CONTENTS

AAIB CORRESPONDENCE INVESTIGATIONS - Cont

GENERAL AVIATION - Cont

SPORT AVIATION / BALLOONS

MISCELLANEOUS

ADDENDA and CORRECTIONS

None

(ALL TIMES IN THIS BULLETIN ARE UTC)

AAIB Special Bulletins / Interim Reports

AAIB Special Bulletins and Interim Reports

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

ACCIDENT

Aircraft Type and Registration:	EC225 LP Super Puma, G-CHCN
No & Type of Engines:	2 Turbomeca Makila 2A1 turboshaft engines
Year of Manufacture:	2007 (Serial no: 2679)
Date & Time (UTC):	22 October 2012 at 1418 hrs
Location:	In the North Sea, approximately 32 nm southwest of Sumburgh, Shetland Islands
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - 17
Injuries:	Crew - None Passengers - None
Nature of Damage:	Fracture of the Main Gear Box bevel gear vertical shaft
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	Approximately 12,000 hrs (approx 1,000 hrs on type)
Information Source:	AAIB Field Investigation

Background

This Special Bulletin contains information on the progress of the investigation into identifying the cause of the 360º circumferential crack in the bevel gear vertical shaft on G-CHCN (AAIB Special Bulletin S6/2012). It also compares the findings with those recorded previously on another EC225 LP accident involving a similar failure on G-REDW on 10 May 2012 (AAIB Special Bulletin S3/2012) and provides a further update on the investigation into both accidents.

The Chief Inspector of Air Accidents has ordered that the investigations into the accident to G-REDW on

10 May 2012 and to G-CHCN on 22 October 2012 be combined, and to publish an Inspector's Investigation Report.

History of the flight

The helicopter was on a planned flight from Aberdeen International Airport to the West Phoenix drilling rig, approximately 226 nm to the north.

The crew reported that, whilst in the cruise at about 140 kt and 3,000 ft amsl with approximately 81% total torque applied, the XMSN (transmission) caption illuminated on the Central Warning Panel (CWP). They added that the CHIP, M.P (main pressure), and the S/B.P (standby oil pump pressure) captions on the Vehicle Management System (VMS) also illuminated and the main gearbox oil pressure indicated zero. The MGB.P (main gear box oil pressure) caption then illuminated on the CWP. The crew actioned the '*Total Loss of MGB (Main Gear Box) Oil Pressure*' checklist, which required the activation of the MGB emergency lubrication system (EMLUB). However, within a minute the MGB EMLUB caption illuminated on the CWP indicating that the emergency lubrication system had failed. The crew carried out the '*Emergency Landing – Power ON*' checklist and successfully ditched the helicopter in the sea, close to a ship. There were no reported injuries.

Health and Usage Monitoring System (HUMS)

HUMS trend indicator MOD-45 is used to monitor the meshing frequency of the bevel gear and indicator MOD-70 the meshing frequency of the oil pump wheels. Both indicators have thresholds which are used to generate alerts when two out of five consecutive data points exceed the thresholds. This monitoring is carried out at a ground station post flight.

Figures 1 and 2 compare the MOD-45 and MOD-70 indicators for G-CHCN and G-REDW. The indicator values are plotted with respect to flying hours relative to the time at which the MGB oil pressure was lost; the period covered by each figure is 30 flying hours. Also plotted are the threshold values of these indicators unique to each helicopter[1] and applicable at the time of each accident.

At the time of the first accident in May 2012, the MOD-45 and MOD-70 indicators only included amber thresholds; these were 'learned' thresholds each with a maximum value of 0.6.

After the accident to G-REDW, Eurocopter published EC225 Service Bulletin No 45-001, in July 2012 that included the introduction of a red threshold and lowered the fleet-wide maximum threshold values for both indicators. For MOD-45 the amber alert was reduced to 0.3 and a red alert of 0.4 was introduced. For MOD-70 the amber alert was reduced to 0.4 and a red alert of 0.5 was introduced.

After the accident to G-CHCN, Eurocopter published an Emergency Alert Service Bulletin (ASB), on 21 November 2012, which removed the maximum amber alert threshold for MOD 45 and lowered the red alert threshold to 0.2. No change was made to indicator MOD-70 thresholds. These maximum thresholds are greater than G-CHCN's and G-REDW's 'learned' thresholds.

Both helicopters were operating within the published HUMS monitoring procedures valid at the time of their accidents.

Footnote

[1] These are 'learned' thresholds that are a function of the mean of the indicator values recorded to date. These will, therefore, vary from helicopter to helicopter. Eurocopter also publish 'maximum' thresholds that are applicable fleetwide which can, if required, be set sufficiently low to predominate existing 'learned' thresholds.

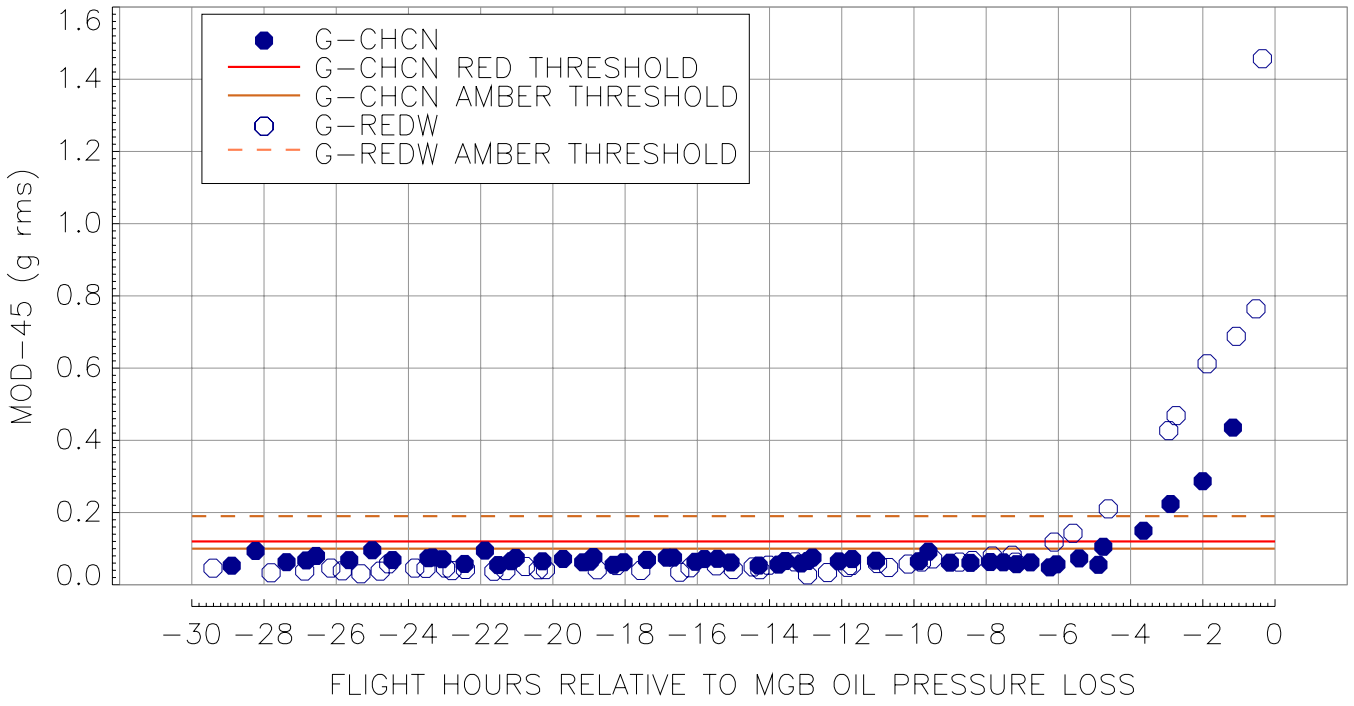

Figure 1

Comparison MOD-45 trend indications between G-CHCN and G-REDW

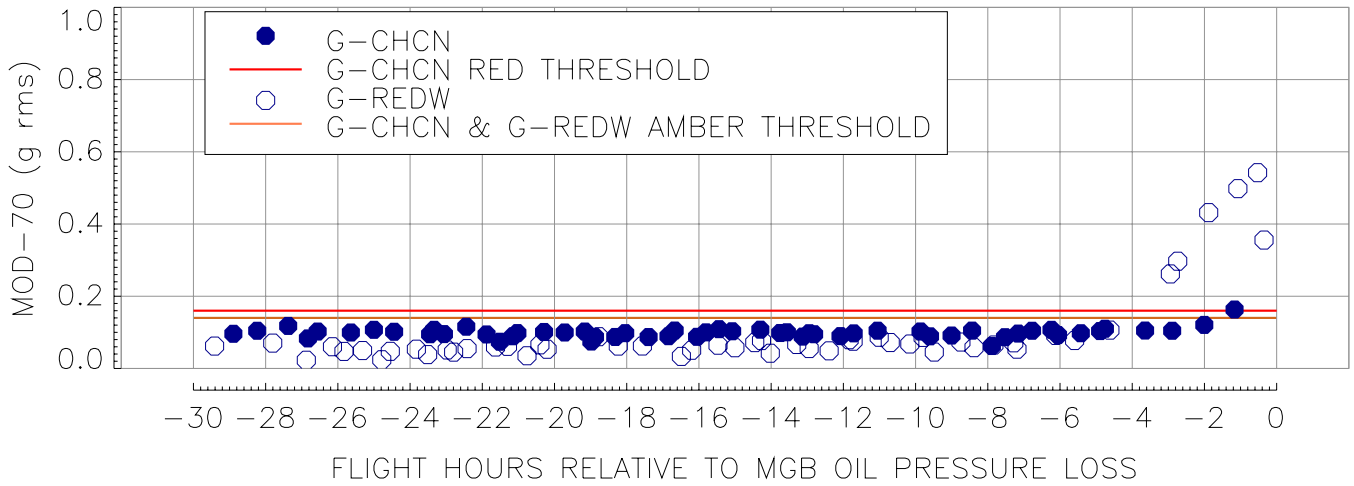

Figure 2

Comparison MOD-70 trend indications between G-CHCN and G-REDW

Figure 1 shows that the MOD-45 indicator for G-CHCN, exceeded its 'learned' amber threshold (0.10) 4.75 flying hours and its 'learned' red threshold (0.12) 3.63 flying hours prior to the loss of oil pressure. For G-REDW the MOD-45 indicator exceeded its 'learned' amber threshold (0.19) 4.62 flying hours before the loss of the MGB oil pressure.

Figure 2 shows that for the MOD-70 indicator, the first instance that it exceeded the 'learned' amber

threshold (0.14) for G-REDW was 2.95 flying hours before the loss of MGB oil pressure. However, for G-CHCN only the last recorded value of this indicator, which was captured 1.17 flying hours before the loss of the MGB oil pressure, exceeded both its amber (0.14) and red (0.16) 'learned' thresholds.

Aircraft information

A description of the development of the Eurocopter EC225 LP helicopter and a systems description of the Main Gear Box (MGB) and the emergency lubrication system was provided in AAIB Special Bulletin S3/2012. In comparison with the AS332 L2, the EC225 LP helicopter has a five-bladed spheriflex composite main rotor and uprated Turbomeca Makila 2A1 engines that deliver approximately 15% more torque to the main rotor system.

The helicopter manufacturer advised that the EC225 LP fleet has flown approximately 300,000 hours. In comparison, the AS332 variants have flown approximately 4.3 million hours.

MGB bevel gear vertical shaft

The bevel gear vertical shaft consists of a main bevel gear wheel and a vertical shaft that are joined together by an electron beam weld. To ensure the integrity of the weld, the disrupted material at the end of the weld is removed by drilling and reaming a diameter (Ø) 4 mm hole. The inner and outer surface of the weld region is then machined to remove the cap and root of the weld. A plug is fitted into the hole to prevent leakage of lubrication oil.

The bevel gear vertical shaft is supported in the gearbox by two upper bearings (roller and ball) mounted adjacent to each other above the bevel gear wheel, and a lower roller bearing mounted at the bottom of the vertical shaft above the oil pump drive wheels. Following the failure of the bevel gear vertical shaft, the bevel gear wheel will only be supported by the two upper bearings.

On bevel gear vertical shafts originally designed for the AS332 variants, both parts of the shaft are manufactured from 16NCD13 steel alloy. The gear teeth are surface hardened, by a process called carburising, prior to the bevel gear wheel being welded to the vertical shaft. The manufacturer's design does not require the vertical shaft, or the part of the bevel gear wheel that is welded to the vertical shaft, to be surface hardened.

The parent material and surface hardening process were changed for the EC225 LP to accommodate the increased loads and the elevated temperatures in the MGB during the operation of the emergency lubrication system. This was achieved by changing the parent material to 32CDV13 steel alloy and applying a different surface hardening process, called nitriding, to the teeth on the bevel gear wheel. The vertical shaft, which is also manufactured from this steel alloy, is not subject to the nitriding process. The 32CDV13 steel alloy shaft can also be fitted to the AS332 variants.

On G-REDW and G-CHCN, the cracks initiated and grew to failure in areas of the vertical shaft that had not been, nor were required to be, surface hardened.

The bevel gear vertical shaft has a life of 20,000 flying hours with a requirement for overhaul every 2,000 flying hours for the EC225 LP and a life of 50,000 flying hours and overhaul every 3,000 flying hours for the AS332 L2. According to the manufacturer, no shaft manufactured from 32CDV13 steel alloy has flown sufficient hours to reach its second overhaul, at 4,000 flying hours.

Engineering investigation

Overview of bevel gear vertical shafts fitted to G-REDW and G-CHCN

The bevel gear vertical shaft (serial number M385) fitted to G-REDW was manufactured in March 2011 and had operated for 167 flying hours[2], which equates to approximately 20 million shaft cycles since new[3]. The shaft (serial number M122) fitted to G-CHCN was manufactured in March 2008 and had operated for 3,845 flying hours which equates to approximately 553 million shaft cycles. Shaft M122 had remained with the same MGB since new and had operated for approximately 1,800 flying hours since the MGB had been overhauled. Its second overhaul was due in approximately 200 flying hours.

Failure of the bevel gear vertical shaft on G-REDW and G-CHCN

The failure of the bevel gear vertical shaft on both G-REDW and G-CHCN occurred as a result of high cycle fatigue cracking in the area of the weld and is thought to be as a result of the shaft bending (flexing) as it rotates.

On G-REDW, the first crack to develop was identified as Crack 'A', which initiated at a corrosion pit approximately 0.06 mm deep located in the inner countersink of the Ø 4 mm hole (Figure 3). The crack then propagated along the fusion line between the area of the weld which had been previously melted, and the heat affected zone in the parent material in the vertical shaft. A second crack, Crack 'B', initiated after Crack 'A' at a small

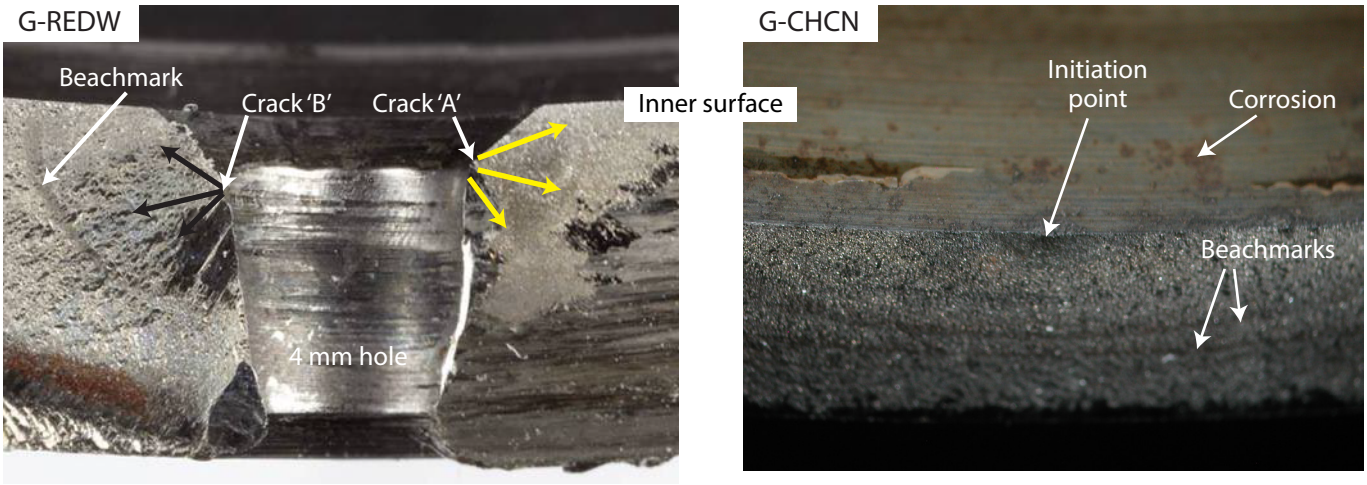

Figure 3

Location of crack initiation on G-REDW and G-CHCN

Footnote

[2] These flying hours are recorded by the flight crew in the helicopter's technical log and are taken as the time between the wheels off and wheels on the ground.

[3] A shaft cycle is defined as one rotation of the bevel gear vertical shaft, which rotates nine times faster than the main rotor.

scratch in the internal surface of the hole. Numerous corrosion pits that could only initially be detected by a scanning electron microscope were also present around the circumference of the inner countersink. Crack 'B' ran into a third crack identified as Crack 'C' (Figure 4).

On G-CHCN the fatigue crack initiated at an area of corrosion on the inner surface of the shaft (Figure 3), approximately 47° around the circumference from the Ø 4 mm hole (Figure 4). It has not yet been determined where the crack initiated in relation to the heat affected zone. Away from the initiation point, the crack propagated in both directions in the parent material in the vertical shaft. Small areas of corrosion were also visible in the machining marks around the inner flange that had been machined during manufacture to remove the root of the weld. The initial examination has not identified corrosion on any other part of the bevel gear vertical shaft.

The fracture surfaces of the shafts on G-REDW and G-CHCN both displayed characteristic fatigue beachmarks, which can be formed when an event such as an engine start or significant change in torque has taken place (Figure 4). Beachmarks can be difficult to identify and can be interpreted in a number of ways.

For G-REDW the first beachmark was identified at 4 mm from the initiation point. Crack growth estimates are complicated by variations in engine torque and the changing stiffness of the shaft as the crack grows to failure. A number of different models are being considered, one of which suggests that the time for the crack to grow from the first beachmark to failure could be

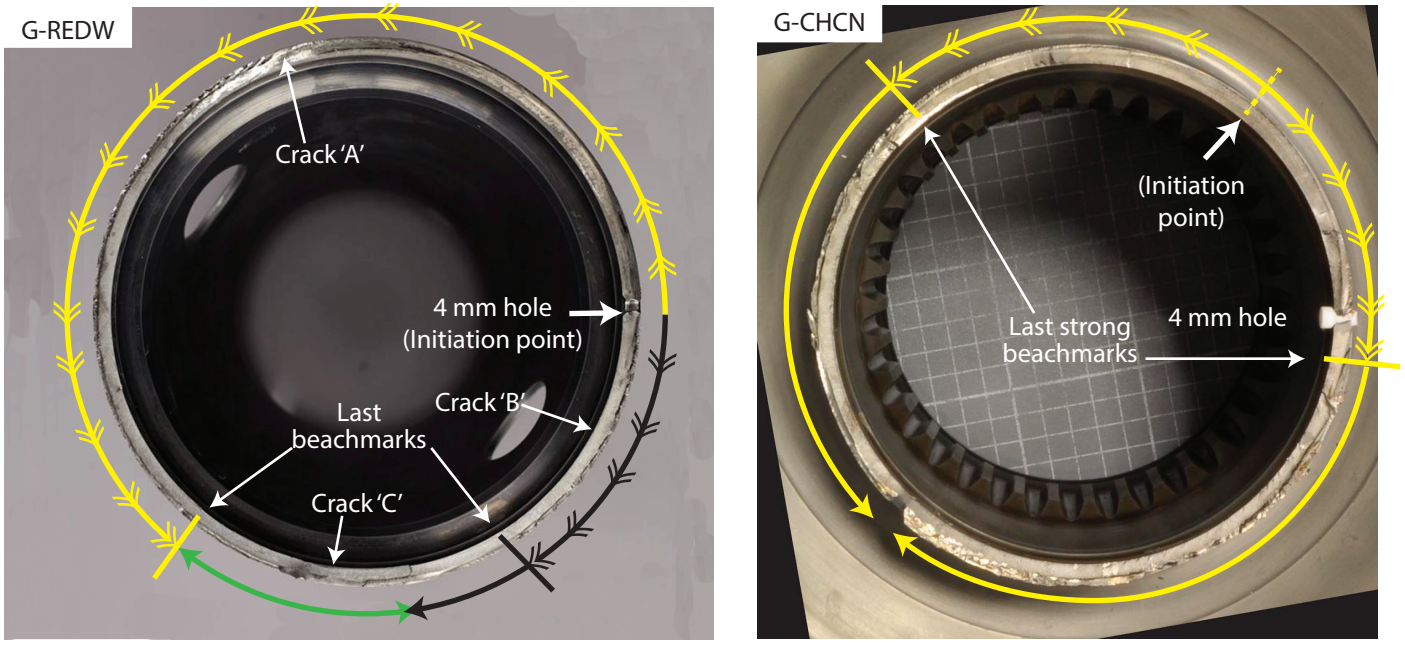

Figure 4
Location of beachmarks on G-REDW and G-CHCN

Cracks without beachmarks
Cracks with beachmarks

as low as 20 engine[4] hours. From the recorded data this corresponds to approximately 15 flying[5] hours. Another model has shown that the crack growth time could be as high as 31 flying hours. Detailed analysis of the beachmarks continues.

At present it is not possible to determine how long it took for the crack to initiate and grow to 4 mm. The growth of the crack from the last identified beachmarks could have occurred during the accident flight.

For G-CHCN, work continues to identify all the beachmarks on the fracture surface. The provisional examination and analysis indicates that the first beachmark was identified at 2 mm either side of the initiation point (giving a crack length of 4 mm). Early analysis shows that there is a possible close correlation in the crack propagation time in the shafts fitted to G-CHCN and G-REDW.

Condition of MGB on G-REDW and G-CHCN

Examination of the MGBs fitted to G-REDW and G-CHCN identified the presence of glycol throughout and no visual evidence of heat distress or significant damage to any other components in the MGB.

On G-REDW, light, unsymmetrical, marks were found on the bearing cages fitted to the upper roller and ball bearings that are believed to have occurred after the shaft failed. Part of the outer race on the lower roller bearing had broken away as a consequence of the shaft failure.

On G-CHCN, there was evidence of the rollers on the upper roller bearing having slipped along the outer race and there were light marks, similar to those seen on G-REDW, in the cage on the roller bearing. The lower roller bearing displayed no unusual marks.

Ongoing investigation into the failure of the bevel gear vertical shaft

The investigation has not identified the root causes of the failure of the bevel gear vertical shafts fitted to G-REDW and G-CHCN. It is possible that the failures occurred for different reasons.

To date the investigation has carried out a detailed examination of the MGB and the bevel gear vertical shaft fitted to G-REDW. A component fatigue test has been carried out on a new bevel gear vertical shaft and the stresses in the component, determined using finite element modelling, have been verified against the stresses measured on a shaft run in the manufacturer's dynamic test rig. A review of the manufacturing process of the bevel gear vertical shaft and the HUMS data from both accident aircraft has also been carried out.

The investigation is currently seeking to confirm the material properties and the in-flight dynamic loads on the MGB and bevel gear vertical shaft. On-going work, some of which is anticipated to extend into 2013, includes:

- Dimensional analysis, fractography and metallographic examination of the bevel gear vertical shaft and MGB fitted to G-CHCN.
- Tests on parent and welded material samples (coupons) to confirm the material properties of the 32CDV13 steel alloy, used

Footnote

[4] Engine hours are based on the first engine start to the last engine shut down, which closely corresponds to the times that the bevel gear vertical shaft is rotating.

[5] The flying hours used in the HUMS were established from the operation of the air / ground switch. In the AAIB calculation the flying hours were established using recorded data from the radio altimeter.

by the manufacturer in the design of the component, and the material's susceptibility to cracking from small features.

- A flight load and vibration analysis programme to confirm the predicted loads in the weld region, and to establish if there is an area in the flight envelope where the bevel gear vertical shaft might operate at one of its natural frequencies.

- Examination of a sample of shafts removed from EC225 LP helicopters and an analysis of oil removed from other EC225 LP helicopters operating out of Aberdeen.

Emergency Lubrication system investigation

The first in-flight activation of the emergency lubrication system on the EC225 LP was during the G-REDW accident on 10 May 2012. The second in-flight activation was during the G-CHCN accident on 22 October 2012. On both occasions the EMLUB failure caption illuminated, resulting in the ditching of the helicopters. The initial examination of both helicopters revealed that the emergency lubrication system had operated. The lack of visual evidence of heat damage to the gearbox components indicates that the system had lubricated and cooled the MGB during the short period[6] between the loss of oil pressure and the aircraft ditching.

On 17 October 2012 the AAIB published Special Bulletin S5/2012, which contained a description of the emergency lubrication system and included the following Safety Recommendation:

Safety Recommendation 2012-034

It is recommended that the European Aviation Safety Agency requires Eurocopter to review the design of the main gearbox emergency lubrication system on the EC225 LP Super Puma to ensure that the system will provide the crew with an accurate indication of its status when activated.

Tests have been carried out on a ground test rig using a Turbomeca Makila 2A1 engine and all the parts of an EC225 bleed air system. The preliminary finding is that the bleed air pressure sensor was probably the source of the low-pressure signal that led to the MGB EMLUB caption illuminating on G-REDW. This pressure sensor has been tested and was found to operate within its specification. Tests on a complete emergency lubrication system, with and without an engine, and components from G-CHCN are ongoing.

Further safety action taken by Regulatory Authorities and Eurocopter

On 21 November 2012 Eurocopter issued revision 2 of EC225 ASB No.04A009 and revision 2 of AS332 ASB No.01.00.82. These were mandated by the EASA Emergency AD 2012-0250-E which superseded the previous EASA Emergency AD 2012-0225-E. These introduced operational changes and additional inspection requirements. The UK and Norwegian Civil Aviation Authorities have issued Safety Directives[7] that prohibit flight in a hostile environment of AS332 and EC225 helicopters that are applicable to the EASA AD.

Published 29 November 2012

Footnote

[6] Approximately 9 minutes for G-REDW and 7 minutes for G-CHCN.

Footnote

[7] UK CAA SD-2012/005.

AAIB Field Investigation reports

ACCIDENT

Aircraft Type and Registration:	Airbus A300B4-622R(F), D-AEAP
No & Type of Engines:	2 Pratt & Whitney PW4158 turbofan engines
Year of Manufacture:	1994 (Serial no: 724)
Date & Time (UTC):	14 April 2012 at 1753 hrs
Location:	East Midlands Airport, Derby
Type of Flight:	Commercial Air Transport (Cargo)
Persons on Board:	Crew - 3 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose landing gear and minor damage to a tug
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	5,878 hours (of which 111 were on type) Last 90 days - 79 hours Last 28 days - 20 hours
Information Source:	AAIB Field Investigation

Synopsis

After disconnection from the pushback tug, the aircraft taxied forwards into the tug before the ground crew had signalled that they and the tug were clear. There were no injuries to the two ground crew or the three aircrew but there was some damage to the aircraft and the tug.

History of the flight

The aircraft was on a scheduled cargo flight, departing at 1745 hrs from East Midlands Airport to Paris Charles De Gaulle Airport. It was being conducted as a training flight, with a captain-under-training in the left seat, acting as Pilot Flying (PF), and a training captain in the right seat, who was the commander of the aircraft. There was also a loadmaster onboard who was sitting in the cabin.

The aircraft was parked on Stand 102 on the West Apron at East Midlands Airport, a dedicated cargo area (see Figure 1). At 1744 hrs, when the aircraft was ready to depart the commander made a radio call to ATC to request start and pushback clearance. The PF completed the Before Start scan and called for the Before Start checklist. When start clearance had been obtained, he contacted the ground crew headset operator on the flight interphone and advised him that the aircraft was ready to push.

During the pushback, which commenced at 1747 hrs, the flight crew started No 2 engine. When the pushback was complete, with the aircraft facing west, the headset operator contacted the flight crew and the park brake was set. The headset operator then stood by while No 1

Figure 1

Cargo ramp area at East Midlands Airport

engine was started. When both engines were running, PF told the headset operator to disconnect the tug and that he would look for his hand signals on the left side of the aircraft. The headset operator went to remove the pin from the tug end of the towbar but was unable to get the pin out of the towing eye, so he sought the assistance of the driver. Between them they withdrew the pin and disconnected the towbar from the tug. The headset operator then disconnected the towbar from the aircraft, turned his back on the aircraft and started to push the towbar to an area forward of the aircraft, to reconnect it to the rear of the tug. At the same time, the tug driver reversed the tug away from the aircraft, before driving forward to pick up the towbar.

Meanwhile, the PF completed the After Start scan, with some intervention from the PNF, and called for the After Start checklist. The checklist was completed and the PF then asked the PNF to request taxi clearance from ATC. At 1753 hrs, the aircraft was cleared to taxi to the Golf 1 holding point for Runway 09, which was near the aircraft and in sight of the flight crew (see Figure 1). The PF switched on the taxi light and increased power to start taxiing.

As the headset operator was moving the towbar to reconnect it to the tug, he described "feeling" the aircraft above him. He pushed himself backwards off the towbar, pushing it clear of the nosewheels, and watched the aircraft pass in front of him, strike the tug and stop. He then called the flight crew on the interphone to inform them that he was still connected.

The tug driver had begun to drive forward to pick up the towbar, when he realised the aircraft was moving. He attempted to drive clear but was unable to do so and the aircraft struck the rear left side of the tug, pushing it a short distance. As the tug and aircraft both stopped moving, the driver exited the vehicle and quickly moved to a safe area.

The aircraft had taxied forward a total of 8 metres, before stopping. The aircraft engines were shut down a minute later, at 1754 hrs, following instructions from the headset operator. The flight crew advised ATC that they had a problem and that they could not move off the taxiway. ATC offered further assistance, which was declined. At 1801 hrs, the AFRS was notified of a ground incident and attended the scene. At 1818 hrs, ATC upgraded the incident to an aircraft accident.

Damage to the aircraft and tug

The aircraft's nose landing gear drag strut was damaged and one of the drag strut attachment pins had sheared. There was also damage to the left steering actuator, on the nose landing gear leg, and damage to the nose landing gear doors. Both nosewheels were replaced.

There was some damage to the bodywork on the tug which was subsequently repaired.

Ground personnel and equipment

The headset operator was experienced in a wide variety of airside operations but was relatively new to the job of headset operator. He had completed his training for the role a few days prior to the accident and this was his fourth shift as a headset operator.

When the aircraft's engines are started during pushback, the usual procedure is for the headset operator to walk alongside the aircraft while monitoring the starts. When the aircraft is in position on the taxiway the headset operator asks the flight crew to set the parking brake. He then waits until he receives a message from the flight crew that both engines are started and he is cleared to disconnect. He disconnects the towbar, first from the tug and then from the aircraft. Once disconnected, the tug reverses and then drives forward to the side of the aircraft, to allow the towbar to be re-attached to the rear of the tug by the headset operator. When the towbar is re-attached, the tug is driven clear of the aircraft to a position in full view of the flight crew. The headset operator then disconnects his headset from the aircraft and walks to the side of the aircraft, to a position from which he can signal to the flight crew that the ground equipment and ground crew are clear.

Recorded information

The aircraft's flight data recorder (FDR) and cockpit voice recorder (CVR) were removed from the aircraft and downloaded at the AAIB. A closed-circuit television (CCTV) camera recording of the pushback was also available. This captured most of the pushback, all the tug movements, the moment of the collision and the subsequent ramp activity.

The FDR recordings of the engine EPR and thrust lever angle parameters were only sampled every four seconds. Also, there was no requirement to record parameters

associated with the use of aircraft's brakes. However, the recording of the longitudinal acceleration enabled the calculation of the speed of the aircraft at the point of collision (2.4 m/s = 4.7 kt) and the distance travelled (8 m) (see Figure 2).

Tug information

The tug was 6 metres long, 2.5 metres wide and 1.8 metres high. It was fitted with an orange high visibility light which was on at the time of the collision. Its mass was 30 tonnes.

Aircraft information

The flight interphone system is selected on the radio panel and when selected all parties can hear the communications. Thus the headset operator could hear all the communications made between the pilots as well as those addressed to him.

Visibility from flight deck

The forward and downward visible segment from the flight deck to the ground is restricted by the aircraft

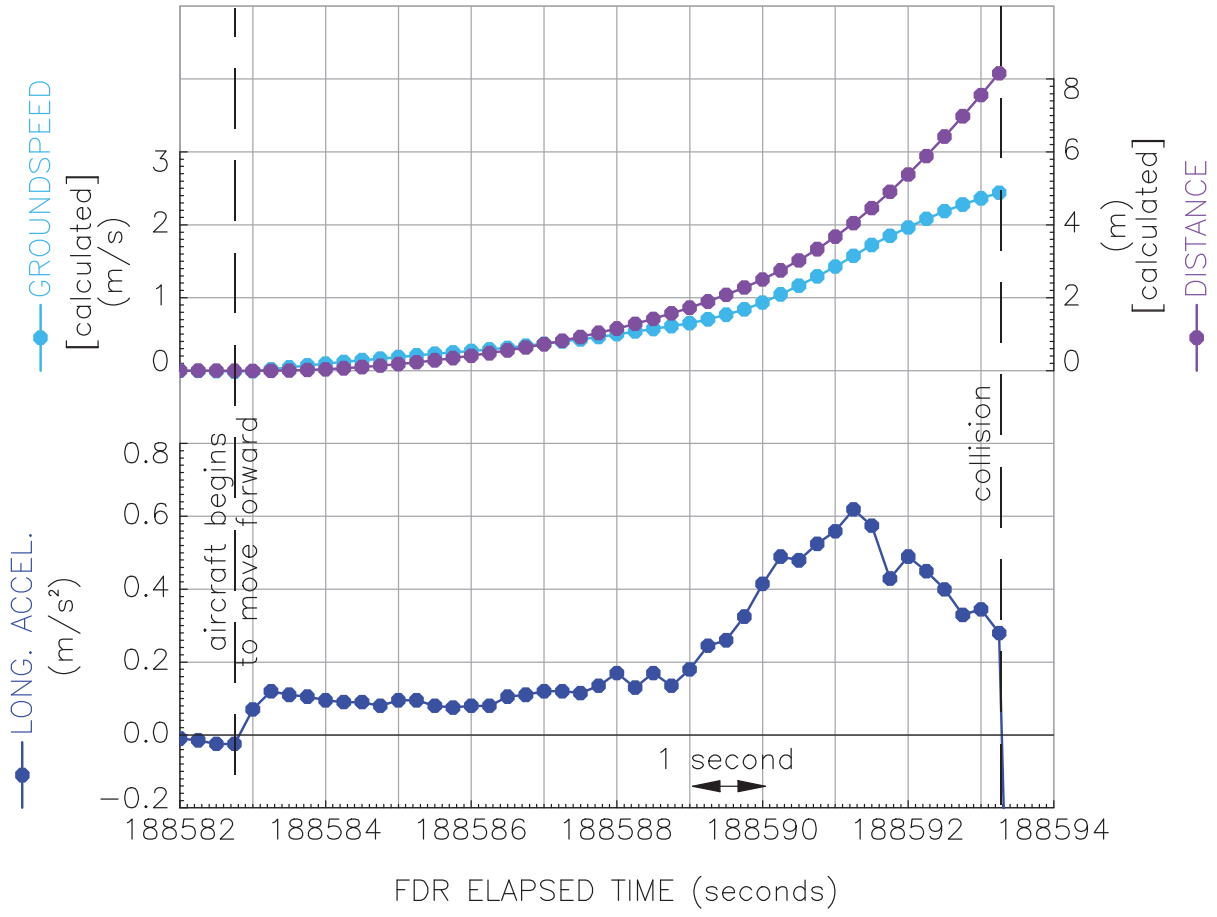

Figure 2

FDR derived groundspeed and distance

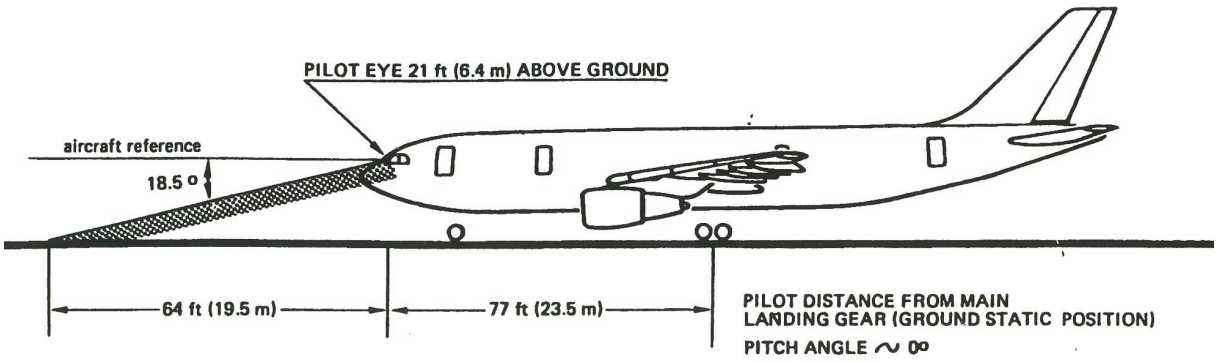

Figure 3
Field of view from pilot's seat

structure. With the pilot's seat position adjusted for flight, a 1.8 m high object (the height of the tug) becomes visible when approximately 14 m in front of the pilot.

Organisational and management information

The operations manual contained, as the final item of the After Start procedure and before the After Start checklist, a check for a hand signal from the ground crew on one or other side of the aircraft. The After Start checklist did not contain an item to check that the hand signal had been received.

There are a variety of Standard Operating Procedures (SOP) that have been developed by operators in order to prevent aircraft moving before ground equipment and personnel are clear. For example, some operators do not allow the After Start checklist to be read until both pilots have seen the hand signal, some include 'ground crew clear' as an item on the after start checklist and some do not allow a call to be made to ATC for taxi clearance until the ground crew's hand signal has been seen.

Other information

The field of view from the flight deck of a large aircraft is very restricted and some aircraft are equipped with under body cameras to increase the flight crew's situational awareness.

Often, pushback tugs are fitted with a rotating light to increase their visibility. However, this is mainly effective at night. Some tugs are fitted with a flag on an extended aerial, above the cab, to increase their conspicuity to pilots in daylight conditions.

Discussion

The incident occurred in daylight and clear weather conditions on a dry ramp surface. The pushback proceeded without incident until the headset operator was unable to withdraw the towbar pin from the tug. With the assistance of the driver, it was then removed but the process of disconnecting the tug took longer than usual.

The PF advised the headset operator that he would expect to see him on the left side of the aircraft, for hand signals. Once both the engines had been started, the PF carried out the After Start scan, during which he was corrected in some actions by the PNF. This took a little extra time and may have caused a distraction, possibly resulting in the omission of the action of waving off the headset operator. After completing the scan, the PF called for the After Start checklist and, immediately afterwards, for clearance to taxi, omitting the check for a hand signal from the ground crew at the side of the aircraft. Analysis of the CCTV, recorded flight data and the field of view

from the flight deck indicated that it is likely that the tug and ground crew were not visible to the pilots when the aircraft started to taxi.

Ground personnel carrying out tasks close to an aircraft, together with any equipment, may well be out of sight of the flight deck. The safe completion of the pushback procedure relies on the flight crew being certain that all is clear before starting to taxi. This is achieved by the means of SOPs for flight and ground crews. On this occasion, the final safety element relied on the flight crew observing a hand signal before starting to taxi. While there may be equipment available that increases the area observable from the flight deck, the operation is dependent upon an operator's SOPs being robust.

Safety action

The operator has reviewed its procedures since the event. A revised After Start checklist has been introduced which includes *'HAND SIGNAL ..... RECEIVED'* as the final check.

ACCIDENT

Aircraft Type and Registration:	Airbus A319-111, G-EZFV
No & Type of Engines:	2 CFM56-5B5/3 turbofan engines
Year of Manufacture:	2010 (Serial no: 4327)
Date & Time (UTC):	14 February 2012 at 1359 hrs
Location:	London Luton Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 142
Injuries:	Crew - None Passengers - None
Nature of Damage:	All landing gear legs exceeded their maximum certified load
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	10,700 hours (of which 500 were on type) Last 90 days - 128 hours Last 28 days - 61 hours
Captain U/T's Licence:	Airline Transport Pilot's Licence
Captain U/T's Age:	37 years
Captain U/T's Flying Experience:	3,998 hours (of which 672 were on type) Last 90 days - 170 hours Last 28 days - 19 hours
Information Source:	AAIB Field Investigation

Synopsis

The flight crew carried out a manually flown ILS approach to Runway 26 at London Luton Airport. Shortly before touchdown, both pilots sensed the aircraft was sinking and a go-around was initiated. The aircraft made firm contact with the runway before starting to climb. The normal acceleration recorded at touchdown was 2.99g, which is classified as a Severe Hard Landing. The subsequent landing was uneventful. All three landing gear legs exceeded their maximum certified loads and were replaced; there was no other damage to the aircraft.

History of the flight

The aircraft was on a scheduled flight to London Luton Airport, from Faro, Portugal. The pilot flying (PF) was a captain-under-training (Capt U/T), occupying the left seat; the right seat was occupied by a training captain, who was the commander of the aircraft.

The aircraft was inbound to Luton from the south on the LOREL 4C standard arrival procedure. This procedure requires the aircraft to cross the extended runway centreline, before positioning for the Runway 26 ILS/DME approach from the north. When traffic allows, ATC will vector the aircraft towards the final approach course before the arrival procedure is completed, thereby shortening the track mileage to the landing. The flight crew were familiar with the airport procedures and were prepared for this to happen.

The aircraft was given an early radar vector towards the final approach track and the PF increased the rate of descent to close the correct descent profile from above. The aircraft was then allocated a heading of 220°M, cleared to intercept the localiser and, once established, to descend on the glidepath. The PF realised that the aircraft would be high and configured the aircraft with flap 2 and the landing gear down, to capture the 3º glideslope from above. He armed the localiser mode and then attempted to arm the approach mode but inadvertently selected the EXPED[1] pushbutton. The expedite climb mode engaged but, to prevent a climb or any mode confusion and to regain the correct profile, the PF disconnected the autopilot and the autothrust. The aircraft passed through the localiser and ATC issued a revised heading to enable the aircraft to intercept from the south.

The PF decided to continue flying the approach manually and the aircraft was established on the localiser at 5.5 nm. It was configured for landing, with full flap, at 5 nm. Landing clearance was issued at 1355 hrs, with a reported surface wind of 320°/15 kt. A subsequent wind check of 320°/16 kt was broadcast at 1356 hrs, three minutes before touchdown. The wind conditions were gusty and gave rise to some turbulence on the approach.

Footnote

[1] EXPED - Expedite mode is used in climb or descent to reach the desired altitude with the maximum vertical gradient.

Stabilised approach criteria were met at 1,000 ft and 500 ft radio altitude (RA). The V_{APP} (final approach) speed was 129 kt and at 50 ft RA the approach remained stable. Just below 50 ft there was a small nose-up pitch input followed by two nose-down inputs and, below 50 ft, the flight data indicated an increasing rate of descent from about 600 fpm to about 850 fpm. The data also showed that, below 100 ft RA, there were some left and right roll control inputs.

Below 30 ft, over the runway, both pilots sensed that the aircraft was sinking rapidly and both initiated a TOGA 10[2] go-around. The PF momentarily retarded the thrust levers to idle before advancing them to the TOGA (Takeoff and Go-around) position. At the same time, he made a full forward sidestick input, within one second, which was then rapidly reversed to full aft sidestick. As the PF made the forward sidestick input, the commander initiated an aft sidestick input which reached the full aft position within one second. He followed through the PF, pushing the thrust levers fully forward and announced "I HAVE CONTROL". The aircraft made firm contact with the runway, on all three landing gear legs simultaneously, before lifting off and starting to climb. During this phase the PF relinquished control and reverted to the PNF role.

The commander remained as the PF, completed the go-around and subsequently carried out an uneventful landing on the same runway. There were no reported injuries.

Flight crew information

The Capt U/T had completed nine sectors of command training without notable incident and the training reports prior to the event had all been positive. His command

Footnote

[2] TOGA 10 Baulked landing procedure.

training had included practice in TOGA 10 manoeuvres in the simulator but he had never carried out a TOGA 10 manoeuvre in the aircraft.

The commander had previous experience of line training on another aircraft type, but was relatively inexperienced in this capacity on the Airbus 320 series aircraft. He reported that he had practised TOGA 10 manoeuvres in the simulator but this was his first experience of one in the aircraft.

Meteorological information

The ATIS information issued at 1320 hrs, and copied by the crew, was surface wind from 300°M at 12 kt, CAVOK, temperature 7°C, dewpoint 3°C and pressure 1024 hPa. There was no significant change between 1320 hrs and 1400 hrs.

Wind data was obtained from the Runway 26 touchdown zone sensor. Readings are taken every 10 minutes and include the average direction and speed reported, along with min/max variations. The readings for 1400 hrs were average wind direction from 315°M, varying between 297°M and 342°M, and average wind speed 13 kt, varying between 9 kt and 17 kt.

The crew were aware that some turbulence can be expected on the final approach to Runway 26 when the wind is from the north-west.

Baulked landing procedure

The operator provides the following Baulked Landing Procedure, entitled *TOGA 10*, in its operations manual. Either pilot may carry out this manoeuvre.

> *'In the event of a rejected landing from flare initiation until thrust reverser selection*
>
> - *call "TOGA TEN"*
> - *select TOGA*
> - *pitch to 10° (this may mean holding the attitude or de-rotating to achieve or maintain 10° pitch.)*
> - *do not retract the flaps until a positive rate of climb is established.*
> - *When positive ROC confirmed, call "GO AROUND FLAPS" and apply normal go around procedure.'*

Through its Flight Data Monitoring programme, the operator has carried out several analyses of TOGA 10 manoeuvres conducted by its crews. The most recent analysis, which was completed following a programme of TOGA 10 training for crews in the simulator, examined 67 events. The report concluded that the manoeuvre was generally well flown and there were no significant dual inputs recorded.

Aircraft information

Autothrust

The manufacturer provides the following information concerning the use of autothrust:

> *'The A/THR is, in particular, best suited to tracking a moving target speed, when flying in managed speed mode. Statistically, the A/THR provides the best protection against airspeed excursions and its use is, therefore, recommended even in turbulent conditions, unless thrust variations become excessive.*

A/THR response to airspeed variations is the result of a design compromise between performance and comfort, and it is optimized when the AP is engaged. Therefore, in turbulent conditions and when flying manually, the pilot may sometimes find it to be too slow or lagging.'

Sidesticks

There is a sidestick for each pilot, located outboard of the seating position. There are two switches on the sidestick, one of which is the autopilot disconnect and sidestick takeover pushbutton. The sidestick controls move independently, so one pilot may not be aware of a control input being made by the other.

The manufacturer advises:

'When the Pilot Flying (PF) makes an input on the sidestick, an order (an electrical signal) is sent to the fly-by-wire computer. If the Pilot Not Flying (PNF) also acts on the stick, then both signals/ orders are added.'

And:

'If the PNF (or Instructor) needs to take over, the PNF must press the sidestick takeover pushbutton, and announce: "I have control".'

Further:

'In the event of simultaneous input on both sidesticks the two green SIDE STICK PRIORITY lights on the glareshield come on and "DUAL INPUT" voice message is activated. A pilot can deactivate the other stick and take full control by pressing and keeping pressed his priority takeover pushbutton.'

The operator provides the following guidance for flight crew in their operations manual:

'If a take-over becomes necessary during flight, the PNF must call clearly "I have control", and press the sidestick priority pushbutton, keeping it pressed until the transfer of control is clearly established. During critical phases of flight the PNF should be in a position to takeover, this may be achieved by resting the hand on the console or indeed on the stick itself but it is imperative that no input is made on the sidestick.'

The use of the takeover pushbutton has been shown from previous incidents not to be instinctive.[3] Training in taking over control, including the use of the takeover pushbutton, is provided by the operator.

Flare Mode

When the aircraft descends through 50 ft RA it enters Flare Mode. The manufacturer's description is:

'The system memorizes the attitude at 50 ft, and that attitude becomes the initial reference for pitch attitude control. As the aircraft descends through 30 ft, the system begins to reduce the pitch attitude, reducing it to 2° nose down over a period of 8 s. This means that it takes gentle nose-up action by the pilot to flare the aircraft.'

Engineering investigation

The A319 is fitted with a system that senses when landing parameters have been exceeded and generates a LOAD<15> report, following which inspection of the aircraft for damage is required.

Footnote

[3] Ref ; AAIB Bulletin No: 11/2004 Airbus A320, C-GTDK, AAIB Bulletin No: 5/2001 Airbus A321, D-AIRE and Airbus A321-211, EI-CPE.

A LOAD <15> report will automatically be generated during a landing if any of the following conditions are met:

- The normal acceleration is greater than 2.6g at touchdown (+/-0.5 second). If the aircraft weight exceeds the maximum landing gross weight, the normal acceleration limit is reduced to 1.7g.
- The rate of descent on the radio altimeter is greater than 9 ft/sec at touchdown (+/ 0.5 second). If the aircraft weight exceeds the maximum landing gross weight, the radio altimeter descent rate limit is reduced to 6 ft/sec.
- During a bounced landing, the normal acceleration exceeds 2.6g.

The normal acceleration parameter used within the LOAD <15> report computation is provided by an accelerometer mounted near to the aircraft's centre of gravity; the same accelerometer is used by the flight data recorder (FDR) system. The accelerometer incorporates a filter that attenuates its output above a predefined frequency. Under certain conditions, such as during rapid changes in acceleration, the accelerometer output may not always reflect the maximum attained normal acceleration level. In addition, during various phases of flight, acceleration levels experienced by other areas of the airframe, such as the nose gear, may be different from those measured at the centre of gravity.

A LOAD <15> report for the incident landing was automatically generated shortly after the hard landing, having recorded a normal acceleration of 2.99g and a rate of descent of 12.5 ft/sec.

Aircraft examination

The operator sent the FDR data to the manufacturer. Due to the high level of vertical acceleration and the fact that the aircraft had made a three-point landing, the manufacturer requested a comprehensive list of structural inspections which included several areas of the fuselage, the belly fairing, the pylons, the horizontal stabilizer and the wings. No damage was found in these areas.

The manufacturer's analysis confirmed that the following components had exceeded their design loads and needed to be replaced:

- Nose Landing Gear shock absorber.
- Left Main Gear sliding tube assembly (including shock absorber internals)
- Right Main Gear Main fitting, including both pintle pins
- Right Main Gear sliding tube assembly (including shock absorber internals)

The operator replaced all three landing gear legs, which were returned to the landing gear manufacturer for overhaul.

Recorded flight data

The aircraft's FDR and CVR were removed from the aircraft, downloaded and the recordings were analysed by the AAIB. Recordings on the CVR at the time of the hard landing had been overwritten by more recent recordings while the aircraft was on the ground, after the final landing.

From the FDR data it was determined that at 8.3 nm DME range from Luton and a height of 3,500 ft agl, the Expedite Climb Mode was selected. Three seconds

later, the autothrust was disconnected, followed by the autopilot. The Expedite Climb Mode was deselected after 10 seconds. The aircraft was established on the localizer at 5.5 nm DME and 2,000 ft agl. The flaps were fully extended by 5.0 nm DME.

Figure 1 shows the salient recorded parameters approaching the touchdown. The data illustrated starts at 1358:38 hrs, with the aircraft at 200 ft agl, 130 kt indicated airspeed and descending at 625 ft/min. At this point the aircraft's attitude was 3º nose-up and 2º left wing low. Left-seat sidestick control inputs were made which resulted in the aircraft rolling wings level as it descended though 100 ft agl. The wings remained level for just over one second before further inputs rolled the aircraft right (to 4.5º at 60 ft agl), then left (to 5.5º at 21 ft agl), then back to wings level at touchdown.

As the aircraft descended through 60 ft agl, at 1358:46 hrs, a momentary 2º reduction in angle of attack was recorded while the pitch attitude remained steady at 3.5º nose-up. A maximum pitch attitude of 4.2º occurred at 32 ft agl, 2.5 seconds before touchdown. This was followed by some pitch-down control inputs (from the left seat) which resulted in a decreasing pitch attitude, the descent rate peaking at just under 900 ft/min, and the aircraft descended below the nominal glideslope. The left-seat pilot then applied an aft sidestick control input of 10º (out of a maximum of 16º) which was coincident with a small aft-stick input by the commander. Both thrust levers were then advanced to the TOGA position. However, there was also a simultaneous forward sidestick input of 15º from the left seat pilot, which was countered by an aft input of 8º by the commander (ie a net input of 7º forward). Both sidesticks were then moved to the fully aft position. Half a second later the aircraft touched down on all three landing gear simultaneously, during which a normal acceleration of 2.99 g was recorded. The aircraft then lifted off, completed a go-around and returned for an uneventful landing.

The manufacturer's analysis of the data provided the following information:

> *'Inputs performed simultaneously by pilots were equivalent to a pitch down order at ~+7° of side sick deflection leading to a strong pitch decrease.'*

Analysis

In the early stages of the approach there was a period of increased workload for the PF, caused by the aircraft being above the nominal 3º descent profile. This was exacerbated when the PF inadvertently selected the Expedite Mode, instead of the Approach Mode, and missed intercepting the localiser. He recovered from this by reverting to manual flight and the aircraft was re-established on the expected profile by 5 nm. This does not appear to have directly affected the outcome of the approach other than that it led to the PF's decision to use manual thrust for the remainder of the approach, which increased the workload in turbulent conditions.

The manufacturer advises the use of autothrust in most circumstances but also notes that there are conditions in which autothrust may not be the best option. Thus, it is accepted that a pilot may need to use manual thrust.

Once established on the ILS in the landing configuration, the remainder of the approach was stable and it was only at a late stage that it deviated from what would normally be expected. There was a momentary reduction in angle of attack at about 60 ft agl and an increasing rate of descent below around 50 ft agl, with an increasing

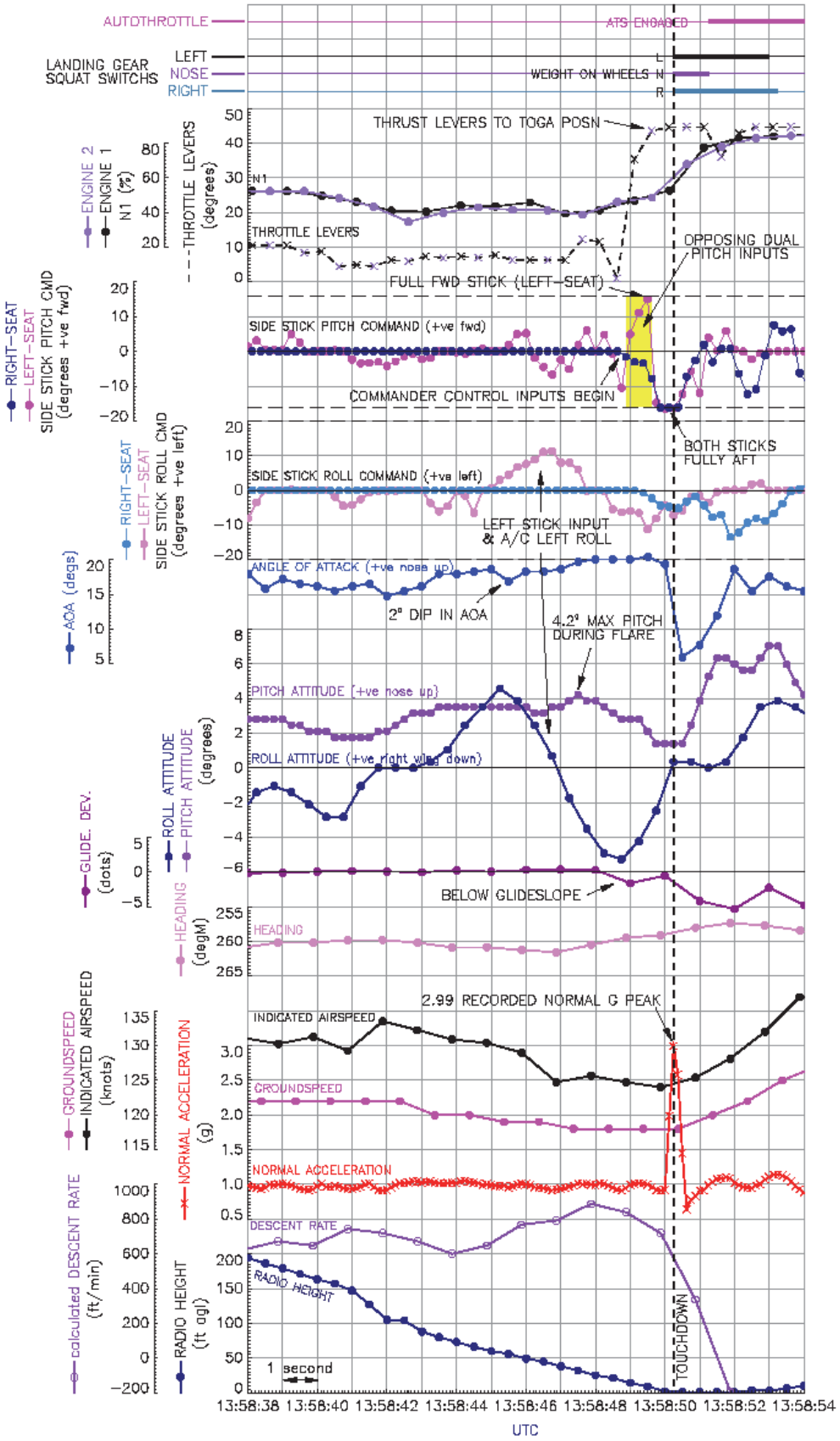

Figure 1

Salient FDR parameters for incident touchdown at Luton

pitch attitude. The PF then made two brief nose-down inputs and the aircraft's pitch attitude decreased. One or all of these factors may have provided the cue to the pilots that the aircraft was sinking.

As the pilots responded to the sink, a period of dual sidestick inputs was recorded. The dual input phase lasted for approximately four seconds before the commander established sole control and took over as PF. Initially these dual inputs were in opposing directions, before the Capt U/T's input was reversed. The commander made a nose-up control input on the sidestick but did not use the takeover pushbutton to establish control, so the effect was limited to reducing the magnitude of the nose-down input made by the Capt U/T. If the commander had used the sidestick takeover pushbutton the severe hard landing may have been prevented.

The brief nose-down inputs made by the Capt U/T occurred at a time when a nose-up control input would normally be expected and probably took the commander by surprise. The sidesticks move independently. So he would have had no knowledge of the inputs being made by the Capt U/T until the flightpath of the aircraft changed.

In attempting to carry out the TOGA 10 manoeuvre, the Capt U/T appears to have made a sidestick input opposite to that expected and there was also a brief retardation of the thrust levers before they were pushed forward to the TOGA position. One possible explanation is that there was momentary confusion between the actions of his left and right hands.

When the aircraft entered the Flare Mode at 50 ft the pitch attitude was 3.2° nose-up. The system would have ordered a nose-down pitch to reach 2° nose-up over a period of 8 seconds. However, this would have been a relatively gradual change and was not considered to be a significant factor in this event.

Following this event, the operator provided additional simulator training for both pilots before returning them to line flying duties. The Capt U/T was returned to line flying as a co-pilot for a period.

Conclusion

Both pilots responded to an increased rate of descent approaching touchdown and each initiated a TOGA 10 go-around. Their initial sidestick inputs were in opposition and, without the use of the takeover sidestick pushbutton, the net effect was a pitch-down control input. If the commander had operated the sidestick takeover pushbutton, his nose-up pitch input would not have been counteracted by the nose-down input of the Capt U/T. In the event, his control input reduced the effect of the nose-down input made by the Capt U/T.

SERIOUS INCIDENT

Aircraft Type and Registration:	Agusta Bell 206B Jet Ranger II, G-SUEZ
No & Type of Engines:	1 Allison 250-C20 turboshaft engine
Year of Manufacture:	1970
Date & Time (UTC):	20 February 2012 at 1500 hrs
Location:	Approx 3.4 miles NW of Perth, Scotland
Type of Flight:	Aerial Work
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Engine compressor and case damaged
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	1,891 hours (of which 1,020 were on type) Last 90 days - 168 hours Last 28 days - 38 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

Synopsis

After suffering an engine failure at 600 ft agl the helicopter completed a successful autorotation into a field. The engine failure was a result of a fracture in fatigue of a stage-two compressor blade.

History of the flight

The helicopter was carrying out a pipeline inspection approximately 2 nm north-west of Perth. At 600 ft agl a loud bang was heard by the crew and the helicopter yawed to the left. The main rotor rpm decreased and the engine was seen to "wind down". The pilot completed a successful autorotation into a field after which he reported the incident to ATC. There were no injuries.

Investigation

Initial inspection revealed that the engine had suffered from a failure of the axial compressor and the compressor case had been breached. No damage was found to any other components or structure of the helicopter. The engine was removed and inspected at the operator's maintenance organisation where numerous fragments of compressor blades and stator vanes were recovered. The engine was then dispatched to an approved overhaul facility where it was examined under the supervision of the AAIB and a representative of the engine manufacturer.

Several ruptures were observed to the compressor case in the plane of the stage-two and three compressor discs. Removal of the compressor cases showed that

all the blades on stages two through to six of the axial compressor had separated from their associated discs. The stage-one compressor blades remained attached to the disc but had suffered from significant trailing edge damage. The stage-two and three compressor stator vanes had been heavily damaged and distorted. Most of the stator vanes from subsequent stages had separated from the compressor case. The centrifugal impeller showed signs of impact damage but was intact. Impact damage was observed on the compressor diffuser tubes and the turbine. The extent of the damage to the compressor assembly prevented the identification of the cause of the failure using optical examination so it was dispatched to the engine manufacturer for a detailed investigation.

Metallurgical tests of the compressor components confirmed that no material abnormalities were present and there was no evidence of Foreign Object Damage (FOD). The fracture surface of a large number of the compressor vanes had been smeared during the incident which prevented their initial failure mode from being identified. Scanning Electron Microscope (SEM) examination of the remaining fracture surfaces showed some features indicating that they had failed due to tensile overload.

The compressor blade fracture surfaces had also suffered from significant secondary damage, but most contained localised areas where the initial fracture surface was visible. SEM examination of these areas confirmed that these compressor blades had failed due to overload. However, a section of a fracture face on one stage-two compressor blade had evidence of crack progression in fatigue. Further examination suggested that the crack had propagated in High Cycle Fatigue (HCF) from the suction side of the blade. Secondary damage to the majority of the fracture surface prevented the initiation point of the crack from being identified. Further SEM examination revealed pits in the leading edge blade root area of several stage-two and three compressor blades, the largest of which was 0.0053" deep and 0.0055" wide.

Maintenance requirements

The manufacturer's Maintenance and Operation manual (72-00-00 page 617) for the M250 engine contains a 300-flying hour inspection which includes a task that states:

> *'Inspect the compressor case when operating in an erosive and/or corrosive environment.'*

The United Kingdom is considered to be a corrosive environment. This task makes reference to Paragraph 1.D (9), 72-00-00, which states:

> *'(9) Erosion and Corrosion Inspection*
>
> *If the aircraft is frequently subjected to sand or dust ingestion or operated in a corrosive environment (salt laden or other chemically laden atmosphere such as pesticides, herbicides, sulphur, industrial pollutants, etc), inspect compressor blades, vanes, and case plastic coating for erosion or corrosion damage. Engines operated in a corrosive environment should be subjected to daily water compressor rinses.'*

There is no requirement to use additional optical magnification when completing the visual inspection. The compressor blade and vane inspection limits are specified in section 72-30-00 paragraph 5 of the Maintenance and Operation Manual.

Maintenance activity

A review of the maintenance records for the helicopter confirmed that the compressor had been installed in the engine on 19 August 2011 and had operated 341 flying hours prior to the failure. The compressor had previously been installed on an engine fitted to a helicopter that had been operating outside the UK. Before its installation into G-SUEZ, the engine's compressor had undergone a 300-hour inspection. A 300-hour inspection had been subsequently completed on the compressor in January 2012.

The maintenance organisation's 300-hour inspection for the Allison 250 engine contained the task shown in Table 1.

Whilst the required maintenance task for the inspection of the compressor was detailed in the helicopter's maintenance programme and provided a generic reference to the engine Maintenance and Operation Manual, it did not provide a reference to the specific section of the manual which detailed the full inspection requirements. In discussions with representatives of the maintenance organisation it became apparent that the use of a generic reference and the description of the inspection task in the maintenance programme was ambiguous.

The maintenance organisation confirmed that G-SUEZ was subject to routine compressor washes as part of the normal daily maintenance requirements when operating from its maintenance facility. At the time of the incident, G-SUEZ had been operating away from its main maintenance base for two days and had not received a compressor wash during this period. It was not possible to determine how frequently the compressor had been washed prior to its installation in G-SUEZ.

Analysis

The damage observed to the compressor was consistent with a failure within the stage-two compressor rotor which resulted in significant downstream damage to the engine. The examination of the remains of one stage-two blade root indicated that the probable cause of the event was the fracture of a stage-two blade due to crack progression in fatigue. Whilst the origin of this crack could not be identified, there was no evidence of Foreign Object Damage to the stage-one compressor blades, or to the inlet guide vanes. It was not possible to eliminate the possibility of the presence of pitting which had been observed on other blades. If pitting was present this could have been a potential initiator of the fatigue crack.

The manufacturer's inspection programme for the engine type includes visual inspections of the compressor rotor

DATA REFERENCE	INSPECTION TASK DESCRIPTION	Mech	Insp
Allison 250 M & O	Inspect the compressor case halves. NOTE: only required if flown 300 hours since last compressor split – see six monthly inspection		

Table 1

for damage and pitting during the 300-hour compressor case inspection task. Whilst wording of the compressor inspection task in the maintenance organisation's 300-hour inspection programme reflected the wording of the manufacturer's manual, it did not provide the reference to the specific tasks associated with the inspection requirements contained in that manual. This lack of references were such that the requirements were ambiguous, and therefore could result in an incomplete visual inspection of the compressor rotor.

Safety action

As a result of this investigation, the maintenance organisation has revised its maintenance programme to include a specific task for the inspection of the compressor rotor during the 300 hour inspection. In addition, the inspection task now includes specific references to the sections of the manufacturer's manual which lay out the inspection criteria and limitations.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quik, G-CWIK
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2004 (Serial no: 8018)
Date & Time (UTC):	12 May 2012 at 1013 hrs
Location:	100 ft below summit of Ben More, Stirlingshire, Scotland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence (Microlights)
Commander's Age:	63 years
Commander's Flying Experience:	826 hours (of which 1 was on type) Last 90 days - 12 hours Last 28 days - 6 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was being flown by an experienced microlight pilot accompanied by the owner, who was a passenger, occupying the rear seat. They were transiting from Perth to Glenforsa, on the Isle of Mull, at about 6,000 ft, above scattered cloud. Approximately 2 nm east of Ben More mountain, in Stirlingshire, the aircraft descended in good visibility, remaining clear of the cloud. The descent and flight up to one second before impact was recorded on a video camera attached to the aircraft. The aircraft levelled off below the cloud base and approximately 100 ft above the summit of the mountain. It continued towards the mountain and encountered severe turbulence in the lee of the summit. This appeared to cause the pilot to lose control of the aircraft, which impacted the south side of the summit, fatally injuring both occupants.

History of the flight

A group of friends had agreed to fly from Perth Airport to Glenforsa, an airfield on the Isle of Mull, using four weight-shift microlight aircraft. The owner of G-CWIK had purchased the aircraft in October 2011 and was taking flying lessons in it. On the day of the accident the pilot and the owner (his passenger) arrived between 0700 and 0730 hrs and prepared their aircraft. G-CWIK had been refuelled the day before the accident and at about 0800 hrs the group met to discuss the flight. They would not be flying in formation, or as an organised stream,

but would make their way independently, meeting at Glenforsa for lunch.

According to the ATC movements log, the group of aircraft departed to the west, between 0917 and 0927 hrs with G-CWIK departing at 0920 hrs. The pilots described the weather at Perth when they departed as having good visibility, with scattered clouds at about 4,000 ft. One of the pilots later reported that he initially climbed to 4,000 ft, where he estimated, from his GPS groundspeed and his indicated airspeed, a headwind component of about 15-20 mph with moderate levels of turbulence. Due to the turbulence, he climbed to between 6,000 and 7,000 ft, where the flying conditions were smoother. G-CWIK was last seen by one of the other aircraft at about 6,000 ft to the northeast of Ben More, where it was seen to descend.

A GoPro Hero video camera, attached to G-CWIK and facing forward in the direction of flight, was later used by the investigation to reconstruct the later stages of flight. The final camera recording commenced 3 minutes and 21 seconds before impact and showed the aircraft descending above a small patch of stratus cloud, with the snow-capped summit of Ben More (elevation 3,850 ft amsl) clearly visible through a gap. The local terrain was visible in sunshine with the slow-moving shadows of the scattered cloud. There was no smoke or other visual means to indicate the direction and strength of the wind, and no snow 'spindrift'[1] was being blown from the summit. The aircraft manoeuvred to the right and left avoiding entering cloud and then passed clear of the edge of a cloud, heading towards the top of the mountain. The aircraft levelled off and engine speed increased just below the cloud base, which was about 300 ft higher than the summit. The recording shows that the aircraft descended slightly, to about the same height as the summit and heading directly towards it, as if to pass over the top. The flight path appeared stable until about 300 m before the summit, when the aircraft began rolling from side to side, with some pitching motion. The engine speed increased significantly and the aircraft banked rapidly left and right and then pitched rapidly nose-down before impacting the mountain side.

A witness on top of Ben More saw the last moments of the aircraft's flight but did not see or hear the impact. He described the wind at the summit as "very strong" and that when he removed an item of clothing from his rucksack it was nearly "ripped" out of his hand by the wind. He did not realise that the aircraft had crashed; the noise of the wind had probably masked the sound of the impact. Shortly after this he met two other hill walkers and they came across the wreckage some time later. They reported the accident to the police, who mobilised the Search and Rescue response. Both occupants had been fatally injured.

Aircraft description

The Pegasus Quik is a tandem two-seat weight-shift microlight, powered by a Rotax 912 ULS piston engine driving a Warp Drive three-bladed propeller (Figure 1).

Figure 1

Accident aircraft G-CWIK

Footnote

[1] Spindrift is the movement of the surface snow particles due to the effect of the wind.

G-CWIK was fitted with the optional electric pitch trim system and the GoPro Hero video camera was mounted on the forward strut. The Permit to Fly had been renewed on 3 May 2012 and the airframe and engine had accumulated 438 hours. The wing, which had been replaced in July 2010 following an accident, had accumulated 62 hours.

Accident site and wreckage examination

The aircraft had struck Ben More mountain on its south-eastern side 100 ft below the summit (Figure 2). The accident site was consistent with the aircraft having hit a small rock in a steep nose-down attitude with some left bank. The nosewheel and parts of the nose structure were embedded in the ground by the rock and the main aircraft wreckage was lying inverted 8 m away from the rock in the direction of 225°(M). The fuel tank had split and was empty but there was a distinct smell of fuel at the accident site. All three propeller blades had failed near the root.

The wreckage was recovered from the mountain by helicopter on 16 May 2012 and then transported to the AAIB's facility in Farnborough for more detailed examination. All the failures within the airframe and wing structure could be explained as a result of impact forces. The pylon had failed aft due to buckling loads which permitted the propeller to strike the wing. The aft end of the keel and the aft end of the fin tube had been deformed as a result of propeller strikes indicating significant energy in the propeller. All failures within the rigging were due to overload resulting from impact forces or propeller strikes. The electric motor for the pitch trim system was found set to 'six turns'. According to the aircraft manufacturer this trim setting, with two occupants, would result in an approximate trimmed airspeed of 60 to 65 mph.

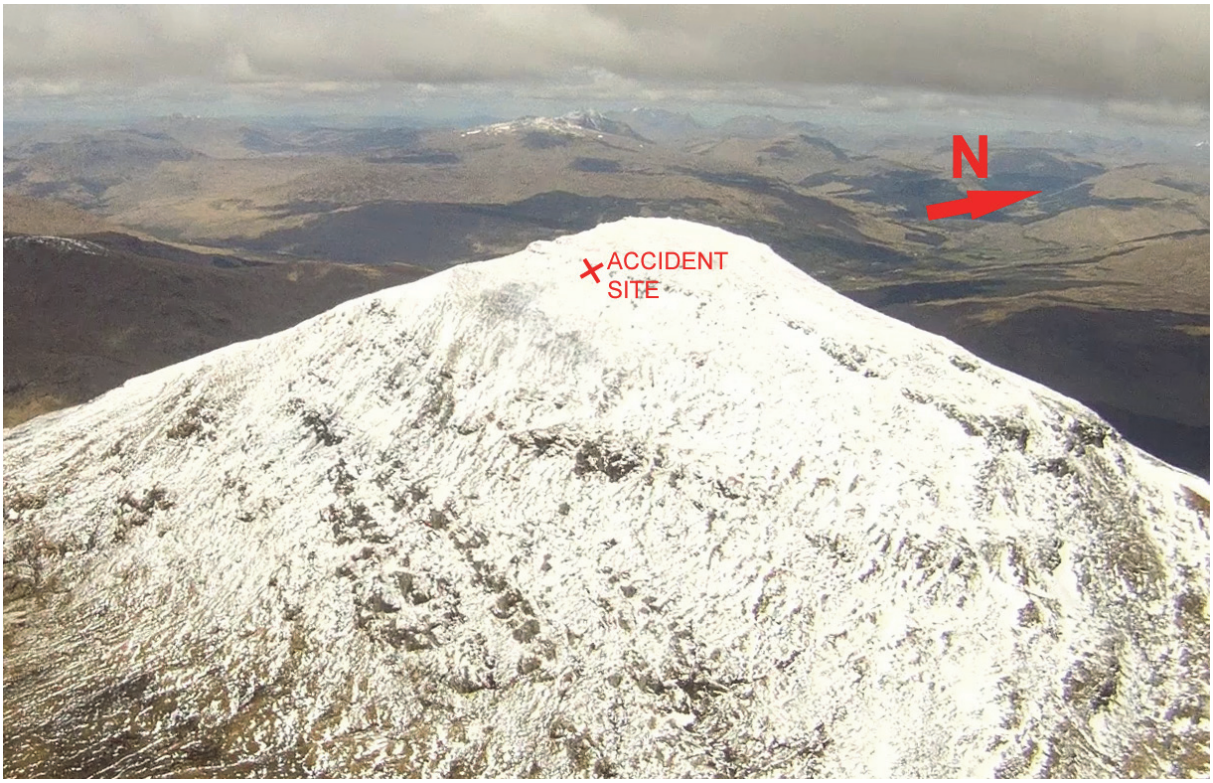

Figure 2

Accident site location, 100 ft below summit of Ben More (image extracted from video camera fitted to G-CWIK)

The lap straps from both seats had failed in overload. However, the harnesses on UK microlights are only required to restrain occupants in the case of 9.0g forward loading and 4.5g upward loading – the impact loads in this accident would have been considerably higher.

Recorded data

Devices from the aircraft

A number of electronic devices were recovered from the accident site, including a GPS eTrex Legend C and a GPS-enabled iPad. However, the only relevant recordings that were recoverable were from the memory card of the GoPro Hero video camera.

Two video files were recovered from the video camera, both taken in the air during the accident flight. The first covered a period of one minute and four seconds while approximately 25 km east-south-east of the accident site. The second video file had not been completed properly, indicative of a loss of power, and required forensic techniques to make it playable. This video was three minutes and 21 seconds long and ended with the aircraft in a steep nose-down attitude, visually estimated to be 10 to 20 ft above the ground, within 20 m of where the main wreckage was found.

The video images provided good evidence of the weather conditions and flight path, shown in Figures 3 and 4 and described in the 'History of the flight' section of this report. The Figure 3 images at '6 seconds' and '5 seconds' indicate a roll rate of about 55º/sec and subsequent images showed a nose-down pitch.

Analysis of the recorded audio showed clear engine-related signatures. The engine speed varied for the bulk of the recording and towards the end increased in increments until reaching the maximum continuous speed of 5,500 rpm, 40 seconds before the end of the recording. This was maintained for 9 seconds before increasing to the redline speed of 5,800 rpm. 10 seconds before the end of the recording the engine speed increased to approximately 6,090 rpm. 3.6 seconds from the end of the recording, the audio signatures stopped, returned and then disappeared once more, coincident with moments of more extreme attitude apparent from the video images.

Radar

Radar return recordings from Kincardine and Lowther Hill radar heads were provided by the national provider of air traffic services, NATS. The aircraft was not using an ATC transponder so could only be tracked using primary radar. Microlight aircraft do not present a strong primary radar target and intervening terrain between the aircraft and the radar heads caused further problems in reconstructing the flight, resulting in parts of the flight path not being detected by radar and the other parts being subject to large errors. The last recorded radar return relating to the accident aircraft was 2.2 km east-north-east of the accident site.

The radar data included sporadic coverage of the other microlight aircraft in the area, showing them generally flying several kilometres apart, following different paths. This concurred with GPS tracks recovered from other microlight aircraft involved in the journey.

A secondary radar track from a helicopter in the area at the time was also reviewed. The helicopter flew from the south-east, between Ben More and the adjacent peak, below the height of the peaks, and then to the north-west (Figure 4). Photographs and video taken from this helicopter at about the time of the accident were reviewed but did not capture the accident aircraft.

Start of video

Video at ~1 minute

Video at ~2 minutes 40 seconds

Video at ~3 minutes

6 seconds to final frame

5 seconds to final frame

Figure 3

Snapshots extracted from the recovered video, showing the approach to Ben More

Combined data

The final section of the radar track of the accident aircraft was consistent with the position of the aircraft established by analysis of the video. The correlation was used to derive the approximate timings for the video (Figure 4).

The paths and timings of the helicopter and the microlight indicate that the microlight impact was

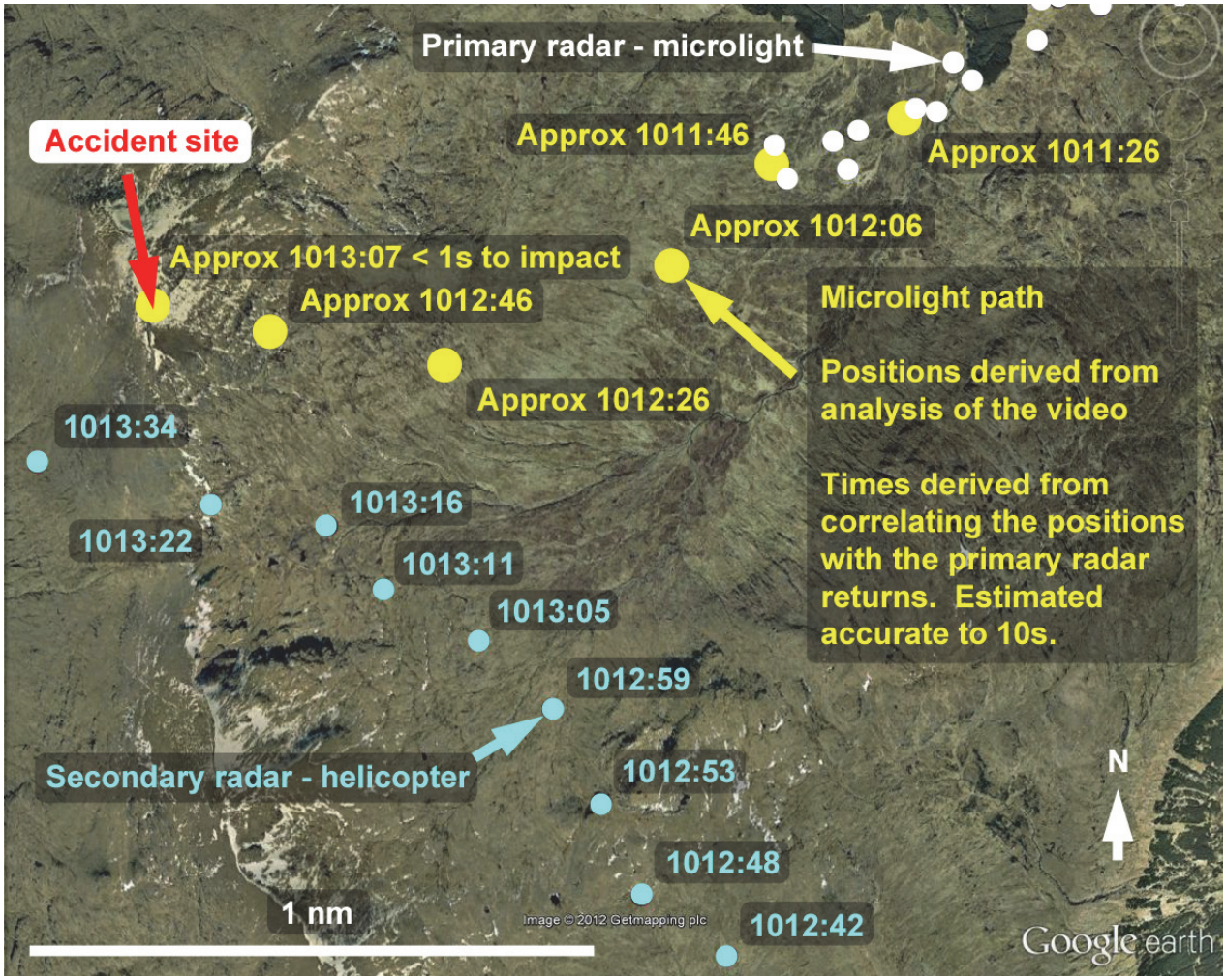

Figure 4

Flight paths and timings of the microlight and helicopter

between 0.4 nm and 1.1 nm ahead of the helicopter. This established that the helicopter was not a factor in the accident.

Meteorological information

On the day of the accident a large high pressure system was established to the west of the UK, extending its influence over Scotland. Over Scotland, the surface wind observations valid at 1100 hrs UTC show westerly winds of 10-15 kt with a 2,000 ft gradient wind of 310° at 25-28 kt. At Glen Ogle, near the crash site, the surface wind between 1000 and 1200 UTC was westerly 16-19 kt with gusts of 24-26 kt.

The movement of the cloud shadows near the summit of Ben More was recorded on the video and analysis indicated a wind of 306°T at 32 kt, at about 4,000 ft. The visibility was approximately 40 km with the generally scattered cloudbase between 3,500 and 5,000 ft. The sea level temperature was about 12°C.

Medical and pathological information

A post-mortem examination of both occupants revealed that they had died of severe multiple injuries, consistent with having been caused when the aircraft struck the ground. The crash forces were outside the range of human tolerance and therefore the impact was not

survivable. There was no evidence of any pre-existing condition that may have contributed to the accident and toxicology showed no evidence of drugs or alcohol in either occupant.

Mountain flying guidance

There are a number of documents available on the internet covering mountain flying. An example is the Civil Aviation Authority of New Zealand '*Good Aviation Practice (GAP), Mountain Flying*' publication (www.caa.govt.nz/safety_info/good_aviation_practice.htm). It contains valuable information and clearly describes the potential hazards associated with flying in mountainous terrain. The illustrations below are reproduced from this document.

Wind strength increases as it passes over a mountain feature, due to the Venturi effect of the mountain. As a result, wind strength on the summit of a mountain will be significantly greater than the ambient wind speed away from the summit at the same height.

This fact is illustrated in Figure 5, with wind speeds for illustrative purposes only.

The strength of the ambient wind will govern the degree of turbulence created. A gentle wind will simply flow over the terrain following the contours but as the strength increases the wind will curl over and around features, forming up and down drafts as well as vortices, the severity of which will increase with the strength of the wind. This effect is shown in Figure 6.

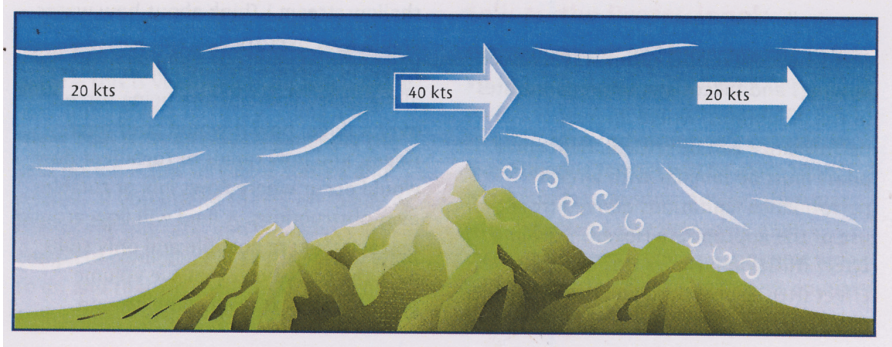

Figure 5

The Venturi effect of the mountain increasing the wind speed at the summit

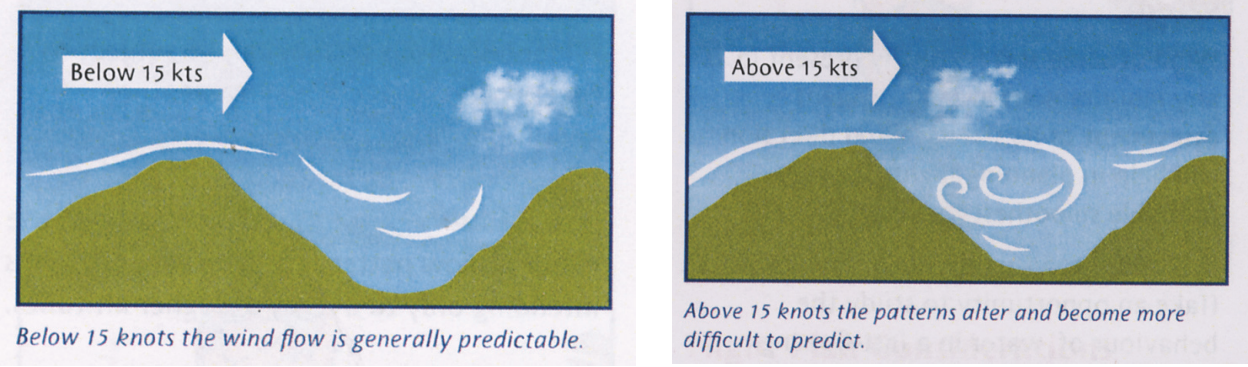

Figure 6

The creation of hazardous turbulence in the lee of high ground related to wind strength

Analysis

The wreckage examination did not reveal any evidence of a technical fault or pre-impact structural failure. The engine was not examined in detail as audio evidence from the video camera, and the damage to the propeller blades, indicated that the engine was producing power at impact.

The video retrieved from the GoPro camera recorded the flight path as stable up to a point about 300 m from the summit of Ben More. At this point the aircraft started to roll rapidly from left to right and pitched nose-down. The increase in engine power up to the redline speed of 5,800 rpm and then, in the last 10 seconds before the end of the recording, to approximately 6,090 rpm, suggests the pilot was trying to arrest his rate of descent and climb out of the turbulence. The aircraft's motion and final flight path is consistent with the effect of turbulent air in the lee of a summit, which creates downdrafts, rotors and vortices.

The evidence of the hill walker on the summit of Ben More, regarding the direction and strength of the wind, indicated that the aircraft's track was downwind of the summit with a wind speed of 30 to 35 kt. This is supported by the recorded video data showing the clouds indicating a wind of 306° at 32 kt near the summit. The pilot of G-CWIK would have known that the winds were westerly from his takeoff at Perth but it is not known how he was conducting his en route navigation and whether that would have given him an appreciation of the wind speed and direction at Ben More. Further, the video recording shows that there was no compelling visual evidence of the wind speed and direction at the summit, such as snow 'spindrift'. It is likely that, in this case, a lack of awareness of the wind conditions, and of the likelihood and severity of turbulence downwind of high ground, were factors in this accident.

In summary, the severity of the turbulence created by the wind, close to the summit of Ben More, was such that it exceeded the safe conditions for flight in the microlight aircraft. This resulted in a loss of control, which led to the impact close to the summit of the mountain.

Safety Recommendation

The UK CAA produces a series of Safety Sense Leaflets covering a wide range of aviation activities but this does not currently include a leaflet covering mountain flying. The following Safety Recommendation is made:

Safety Recommendation 2012-037

It is recommended that the Civil Aviation Authority produce a Safety Sense Leaflet, or other guidance material, covering the activity of mountain flying for the UK general aviation community.

AAIB correspondence reports

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

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

The accuracy of the information provided cannot be assured.

ACCIDENT

Aircraft Type and Registration:	DH89A Rapide Dragon, G-AIYR
No & Type of Engines:	2 De Havilland Gipsy Queen 3 piston engines
Year of Manufacture:	1943 (Serial no: 6676)
Date & Time (UTC):	8 September 2012 at 1136 hrs
Location:	Duxford Aerodrome, Cambridgeshire
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 1 Passengers - 7
Injuries:	Crew - None Passengers - None
Nature of Damage:	Fire damage to the outer section of the right stub wing and inner section of the lower right mainplane
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	4,134 hours (of which 40 were on type) Last 90 days - 9 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and investigation report by the aircraft operator

The aircraft was being prepared for flight, with the commander and seven passengers on board. The left engine was started first, followed, after priming, by the right engine. Immediately after the right engine started the pilot saw a flame, which appeared to originate from the outboard section of its engine cowling. Believing the right wing to have caught fire, he shut down both engines. The pilot then assisted with passenger evacuation, which had been initiated by the ground crew when the fire broke out. Ground crew also tackled the fire, with hand held appliances, and had extinguished the fire when the aerodrome fire service arrived on scene.

An investigation conducted by the aircraft operator concluded that the probable cause of the fire was over-priming of the hot engine, leading to the ignition of overflowed fuel.

ACCIDENT

Aircraft Type and Registration:	Piper PA-23-250 Aztec, G-BKJW
No & Type of Engines:	2 Lycoming IO-540-C4B5 piston engines
Year of Manufacture:	1971 (Serial no: 27-4716)
Date & Time (UTC):	28 September 2012 at 1204 hrs
Location:	Southend Airport, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 4
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propellers and nose section, engines shock-loaded
Commander's Licence:	Private Pilot's Licence
Commander's Age:	64 years
Commander's Flying Experience:	1,536 hours (of which 1,337 were on type) Last 90 days - 21 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was conducting a normal landing on Runway 24 at Southend Airport following a local flight. The weather was fine, with a surface wind from 240° at 17 kt. The landing gear was selected down and three green 'down' indicator lights obtained, together with visual confirmation that the nose gear was extended. The landing was normal until near the end of the landing roll when wheel braking was applied. The gear warning horn sounded and, two or three seconds afterwards as the aircraft was travelling at about 15 kt, the nose landing gear gently moved towards the retracted position. The aircraft's nose lowered to the ground and both propellers contacted the runway. The aircraft came to a stop within about 20 m and the pilot secured the aircraft. The five occupants were uninjured; they vacated the aircraft through the cabin door as the airfield emergency services arrived.

The aircraft was checked by a local maintenance and repair organisation, which found no faults with the undercarriage system. Several retraction/extension cycles were carried out, on each occasion achieving positive downlock and green indicator lights for all three undercarriage legs. The cause of the accident was thus unresolved.

ACCIDENT

Aircraft Type and Registration:	Aero AT-3 R100, G-SACY
No & Type of Engines:	1 Rotax 912-S2 piston engine
Year of Manufacture:	2007 (Serial no: AT3-029)
Date & Time (UTC):	5 September 2012 at 1050 hrs
Location:	Fishburn Airfield, Co Durham
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to nose landing gear and propeller
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	114 hours (of which 36 were on type) Last 90 days - 4 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

After an uneventful flight from the aircraft's base at Sherburn in Elmet, the pilot prepared for a landing on Runway 26 at Fishburn. The weather was fine, with a surface wind from 330° at 8 to 10 kt. The pilot discontinued his first approach because the aircraft was too high on final. He was content with the second approach, despite the crosswind presenting some difficulty, but as he was about to reduce power and flare for landing, the stall warning activated, which he recalled thinking had sounded unusually early. He thought he may have lowered the nose briefly in response, but the aircraft appeared to stall before striking the runway in a nose-low attitude.

The nosewheel broke off and the aircraft came to rest on its main wheels and propeller spinner. The pilot and his passenger were uninjured and both vacated the aircraft to await assistance from airfield personnel. The pilot thought that the aircraft may have stalled as it flew into the lee of hangars and trees, impacting the runway before he had time to take recovery action.

ACCIDENT

Aircraft Type and Registration:	Beech A23 Musketeer II, G-ATBI
No & Type of Engines:	1 Continental Motors IO-346-A piston engine
Year of Manufacture:	1965 (Serial no: M-696)
Date & Time (UTC):	5 September 2012 at 0830 hrs
Location:	Fishburn Airfield, Co Durham
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to right wingtip and aileron, stabilator and fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	1,150 hours (of which 500 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 was taxiing the aircraft toward the threshold of grass Runway 26, prior to an into-wind takeoff. The runway had several distinct gradients and the ground sloped downwards as the aircraft backtracked toward the start of the runway. The grass was wet and the surface wind was from 330° at 12 kt. The aircraft gained excess speed as it taxied downhill and, as the pilot attempted to turn the aircraft to line up on the runway, it skidded to the right and into a hedge, which arrested its motion. The pilot considered that excess taxi speed and his lack of appreciation of how much the braking effect was reduced on the wet grass had caused the accident. He also observed that the grass surface may have been wetter towards the bottom of the slope, where the attempt to turn the aircraft was made.

ACCIDENT

Aircraft Type and Registration:	Beechcraft 33 Debonair, N35SN
No & Type of Engines:	1 Continental IO-470-J piston engine
Year of Manufacture:	1960
Date & Time (UTC):	22 September 2012 at 0930 hrs
Location:	Perranporth Airfield, Cornwall
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to the nose landing gear, lower forward fuselage and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	463 hours (of which 203 were on type) Last 90 days - 9 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was landing at Perranporth after a flight from Old Sarum. The weather was fine, with a 15 kt easterly wind. The pilot made a normal approach to Runway 09, with both a green light and a mechanical indicator confirming that the landing gear was locked down. As the pilot lowered the nose after touchdown, he heard and felt an impact. He immediately pulled back on the control column to keep the nose off the runway, while steering with rudder and brakes. Eventually, the nose dropped fully to the ground and the aircraft slid to a halt on the runway, about 45° offset from the centreline.

The pilot, who was uninjured, secured the aircraft and vacated it. This required going forward from the cabin door and over the wing, as the rear step was too high off the ground.

The pilot reported that the nose landing gear had suffered a mechanical failure. A knowledgeable witness in the control tower had reportedly observed the landing gear to be down prior to landing, and saw the nose gear collapse after a short ground roll. The reason for the failure of the nose landing gear has yet to be established.

ACCIDENT

Aircraft Type and Registration:	Cessna 152, G-BSZI
No & Type of Engines:	1 Lycoming O-235-N2C piston engine
Year of Manufacture:	1984 (Serial no: 152-85856)
Date & Time (UTC):	22 September 2012 at 1230 hrs
Location:	Carrickmore Airfield, Co Tyrone
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, engine mounting and bulkhead, left wing and nosewheel
Commander's Licence:	Private Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	161 hours (of which 69 were on type) Last 90 days - 13 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries

Synopsis

The pilot decided to abort the landing soon after touchdown. He selected full power and wing flaps 0° for the climb away. However, the aircraft did not climb as expected. With obstacles in the projected flight path, the pilot elected to land immediately. The aircraft landed in a ploughed field and turned over; neither occupant sustained injury.

History of the flight

The aircraft was being flown from its base at City of Derry Airport to Carrickmore Airfield near Omagh in Northern Ireland. The runway at Carrickmore was hard-surfaced and 505 m (1,656 ft) long; it occupied an elevated position and was orientated 08/26. The weather at Carrickmore was fine, with a surface wind from 180° at 5 kt and a temperature of 13°C.

The pilot flew a normal approach profile to Runway 08, configured with 20° flaps and flown at about 70 kt. He reported that he was satisfied with the approach parameters. The aircraft touched down about one third of the distance along the runway, and one wheel briefly left the narrow paved surface. The pilot corrected the deviation, but was generally dissatisfied with the landing. He therefore elected to abort the landing and fly a further approach.

He applied full power and selected flaps 0°, rotating at

a speed he believed to have been around 60 kt. It soon became apparent to the pilot that the aircraft was hardly climbing and would not clear a building and nearby power lines which lay on rising ground ahead and slightly to the left of the extended centreline (the ground fell away after the runway end before rising again). He turned the aircraft to the right but saw another building, also on elevated ground, ahead. He decided that the best course of action was to land the aircraft in the field immediately below, and warned his passenger. The field had been ploughed, and the aircraft's nosewheel dug into the ground on landing, causing the aircraft to pitch nose-down and invert. Neither occupant was injured in the accident. The pilot recalled hearing the stall warning horn after he warned his passenger, but thought that he maintained control of the aircraft and it had not actually stalled.

The pilot thought that the aircraft may have experienced carburettor icing, and that he may have overlooked the need to apply carburettor heat before landing, leading to reduced engine power following the aborted landing. However, apart from the poor climb performance, there were no other unusual indications, such as engine noises or rough running. Although the flap control was found in the 0° position, one wing flap was found at 10° and the pilot could not be sure that the flaps had fully retracted. The pilot thought the aircraft had reached a maximum height of no more than 100 ft.

Aircraft performance

Based on mass and balance figures provided by the pilot, the aircraft was only some 5 kg below its maximum allowable weight at the time of the accident, which would have placed it above the maximum weight at takeoff, 45 minutes earlier. The pilot had been aware that weight was an issue prior to flight, and fuel had been offloaded earlier in the day when his original plans had changed and it was decided that a passenger would accompany him on the flight. He estimated that the aircraft had departed City of Derry with about 11 or 12 US gallons (about 45% of maximum fuel).

The Pilot's Operating Handbook (POH) for the Cessna 152 listed takeoff and landing performance figures for ground roll and distances to and from 50 ft. However, these were based on the most favourable situation, which was achieved using 'short field' techniques. For landing, this entailed using 30° flap and an airspeed of 54 kt. The recommended initial climb configuration and airspeed for a baulked landing was 20° flap and 54 kt. The landing ground roll using POH short field techniques should have been 477 ft, with a total distance from 50 ft of 1,203 ft, before any safety factors were applied.

Discussion

The aircraft was operating at close to its maximum weight on a narrow and relatively short runway. The pilot was not familiar with the airfield and it was considerably different from his home airfield which was an international airport. It would appear that the aircraft gained very little altitude after becoming airborne, with separation from the terrain arising partly through the downwards slope of the ground after the runway end. A reduction in available engine power through carburettor icing could not be ruled out, although there was no rough running, low rpm, or other symptoms (other than an apparent lack of power).

Another possibility is that the aircraft may have been unable to climb as a result of a combination of weight, configuration and airspeed. The decision to abort the landing was made quickly, and the actions taken by the pilot were those appropriate to a touch-and-go landing, with which he was very familiar, including selection

of flaps 0°. The lack of headwind and narrow runway could conceivably have provided misleading visual cues that the aircraft was travelling at greater airspeed than was the case. Consequently, it may have become airborne at too low an airspeed, possibly with flaps still retracting, compromising its initial climb performance.

ACCIDENT

Aircraft Type and Registration:	Cessna FR172J Reims Rocket, G-BDOE
No & Type of Engines:	1 Continental Motors Corp IO-360-J piston engine
Year of Manufacture:	1975 (Serial no: 559)
Date & Time (UTC):	20 August 2012 at 1515 hrs
Location:	Farm strip near Truro, Cornwall
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to landing gear, propeller, wing and tail
Commander's Licence:	Private Pilot's Licence
Commander's Age:	65 years
Commander's Flying Experience:	81 hours (of which 81 were on type) Last 90 days - 7 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was landing back at a private farm strip, orientated 03/21, after a 55-minute flight. The weather was fine, with a south-westerly wind of 10 kt. The approach, which was being made into wind, was slightly higher than usual but otherwise seemed normal. Full flap was selected and power was increased. A small valley lies across the approach to the airstrip and, typically, causes an area of sink, which was anticipated. However, as the pilot opened the throttle, the engine did not respond.

The aircraft was unable to clear a hedge in the undershoot, so the pilot raised the nose of the aircraft just prior to impact. The underneath of the aircraft struck the hedge before it came to rest on the grass runway beyond. The pilot secured the aircraft and he and his passenger vacated it, uninjured. There was no fire and no oil or fuel leaks.

At the time of reporting, the cause of the loss of power had not been established, but the aircraft throttle was found to have been in the fully open position. A person nearby heard the engine rpm increase after full flap was lowered, but then no other engine noise before impact.

ACCIDENT

Aircraft Type and Registration:	Corben Junior Ace, G-BSDI
No & Type of Engines:	1 Continental A75-8F piston engine
Year of Manufacture:	1981 (Serial no: 3961)
Date & Time (UTC):	9 September 2012 at 0921 hrs
Location:	4 nm south-west of Bath
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - Minor Passengers - N/A
Nature of Damage:	Extensive
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	65 years
Commander's Flying Experience:	360 hours (of which 100 were on type) Last 90 days - 30 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot intended making a solo flight from a private grass strip near Bath. The strip was orientated 06/24 and was 520 m long by 30 m wide. The weather was generally fine, with a surface wind from 150° at 9 kt, although this was forecast to gust up to 25 kt by about midday. Takeoff from Runway 06 was normal initially, but the aircraft was subject to a sudden gust of wind when about 65 ft above the ground, causing it to pitch up and roll left. Very soon afterwards, the left wing dropped and the aircraft rolled left to about 70° bank and rapidly lost height. The pilot was unable to correct the flight path before the aircraft hit the surface of a ploughed field in a nose-down attitude and cartwheeled. The pilot sustained only minor injuries, and attributed this to protection provided by the aircraft's steel frame and the full harness he was wearing.

The pilot noted that his GPS navigation unit had recorded a rapid groundspeed change from 47 kt to 33 kt just prior to the accident, and believed that the aircraft had stalled after the upset, with insufficient power or height to effect a recovery.

ACCIDENT

Aircraft Type and Registration:	Europa, G-OJHL
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	1999 (Serial no: PFA 247-13039)
Date & Time (UTC):	24 June 2012 at 1420 hrs
Location:	Cumbernauld Airport, North Lanarkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Propeller, cowling and wheel tunnel distorted
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	69 years
Commander's Flying Experience:	527 hours (of which 55 were on type) Last 90 days - 6 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was flying touch-and-go circuits in benign weather conditions, using Runway 26 at Cumbernauld Airport. He elected to carry out a practice forced landing (PFL) followed by a go-around. He then flew a shortened circuit, but was high on his final approach. Contrary to his normal practice, the pilot did not lower the mono wheel landing gear and flaps (a single control) at the end of the shortened downwind leg, and failed to check this at the start of his final approach, as he was sideslipping to reduce height. The gear-up landing damaged the propeller, cowling and wheel tunnel but did not cause any injury.

The change in pitch attitude associated with extending the flaps on this aircraft type normally alerts pilots to the fact that the wheel has been lowered, but this may have been missed because of the need to sideslip the aircraft to reduce height. The pilot cited the poor location of the landing gear warning light and the fact that, as he was wearing an active noise reduction headset, he did not hear the associated aural warning which sounds in the cockpit, as contributory factors. The pilot intends to modify the aural warning so that it can be heard in the headset.

ACCIDENT

Aircraft Type and Registration:	Jodel D117, G-AWWI
No & Type of Engines:	1 Continental Motors C90-14F piston engine
Year of Manufacture:	1957 (Serial no: 728)
Date & Time (UTC):	14 October 2012 at 1615 hrs
Location:	Rhigos Airfield, 7 nm west of Merthyr Tydfil, South Wales
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller, forward fuselage, cockpit and frame, and crack to fuselage aft of cockpit
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	757 hours (of which 73 were on type) Last 90 days - 14 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was landing at Rhigos Airfield, a site used primarily for gliding activities with a single gravel runway about 730 m long and 6 m wide. The runway was orientated 08/26. Weather conditions were good, with an estimated surface wind from 300° at 4 kt.

The pilot flew a normal approach and touchdown in the easterly direction but, after a short ground roll, the left main wheel contacted the grass verge, causing the aircraft to deviate to the left and to leave the runway. The ground was soft after recent heavy rain and the main wheels sank in, creating furrows. Although the aircraft was by this time heading back towards the runway and slowing down, the main wheels encountered softer ground and dug in, causing the aircraft to pitch forward and come to rest inverted. The canopy frame was crushed, but the pilot was able to release himself from his harness and vacate the aircraft through the passenger door after making switches safe.

ACCIDENT

Aircraft Type and Registration:	Navion NAV 4, F-BAVZ
No & Type of Engines:	1 Continental E185-9 piston engine
Year of Manufacture:	1947
Date & Time (UTC):	1 July 2012 at 1535 hrs
Location:	Dunkeswell Airfield, Devon
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller and airframe underside
Commander's Licence:	Private Pilot's Licence
Commander's Age:	70 years
Commander's Flying Experience:	1,887 hours (of which 1,783 were on type) Last 90 days - 7 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

When the aircraft returned to its departure airfield because of an engine oil leak, the nose landing gear leg would not lock down. The pilot performed a successful gear-up landing on the grass. Upon examination, it was found that a fractured hydraulic pipe was responsible for the failure of the leg to lock down.

History of the flight

The aircraft was departing for Rouen in France. Soon after getting airborne, oil could be seen streaming aft from the engine compartment due to the oil filler cap having been inadvertently left off. With his visibility severely impaired by the oil, the pilot decided to return to Dunkeswell. However, upon selecting the landing gear down, only the two green lights for the main landing gear illuminated. Manual pumping of the gear had no effect and ATC confirmed that the nose landing gear leg appeared to be only halfway down.

An attempt to lower the gear by freefall was unsuccessful, so the pilot decided to land with all the gears retracted. ATC directed him to the grass runway to the left of Runway 17 and a successful gear-up landing was accomplished.

On inspection, an aluminium hydraulic pipe was found to have fractured. It was suspected that this was due to the fact that it had been improperly fabricated by hand, since after failure it had sprung several inches from its installed profile, indicating the presence of residual stresses. When the aircraft was lifted, the nose leg was found to lock down under gravity with a small amount of effort.

ACCIDENT

Aircraft Type and Registration:	Pioneer 300, G-CDPA
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2005 (Serial no: PFA 330-14415)
Date & Time (UTC):	21 July 2012 at 1500 hrs
Location:	Private strip, Blisworth, Northamptonshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Lower fuselage and landing gear damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	906 hours (of which 260 were on type) Last 90 days - 9 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

After takeoff from Orange Grove Airstrip, Gloucestershire, the pilot observed that the right main landing gear indication light was illuminated, which indicated that the landing gear had failed to retract fully. After cycling the landing gear several times, including the use of the manual extension/retraction system, the light remained illuminated. As a precaution, the pilot completed the remainder of the flight with the landing gear in the DOWN position. On landing at Blisworth, after a normal touch down, the right main landing gear collapsed, followed by the left main and nose landing gear. The pilot was uninjured.

The pilot attributed the accident to a failure of the landing gear locking mechanism which may have been damaged following a heavy landing which had occurred a few weeks earlier.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-151 Cherokee Warrior, G-BOTF
No & Type of Engines:	1 Lycoming O-320-E3D piston engine
Year of Manufacture:	1975 (Serial no: 28-7515436)
Date & Time (UTC):	9 September 2012 at 0818 hrs
Location:	Southend Airport, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Fire damage to engine and cowling
Commander's Licence:	Private Pilot's Licence
Commander's Age:	24 years
Commander's Flying Experience:	130 hours (of which 3 were on type) Last 90 days - 5 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft's engine caught fire during an attempt to start the engine whilst it was hot from having recently run. In the absence of evidence of a pre-existing defect in the fuel system within the engine bay, it is likely that the engine fire was caused by over-priming the hot engine.

History of the flight

The pilot taxied the aircraft from its parking position to the fuel pumps with the intention of refuelling the aircraft prior to conducting a local flight. He reported that the aircraft started at the first attempt and remarked that he had experienced difficulty in starting the engine on the same aircraft the previous week and he had been told by an instructor to continue cranking the engine until it eventually started.

After refuelling the aircraft, and with his two passengers onboard, the pilot attempted to start the engine but it did not start, so he continued to crank the engine by using the starter motor whilst advancing and retarding the throttle. He could not recall how many times the throttle control was advanced, nor if the engine was cranked continuously throughout the start attempt. The engine still did not start and the pilot noticed that smoke was issuing from the engine bay, followed by flames. He set the fuel cock to OFF and supervised the successful evacuation of his passengers, shortly after which the airfield fire service arrived and extinguished the fire.

Aircraft examination

The forward lower section of the engine cowling and the inside of the engine bay were extensively fire damaged, Figure 1, with the seat of the fire appearing to have been located at the bottom of the engine, close to the carburettor. An engineering inspection of the fuel system within the engine bay did not reveal loose fittings, split fuel hoses or other pre-existing defects.

Previous similar occurrences

A search of AAIB records for engine fires following engine starting attempts on Piper PA-28 series aircraft revealed seven similar incidents over the period 2000-2012. Three of these incidents were reported in the AAIB Bulletin and in all three cases, over-priming of a hot engine was identified as the likely cause of the engine bay fire.

Figure 1

Fire damage to the forward lower section of the engine bay

Discussion

The source of fuel for the fire was likely to have been fuel pumped into the carburettor venturi by the carburettor accelerator pump, which operates when the throttle lever is advanced swiftly forwards. The induction of the fuel into the engine relies on airflow to move the fuel upwards into the engine inlet manifold. However, if the engine is stopped when the throttle lever is advanced, excess fuel will drip downwards from the carburettor and pool in the carburettor heat box. The heat radiated by the hot exhaust system can then cause the pooled fuel to vaporise and can also act as an ignition source for the fuel vapour.

The PA-28-151 owner's manual contains the following advice:

> *'If the engine fails to start at the first attempt, another attempt should be made without priming. If this fails, it is possible that the engine is over-primed. Turn the magneto switch to OFF, open the throttle slowly, and rotate the engine approximately ten revolutions with the starter. Re-prime the engine with one half the amount used in the initial attempt, turn the magneto switch to "Left", and repeat the staring procedure.'*

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-151 Cherokee Warrior, G-BTNT
No & Type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1976 (Serial no: 28-7615401)
Date & Time (UTC):	9 September 2012 at 1044 hrs
Location:	Cranfield Airfield, Bedfordshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose landing gear and propeller
Commander's Licence:	Student pilot
Commander's Age:	44 years
Commander's Flying Experience:	21 hours (of which all were on type) Last 90 days - 21 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, occurrence report by Cranfield ATC

The student pilot completed four visual circuits with her instructor before being cleared for a first solo flight. Runway 21 was in use, with fine weather and a surface wind from 190° at 13 kt. The student pilot took off to fly a normal circuit and was preparing to land. She described her final approach as steady and stable at about 75 kt, with speed reducing as she approached the runway threshold. She reduced power to idle and started a flare, but the aircraft landed firmly and bounced, pitching nose-down. The student was unable to control the aircraft's oscillatory motion but concentrated on keeping the aircraft wings level until it came to a stop. She was advised by ATC to shut down on the runway and await assistance.

ATC reported that the aircraft had appeared slightly slower over the threshold than before, but not excessively so. It appeared to land firmly and bounce twice, before settling heavily on the runway. The student's flying training organisation commented that the conditions were ideal for a first solo flight and that the event was entirely unexpected, given the student's previous training and progress.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-161 Cherokee Warrior II, G-BURT
No & Type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1977 (Serial no: 28-7716105)
Date & Time (UTC):	27 August 2012 at 1345 hrs
Location:	Enstone Aerodrome, Oxfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to wings, fuel tanks, nose cowling and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	87 hours (of which all were on type) Last 90 days - 19 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed with a crosswind from the right. As the nose wheel was lowered on to the runway surface, the aircraft veered to the left. The pilot was unable to straighten the aircraft before it struck a fence post to the side of the paved area.

History of the flight

The aircraft had flown from Denham to Enstone in fine but breezy weather conditions and, on arrival, the pilot was informed that Runway 08 was in use. The marked runway at Enstone is on the southern half of the original paved runway and, consequently, is about half the original width. A wire fence with 6 ft posts runs along the northern edge of the paved surface. The 2,000 ft wind was forecast to be from 190° at 35 kt and the surface wind at Enstone was forecast to be from 170° at 15 kt, gusting to 25 kt. On final approach, the pilot was advised that the surface wind was from 180° at 12 kt.

The pilot was content with the final approach, which was flown using left rudder and right aileron to fly straight and with two stages of flap extended. He reported that the aircraft landed slightly left of the marked runway centre line but, as soon as the nosewheel was lowered on to the runway surface, with the rudder straight, it veered to the left. The pilot was unable to straighten the aircraft before it had travelled left across the full width of the asphalt surface and struck a fence post with its left wing. The aircraft came to a stop with

fence posts and wire wrapped around both wings and the propeller, which caused the engine to stop. The pilot and his passenger were uninjured and vacated the aircraft through the main door. The pilot considered that the crosswind had been a significant factor in the accident.

ACCIDENT

Aircraft Type and Registration:	Piper PA-38-112 Tomahawk, G-BJUR
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1979 (Serial no: 38-79A0915)
Date & Time (UTC):	6 October 2012 at 1545 hrs
Location:	Skegness Airfield, Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to left wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	112 hours (of which all were on type) Last 90 days - 8 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was flying from his home airfield to Skegness, where he had landed on several previous occasions. The weather was fine, with calm conditions at Skegness. Runway 21, which has a grass surface and is 799 m long and 23 m wide, was in use. There had been heavy rain the night before and the surface was damp. After touchdown, the aircraft encountered a bump in the airstrip which caused the aircraft to deviate to the left. The pilot regained directional control but the aircraft had departed the prepared surface and was, by this time, travelling parallel to it in longer, wet grass with a fence line to its left. Considering the surface conditions, the pilot elected to let the aircraft run to a stop rather than attempt braking or a turn back towards the runway. At the end of the fence line, the aircraft's left wing tip collided with a steel gate post, causing the aircraft to yaw to the left and come to a stop. The aircraft sustained damage to the left wing but the pilot was uninjured.

ACCIDENT

Aircraft Type and Registration:	Rans S6-116 Coyote II, G-BUWK
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	1993 (Serial no: PFA 204A-12448)
Date & Time (UTC):	10 October 2012 at 1440 hrs
Location:	Maypole Airfield, near Canterbury, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to fuselage, engine mount, propeller and landing gear. Damage to electric fencing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	2,203 hours (of which 142 were on type) Last 90 days - 56 hours Last 28 days - 15 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot was unable to prevent the aircraft crashing when it became entangled with an electric fence during a go-around.

History of the flight

The pilot had several years' experience operating from the grass airstrip, which was 650 m long, 20 m wide and orientated 02/20. To the north-west of the strip was pasture for horses, separated from it by a combination of plain and electric fencing.

The weather was fine, with a surface wind from east-south-east to south-east at 5 to 8 kt and the windsock indicated that the wind was across the strip. The pilot elected to land in a northerly direction, which had a slight upslope. The final approach was flown with one stage of flap, at 65 kt. As the pilot commenced the flare, the right wing lifted and she lost sight of the airstrip, so decided to go-around.

The pilot lowered the nose attitude slightly and selected full power, but the aircraft made contact with the wire of the electric fence, rocking violently and yawing to the left before crashing in the adjacent pasture. It came to rest upright in a nose-low attitude, pointing back towards the airstrip, and the pilot vacated it uninjured. Horses in the pasture appeared unconcerned.

The pilot reported that, although she had flown nearly 150 hours in this aircraft type, the handling of

G-BUWK differed somewhat from her own aircraft, requiring lighter control inputs, and she thought this may have influenced events after the wing lifted. The pilot would have been unable to prevent the accident once the aircraft had became entangled with the electric fence, which included stranded polypropylene rope of considerable strength.

ACCIDENT

Aircraft Type and Registration:	Silence Twister, G-TWIS
No & Type of Engines:	1 UL 260i SA piston engine
Year of Manufacture:	2009 (Serial no: LAA 329-14954)
Date & Time (UTC):	25 July 2012 at 1115 hrs
Location:	Henstridge, Somerset
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Right landing gear leg attachment broken, scrapes to right wingtip, aileron and flap
Commander's Licence:	Private Pilot's Licence
Commander's Age:	68 years
Commander's Flying Experience:	4,728 hours (of which 2 were on type) Last 90 days - 16 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

During a "fairly steep, throttle-closed" approach to Runway 25 in fine weather, the pilot reported that his airspeed was slightly lower than required and that the aircraft was "heading too close to the end of the runway". After applying a little power and commencing the flare, the aircraft touched down heavily on the right landing gear which then collapsed. The pilot considered that his inexperience on this aircraft type contributed to the hard landing.

ACCIDENT

Aircraft Type and Registration:	Slingsby T67M260 Firefly, G-BWXD
No & Type of Engines:	1 Lycoming AEIO-540-D4A5 piston engine
Year of Manufacture:	1996 (Serial no: 2239)
Date & Time (UTC):	17 October 2012 at 1025 hrs
Location:	Beverley Airfield, East Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller, engine and wing, including water damage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	44 years
Commander's Flying Experience:	665 hours (of which 45 were on type) Last 90 days - 26 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was landing at Beverley Airfield, intending to refuel before continuing on to Wombleton Airfield. He was familiar with Beverley, having landed there some seventeen times before. It has a single grass runway, 12/30 and the runway in use was 12, which has a Landing Distance Available of 627 metres.

The aircraft touched down about one third of the way down Runway 12 with full flap and at approximately 65 kt. The pilot attempted to slow the aircraft by "pumping" the brakes but this was not effective due to the wetness of the grass, so he attempted to turn the aircraft to the right, as he knew that a deep dyke ran less than 50 metres from the end of Runway 12. He was unable to complete the turn and the aircraft ran down into the dyke, coming to a halt with its nose under the water.

The pilot, who was uninjured, admitted that he should have gone around, having landed long, but at the time he thought he could still stop in time. He stated that he did not appreciate the effect that the wet grass would have on braking performance.

ACCIDENT

Aircraft Type and Registration:	Vans RV-8A, G-RVCH
No & Type of Engines:	1 Lycoming IO-360-A1B6 piston engine
Year of Manufacture:	2009 (Serial no: PFA 303-14116)
Date & Time (UTC):	8 September 2012 at 1220 hrs
Location:	Cranfield Airfield, Bedfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Bent nose leg, damaged spat and nose leg fairing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	41 years
Commander's Flying Experience:	110 hours (of which 6 were on type) Last 90 days - 15 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

During circuit training to Runway 21 at Cranfield Airport the pilot flared the aircraft slightly higher than normal and on touchdown it bounced and became airborne again briefly. The pilot relaxed backpressure on the control column and the aircraft touched down again, nosewheel first. This caused the nosewheel leg to bend backwards until it was in contact with the runway, and the aircraft stopped on the paved surface after a short ground run. The pilot vacated the aircraft uninjured. Figure 1 shows the damage to the nose landing gear.

Figure 1

Damage to nose landing gear

ACCIDENT

Aircraft Type and Registration:	Mainair Blade, G-MYYG
No & Type of Engines:	1 Rotax 462 piston engine
Year of Manufacture:	1995 (Serial no: 1054-0995-7-W852)
Date & Time (UTC):	7 September 2012 at 1320 hrs
Location:	Cromer (Northrepps) Airfield, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Extensive damage to wing and pylon. Engine shock-loaded
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	20 years
Commander's Flying Experience:	84 hours (of which 6 were on type) Last 90 days - 10 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was returning from a local flight and was landing on Runway 22. The wind was 230° at 3 kt. Shortly after touchdown the left wheel lifted and the aircraft rolled over to the right. It came to rest, inverted, approximately 30 m further down the runway, partially trapping the occupants. There were no injuries.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quantum 15-912, G-MDBC
No & Type of Engines:	1 Rotax 912 piston engine
Year of Manufacture:	2001 (Serial no: 7814)
Date & Time (UTC):	20 October 2012 at 0930 hrs
Location:	Sandbach, Cheshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Extensive damage to wing and trike
Commander's Licence:	Student pilot
Commander's Age:	51 years
Commander's Flying Experience:	35 hours (of which all were on type) Last 90 days - 9 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The student pilot misjudged the final approach and touched down about 10 m short of the airstrip, in a muddy ploughed field. The aircraft decelerated rapidly and pitched forward and back again, coming to rest upright at the start of the airstrip. The student pilot was taken to hospital but discharged later that day.

ACCIDENT

Aircraft Type and Registration:	QuikR, G-SUKY
No & Type of Engines:	1 Rotax 912 piston engine
Year of Manufacture:	2009 (Serial no: 8456)
Date & Time (UTC):	22 July 2012 at 1430 hrs
Location:	Old Sarum Airfield, Wiltshire
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A 1 (Minor)
Nature of Damage:	Wing, propeller, engine and trike
Commander's Licence:	Private Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	2,072 hours (of which 528 were on type) Last 90 days - 86 hours Last 28 days - 43 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During a training flight, while in the hold-off immediately prior to landing, the aircraft rapidly rolled to the right and struck the ground.

Description of the event

The weather at Old Sarum Airfield was good, with a reported wind of 10 kt at 190°. Runway 24 was in use. The instructor, who had already completed two training flights earlier in the day, assessed that the weather conditions were suitable for the planned training detail and within the capabilities of the student pilot. The instructor briefed that they would initially fly one circuit to confirm if the conditions were suitable to remain in the circuit. If they were not she planned to revise some upper air exercises with the student.

The instructor described the takeoff, circuit and final approach as uneventful and "handled well by the student". She covered the training bar controls throughout the approach, prepared to take control from the student if required. Whilst the aircraft was in the hold-off phase immediately prior to landing, it rolled suddenly to the right without warning and struck the ground. The instructor and student were unable to exit the aircraft until onlookers assisted by righting the aircraft. Both occupants sustained injuries in the impact.

The instructor reported that she had not detected any developing roll through the training bars. Another instructor commented that he had observed some sudden gusts of around 15 kt at about 90° to the runway around

the time of the flight. This led the instructor of the QuikR to consider that the aircraft had encountered a sudden gust of wind from the left during the hold-off, causing it to roll rapidly to the right without warning.

ACCIDENT

Aircraft Type and Registration:	Rans S6-ES Coyote II, G-BZBX
No & Type of Engines:	1 Rotax 582-48 piston engine
Year of Manufacture:	1999 (Serial no: PFA 204-13501)
Date & Time (UTC):	31 August 2012 at 1230 hrs
Location:	Beverley Airfield, East Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nose landing gear, propeller blades, spinner and engine cowling
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	129 hours (of which 5 were on type) Last 90 days - 1 hour Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was returning to land after a short local flight. The pilot reported that he settled the aircraft about three feet above the runway and as he flared and closed the throttle to land, the aircraft dropped without warning, landing heavily on the main landing gear. It then bounced and the second touchdown was on the nose landing gear, which collapsed, causing the propeller to strike the ground. The pilot candidly commented that he may have reduced the power too quickly with the nose-high attitude, but noted that unexpected sink had been experienced by other pilots that day.

ACCIDENT

Aircraft Type and Registration:	Rans S6-ESD XL Coyote II, G-MZCA
No & Type of Engines:	1 Rotax 503-2V piston engine
Year of Manufacture:	1996 (Serial no: PFA 204-12997)
Date & Time (UTC):	24 August 2012 at 1334 hrs
Location:	Private airstrip 13 nm south-south-east of Norwich
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, engine cowling, nose undercarriage leg, wing struts and leading edges. Possible engine shock-loading
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	164 hours (of which 114 were on type) Last 90 days - 19 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft became low and slow on final approach to a grass airstrip. A go-around was initiated but the aircraft appeared to stall and rolled to the right. The aircraft recovered quickly from the stall, but the manoeuvre left it heading towards a small tree which it subsequently struck.

History of the flight

The purpose of the flight was for the pilot's passenger (a qualified pilot with about 1,300 flying hours) to obtain flight data in support of a proposed modification application. Specifically, the intention was to obtain stall performance data and to calibrate the airspeed indicator. It was the passenger's first experience on type.

The first part of the flight was flown by the pilot/owner while his passenger, who occupied the right hand seat, observed and took notes. The passenger then carried out some general handling practice to gain familiarity with the type before returning to the airstrip for a landing. The passenger flew the rejoin under the pilot's supervision, and it had been agreed that the passenger would also carry out the landing. The grass airstrip was 620 m long and 25 m wide, and orientated 01/19. Weather conditions were good and Runway 19 was to be used for landing.

The pilot advised his passenger that the aircraft had a tendency to float during landing, and recommended

an approach speed of 50 to 60 mph. The passenger flew the approach at the higher speed initially, but the aircraft became low on approach. He applied power and reduced speed to about 50 mph, but with the aircraft's nose raised, the passenger lost sight of the airstrip. He applied more power, but still felt that the aircraft was undershooting so, at about 50 ft, he initiated a go-around, noticing a speed of 42 mph.

The aircraft pitched up and then rolled to the right. Recovery from the apparent stall occurred almost immediately and with minimal height loss, but the manoeuvre left the aircraft heading towards a small tree to the right of the runway threshold. There was insufficient room to steer around it and the aircraft's right wing root collided with the tree, about 10 ft above ground level. The aircraft came to rest at the base of the tree; both occupants were wearing full harnesses and were uninjured.

During the flight, a stall speed of 38 mph had been noted, with a tendency to drop a wing at the stall. The passenger had also noted a marked tendency for the aircraft to pitch up on application of power, but had not allowed for this when he initiated the go-around. He considered that this, together with his late go-around decision, lack of experience on type and using the very beginning of the runway as his intended landing point, had contributed to the accident. The pilot observed that the aircraft, which had fixed flaps and modest engine power, required careful energy management for safe low speed flight. He felt the accident had highlighted the importance of adequate 'differences' training, particularly in approach techniques, which should be mastered at a safe altitude first.

Both the pilot and his passenger recognised that their relative experience levels had played a part in the accident. The pilot had deferred to some extent to his passenger's greater experience, and had been reassured by his competent aircraft handling beforehand, with the result that he did not intervene before the situation had become irrecoverable. The passenger recognised that he could have been more positive in establishing an environment in which the pilot felt more able and ready to intervene if necessary.

ACCIDENT

Aircraft Type and Registration:	Rotorsport UK Calidus, G-ETOJ
No & Type of Engines:	1 Rotax 914-UL piston engine
Year of Manufacture:	2012 (Serial no: RSUK/CALS/021)
Date & Time (UTC):	29 September 2012 at 1618 hrs
Location:	Shoreham Airport, West Sussex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Damaged beyond economic repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	65 years
Commander's Flying Experience:	3,882 hours (of which 17 were on type) Last 90 days - 31 hours Last 28 days - 9 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot heard a bang and the gyrocopter rolled to the left on lift-off from the runway. It is thought that the pilot over-rotated and the main rotor blades struck the ground.

History of the flight

The gyroplane was in the process of taking off. As the pilot lifted the nosewheel off the ground, he heard a bang and the aircraft rotated rapidly to the left, turning onto its side and bouncing before coming to a halt on the grass beside the runway. The pilot was able to evacuate the aircraft through the shattered canopy but suffered injuries requiring several days in hospital to recover. He stated that he was unable to explain the accident.

The Calidus is a relatively new design of Gyrocopter, launched in 2009, and G-ETOJ had received its CAA Permit to Fly in July 2012. The manufacturer/importer conducted an examination of the aircraft and photographs taken by the airport authorities soon after the accident; this was apparently the first accident of its kind involving the type. They reported that there was no evidence of pre-impact structural or mechanical failures, the flying controls were intact and damage to the left mainwheel hub and tyre was consistent with it striking the ground during the rollover. Of particular note was the predominantly upward bending deformation of both main rotor blades. In the experience of the manufacturer, a hard ground contact by a blade at flying speed results in significant bending in the plane of rotation and possible

loss of the blade, whereas the observed upward bending is more characteristic of the rotors clipping the ground behind the aircraft. Such a situation would also account for a roll to the left as the blades rotate counterclockwise, causing left mainwheel contact.

Also noted was scuffing on the underside of the keel in an area where it could only occur with a nose-high attitude with all three wheels off the ground. It was concluded that the evidence indicated an over-rotation on takeoff, causing almost simultaneous runway contact by the keel and main rotor disc. The torque reaction caused a loss of control of the gyrocopter in roll and yaw.

Addendum

An addendum was published to this report in the March 2013 Bulletin and is reproduced below:

Following the publication of the report into the accident to G-ETOJ in Issue 1/2013 of the AAIB Bulletin, the pilot has asked that it include mention of a possible factor which he feels may have contributed to the apparent over-rotation of the gyrocopter on takeoff. He stated that he was aware of a number of anecdotal reports where inadvertent operation of the electro-pneumatic trim system in a fully nose-up direction during the ground roll had been encountered.

G-ETOJ had a two-axis trim system, powered by an electrical pneumatic motor which builds up pressure in pitch and roll cylinders attached to the flying controls. The system is signalled by buttons on the top of the control column (stick), four for trim and one for pre-rotator engagement. Other models used a 'coolie hat' arrangement for trim. In the Calidus, when trimmed fully nose-down, the pitch cylinder is unpressurised but when nose-up trim is required, the pilot presses the aft button of the four, opening a valve and operating the electric motor. When sufficient pneumatic pressure has built up in the nose-up sense, the pilot releases the button, closing the valve and trapping the pressure. This pressure, which is displayed on a gauge mounted on the instrument panel, is therefore an indication of the amount of nose-up trim applied. Pressing the forward nose-down button progressively releases the air in the cylinder.

The pilot of G-ETOJ stated that he had heard reports of one or more instances where, when applying fully aft stick at commencement of the takeoff roll, the nose-up trim button was accidentally pressed. This was reportedly more likely when the pilot was of larger build and could occur if the stick top made contact with the seat harness buckle. The AAIB consulted a recognised authority on gyroplane flying who had experience of the Calidus fitted with this type of stick top and he confirmed that inadvertent trim application had occurred to him on about six occasions, although apparently without incident.

It should be noted that the trim does not apply extra pitch authority when the stick is already fully back. It could, however, be construed as a restriction when checking forward as required when the nosewheel lifts off, which the pilot did not report. However, the agent has agreed to incorporate a caution in the next edition of the Pilot's Operating Handbook for the Calidus.

ACCIDENT

Aircraft Type and Registration:	Savannah VG Jabiru(1), G-CFKV
No & Type of Engines:	1 Jabiru Aircraft PTY 2200A piston engine
Year of Manufacture:	2008 (Serial no: BMAA/HB/579)
Date & Time (UTC):	9 September 2012 at 0920 hrs
Location:	Private airstrip 5 nm south of Newark, Nottinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to wings, undercarriage, fuselage and cockpit
Commander's Licence:	Private Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	1,044 hours (of which 326 were on type) Last 90 days - 13 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot reported that he was taking off from his own airstrip in fine conditions and with a south-south-westerly wind of 4 or 5 kt. The airstrip was orientated east-west, with takeoff being made to the west. The aircraft became airborne at the usual lift off point with an indicated airspeed of 40 mph. It climbed about 10 ft before the climb ceased and the aircraft rolled gently to the left. As the aircraft deviation from the centreline reached 40°, it became obvious to the pilot that it would not clear a line of trees to the left of the airstrip. He closed the throttle and made a heavy landing on rough ground. Although the aircraft was damaged, neither occupant was injured.

The pilot believed that the aircraft stalled after it became airborne with insufficient speed and was unable to climb out of ground effect. He thought that the light crosswind from the left, which would have been disturbed by the trees, may have aggravated the situation.

ACCIDENT

Aircraft Type and Registration:	Shadow Series CD Shadow, G-MZBN
No & Type of Engines:	1 Rotax 503-2V piston engine
Year of Manufacture:	1987 (Serial no: BMAA/HB/073)
Date & Time (UTC):	18 August 2012 at 1540 hrs
Location:	Field near Cromer (Northrepps) Airfield, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nosewheel detached, radio antenna and front pod damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	148 hours (of which 102 were on type) Last 90 days - 2 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was performing a solo flight in fine weather to build hours. With the fuel gauge reading one-quarter full, he decided to return towards the airfield after practising some turns to the left and right. During the return to the airfield, the engine stopped. After selecting the largest field (which contained a standing crop of potatoes) and turning into wind, the pilot executed a landing as "a normal landing on a runway". At touchdown, the aircraft stopped abruptly but the pilot, who was wearing a full harness, was uninjured.

The pilot considered that with a low fuel quantity, air could have been introduced into the fuel system during the left and right turns which caused the engine to stop.

Miscellaneous

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

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

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

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

Published February 2010.

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

Published May 2010.

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

Published May 2010.

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

Published September 2010.

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

Published September 2010.

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

Published November 2010.

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

Published November 2010.

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

Published December 2010.

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

Published September 2011.

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

Published November 2011.

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

http://www.aaib.gov.uk