Form 215 forecast areas of isolated cumulus and strato-cumulus, the observations and satellite imagery suggested this cloud was more widespread. Part of the satellite image from the report, overlaid with G-DALI's track and final radar position, is reproduced at Figure 6.

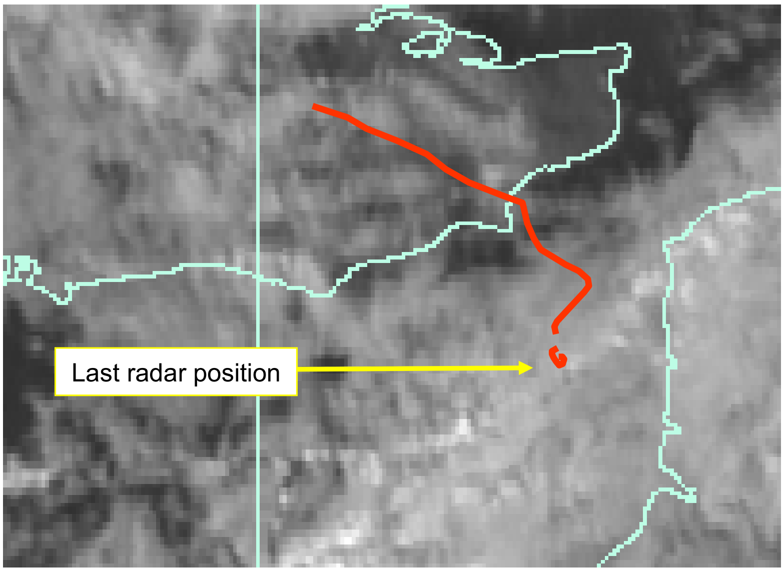

Figure 6

High resolution visible satellite image, 1315 hrs
(Crown Copyright [2010] Met Office)

Footnote

[5] MetForm 215 provides a forecast of in-flight weather conditions below 10,000 ft and is available to pilots on-line.

Medical and pathological information

An autopsy examination was carried out by an aviation pathologist. This revealed that the pilot had died from severe multiple injuries, all of which were consistent with having been caused when the aircraft struck the sea. The nature and pattern of the injuries indicated a very significant deceleration, of the order of 200 to 300 'g', with the major component along the long axis of the spine, which favoured the pilot being in his seat at the moment of impact. This strongly suggested that the aircraft struck the water in an approximately upright orientation at a high rate of descent but with little forward speed. The crash forces were outside the range of human tolerance and no alternative or additional safety equipment would have altered the fatal outcome.

The pilot held a valid JAA Class 2 medical certificate. At his last medical, in December 2009, an ECG showed a common minor rhythm abnormality and, although it merited further investigation, it was not sufficient to prevent the pilot from holding a Class 2 certificate. Although there was the possibility that the pilot may have suffered an incapacitating cardiac event, there was no pathological evidence to support it.

Survival aspects

The pilot had obtained a single man life-raft of a type used in military fast jet aircraft. This was stowed behind his head, on top of the additional fuel tank, secured under elastic netting (see Figure 1). He was wearing a life-jacket with manually activated inflation, which was equipped with a flare and a personal location beacon (PLB). He was also wearing a thermal flying suit with thermal undergarments. He had taken a full immersion suit with him but this was packed in his luggage for use later in the journey. When the pilot was found, none of his survival equipment had been operated, which was consistent with evidence from the autopsy examination that he had died in the initial impact.

From a sea surface temperature analysis chart for 1200 hrs on 17 January 2010, the sea temperature in the English Channel was 8°C. Sea survival times can vary widely between individuals but, in general terms, at 8°C a person without immersion protection is likely to start suffering from the effects of hypothermia, including impaired coordinated muscle activity, within 30 to 60 minutes. Immersion suits are designed to protect the wearer from cold shock and hypothermia and can extend survival times in cold sea temperatures by several hours. Although the pilot's flying clothing would have offered a measure of thermal protection, his survival time in the event of a control ditching, for example, would still be much less than if he had been wearing his immersion suit.

Analysis

The lack of any recovered aircraft wreckage or equipment significantly restricted the scope of the accident investigation and precluded a definitive statement of cause.

The aircraft was almost new and had flown for over two hours before the accident, apparently without problem. Although not certain, in the absence of any emergency transmission from the pilot, this would suggest that a structural or mechanical failure was not the most probable cause of the accident. The aircraft also carried sufficient fuel for it to return and land at Gloucester had the pilot so wished.

The weather was a major factor for the flight and, once in flight, the pilot's decision to undertake the Channel crossing, despite the uncertain meteorological situation ahead, could have been influenced by a number of factors. There was ample fuel on board, so he would have had the option to reverse his route at any time or consider a wide choice of diversion airfields. Although the pilot was not thought to have been influenced by the flight's high profile and media coverage, it remains possible that he felt some degree of external pressure to complete the first leg of his journey, as planned.

It is known that the pilot was familiar with both le Touquet and Abbeville Airports from previous Channel crossings. As it is unlikely that he had a meteorological forecast for Abbeville and he did not seek the latest weather report from London or Lille ATC, this was probably the basis for his declared intention to divert there.

The radar data shows that the pilot did not immediately set course for Abbeville, and in fact turned away from it for a while. The reasons for this are not known; they may be weather related, but are more likely to be linked to a navigational issue, such as a need to manipulate or reprogram the GPS, or an error in waypoint selection. This is supported to some extent by the activation of the 'emergency' satellite position button. The mechanism by which this occurred is also unknown, but it was previously seen when the pilot negotiated the confined airspace around the Heathrow control zone and required assistance from Farnborough ATC.

When the aircraft turned south-westwards, it was apparently to avoid the Lille TMA, but the satellite image at Figure 6 suggests that a line of weather could also have been the reason. If continued, this south-westerly track would have taken the aircraft away from potential landing sites. Therefore, the pilot would have been faced with an increasing need to turn left as soon as he was able or, otherwise, to turn right and return to land in the UK, both options involving an increasingly long over-water element.

The aircraft reappeared on radar shortly after the pilot told ATC that he was heading towards Abbeville. It was heading not towards Abbeville but in a more westerly direction. The lack of any additional information to ATC at this stage suggests that this manoeuvring was not due to a technical issue. Although the aircraft then took up an approximate course for Abbeville for a short while, the final radar returns show that the pilot had deviated again from his intended track. Based upon tidal calculations and the proximity of the last radar return to the position the pilot was found, the aircraft probably crashed soon after it disappeared from radar.

The pilot made no distress calls and, although communications with ATC were not always good, no other aircraft reported hearing such a call. It is unlikely that the pilot had become incapacitated, and the severity of the impact tended to rule out a controlled ditching. It is more probable that the accident resulted from a loss of control at altitude, whether due to a mechanical failure, disorientation brought about by the poor weather, or some other cause. In this case, the nominally upright impact attitude suggested by the pilot's injuries raises the possibility that the pilot may have been attempting to recover from a high rate of descent when the aircraft struck the sea.

There was evidence that the pilot was seated in the aircraft at the time of impact but none to indicate the mechanism by which he became separated from the aircraft afterwards.

Conclusion

The pilot encountered deteriorating conditions whilst flying over the Channel and was seen on radar to be manoeuvring in a manner consistent with attempts to avoid the worst weather. The available evidence regarding the nature of the impact indicates that the aircraft struck the sea with considerable force, consistent with a loss of control at altitude. The pilot gave no indication of any fault with the aircraft and, although a technical failure could not be ruled out, it was considered likely that the pilot lost control of the aircraft after encountering poor weather conditions.

Safety comment

The pilot was not wearing an immersion suit for the Channel crossing, although he was known to be carrying one with him. Given the time of year and weather conditions, if he had been, his potential survival time following a ditching would have been significantly increased.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quik, G-CWIK
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2004
Date & Time (UTC):	23 July 2010 at 1045 hrs
Location:	Ashcroft Airfield, Cheshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Wing and trike unit damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	221 hours (of which 61 were on type) Last 90 days - 21 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

During the climb out from Runway 30 at Ashcroft Airfield the pilot experienced a severe jolt through the airframe. Believing the aircraft to have suffered damage, he conducted a short left hand circuit to land back on grass Runway 31, which is 650 m in length. The aircraft touched down further along the runway than the pilot intended so he applied full power to carry out a go-around. There was insufficient distance remaining and, before it had gained enough speed to take off, the aircraft struck a barbed wire fence and came to rest on its side in the field beyond. The airframe and wing sustained serious damage and the pilot suffered a broken arm. However, there was no fire.

The pilot considered that the jolt may have been a bird strike that reduced the aircraft's performance. Although the damage to the aircraft and his injuries limited his subsequent inspection of the airframe, he was surprised that the aircraft had not become airborne again before striking the fence.

He concluded that he could have taken more time to plan his approach to Runway 31 as the aircraft was still flying satisfactorily.

ACCIDENT

Aircraft Type and Registration:	Team Minimax 91, G-MWZM
No & Type of Engines:	1 Mosler MM CB-40 piston engine
Year of Manufacture:	1993
Date & Time (UTC):	19 June 2010 at 0855 hrs
Location:	Near Great Wishford, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to landing gear and both wings
Commander's Licence:	National Private Pilot's Licence (Microlights)
Commander's Age:	46 years
Commander's Flying Experience:	174 hours (of which 47 were on type) Last 90 days - 19 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft had been flown to Old Sarum earlier that morning to take part in the 'Fly-UK 2010' round-Britain event. The pilot completed the pre-flight checks and the aircraft then took off. At around 800 ft agl the engine started to lose power and a few seconds later it stopped. The pilot had a limited choice of options for a forced landing and chose a narrow strip of long grass alongside a fence. During the approach the pilot allowed the airspeed to decay excessively and the aircraft stalled at a height of between 6 and 10 ft. It then struck the ground, damaging the landing gear and both wings; the pilot was uninjured.

The fuel pipe in the wing tank had recently been replaced and the pilot considered that a fuel problem associated with this pipe might have been a contributory factor.

ACCIDENT

Aircraft Type and Registration:	Team Minimax 91A, G-BXSU
No & Type of Engines:	1 Rotax 503 piston engine
Year of Manufacture:	1998
Date & Time (UTC):	21 September 2010 at 1030 hrs
Location:	Long Lane Farm, Chesterfield, Derbyshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller damaged, landing gear collapsed, wing struts and linkages distorted
Commander's Licence:	Private Pilot's Licence
Commander's Age:	44 years
Commander's Flying Experience:	3,880 hours (of which n/k were on type) Last 90 days - 37 Last 28 days - 20
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot made a local flight before returning to land. He reported that, during the final stages of the approach, the airspeed was allowed to reduce below the normal approach speed. Engine power was reduced for landing, and a combination of low airspeed and reducing elevator authority meant that he was unable to arrest the aircraft's rate of descent. It landed heavily, with the landing gear collapsing and the propeller striking the ground before the aircraft came to a stop. The wing struts were also damaged. The pilot was uninjured and exited the aircraft without assistance. He considered that the cause of the accident was a lack of speed control and power during the flare.

ACCIDENT

Aircraft Type and Registration:	X'Air Falcon 912(1), G-CBVE
No & Type of Engines:	1 Rotax 912UL DCDI piston engine
Year of Manufacture:	2003
Date & Time (UTC):	26 June 2010 at 0430 hrs
Location:	Landing strip near Thorny Road, Peterborough
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Propeller broken, engine shock-loaded, nose, right landing gear, front of pod, footwell, instrument panel and forward structural members deformed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	25 years
Commander's Flying Experience:	183 hours (of which 121 were on type) Last 90 days - 29 hours Last 28 days - 18 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

In preparation for a landing at an unfamiliar field to support a fete, the pilot spoke with the event organiser and walked only part of the field. The next morning the pilot arrived overhead at approximately 0420 hrs and had a closer look at the field during two descending orbits. He failed to notice a ditch running across his intended landing area at a distance of about three quarters of the way along from his anticipated touchdown point. As reasons for this the pilot cited factors including orbiting in a less than optimal location to avoid disturbing local inhabitants, difficult light conditions and concentrating on ensuring no new obstacles, people or animals were in the landing area. He rejected his first attempt to land due to excessive speed and made an immediate right turn to avoid overflying habitation. His second attempt resulted in a successful touchdown but braking was ineffective due to the wet grass and the bumpiness of the field. The pilot did not notice the ditch running across his path until it was too late for a safe go-around. He tried to turn the aircraft using rudder but it slid sideways at a slow speed into the ditch. The pilot shut the aircraft down and exited unaided.

AIRCRAFT ACCIDENT REPORT No 6/2010

This report was published on 3 November 2010 and is available on the AAIB website www.aaib.gov.uk

REPORT ON THE ACCIDENT BETWEEN GROB G115E TUTOR, G-BYUT and GROB G115E TUTOR, G-BYVN NEAR PORTHCAWL, SOUTH WALES ON 11 FEBRUARY 2009

Registered Owner and Operator:	VT Aerospace Limited
Aircraft Types:	Two Grob Aerospace 115E Tutors
Nationality:	British
Registrations:	1) G-BYUT 2) G-BYVN
Location of Accident:	3 nm north-north-west of Porthcawl, South Wales Latitude: 51º 31.5' N Longitude: 003º 43.8' W
Date and Time:	11 February 2009 at 1047 hrs All times in this report are UTC

Synopsis

The accident was reported to the Air Accidents Investigation Branch (AAIB) on 11 February 2009 at 1107 hrs. A field investigation was commenced immediately. A Royal Air Force (RAF) Service Inquiry was also convened, which conducted a parallel investigation. The following inspectors participated in the AAIB investigation:

Mr P Taylor	Investigator in Charge
Mr K W Fairbank	Operations
Mr A Cope	Engineering
Mr S Moss	Engineering
Mr P Wivell	Flight Data Recorders

The two aircraft involved in the accident were based at MOD St Athan near Cardiff and were engaged on air experience flights when they collided in midair. The aircraft were piloted by RAF pilots and each aircraft carried an air cadet as a passenger. The collision occurred in uncontrolled airspace in fine weather, in an area which was routinely used by St Athan based Tutor aircraft.

The investigation identified the following causal factor:

1. Neither pilot saw the other aircraft in time to take effective avoiding action, if at all.

The investigation identified the following contributory factors:

1. The nature of the airspace and topography of the region reduced the available operating

area such that the aircraft were required to operate in the same, relatively small block of airspace.

2. There were no formal procedures in place to deconflict the flights, either before or during flight.

3. The small size of the Tutor and its lack of conspicuity combined to make visual acquisition difficult in the prevailing conditions.

4. At various stages leading up to the collision, each aircraft was likely to have been obscured from the view of the pilot of the other aircraft by his aircraft's canopy structure.

Fifteen Safety Recommendations were made by the RAF Service Inquiry (SI) panel. No further recommendations have been made in this report.

Findings

1. Both aircraft were serviceable prior to the collision.

2. Both pilots were correctly qualified and experienced.

3. The weather was suitable for the proposed flights.

4. All required pre-flight activities had been completed.

5. Neither pilot was in contact with ATC, and was not required to be.

6. Neither aircraft was equipped with an electronic CWS.

7. The primary method of collision avoidance was visual – see and be seen.

8. The physical size of the Tutor, together with its all white colour scheme would have made it difficult to acquire visually in the prevailing conditions.

9. It is likely that each aircraft was physically obscured from the other pilot's view at various times leading up to the collision, thus opportunities to acquire the other aircraft were limited for both pilots.

10. Neither aircraft appeared to take avoiding action.

11. The collision occurred in uncontrolled airspace.

12. The midair collision was catastrophic for both aircraft.

13. Successful abandonment was unlikely in the height and time available.

Safety Recommendations and actions

In view of the wide-ranging recommendations made by the RAF SI panel (Section 1.18), and the responses by the convening authority, no further Safety Recommendations were considered necessary by the AAIB.

FORMAL AIRCRAFT ACCIDENT REPORTS
ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2009

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

Published April 2009.

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

Published May 2009.

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

Published August 2009.

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

Published September 2009.

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

Published October 2009.

2010

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

Published February 2010.

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

Published May 2010.

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

Published May 2010.

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

Published September 2010.

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

Published September 2010.

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

Published November 2010.

AAIB Reports are available on the Internet
http://www.aaib.gov.uk