CONTENTS

SPECIAL BULLETINS

COMMERCIAL AIR TRANSPORT

GENERAL AVIATION

SPORT AVIATION / BALLOONS

ADDENDA and CORRECTIONS

(ALL TIMES IN THIS BULLETIN ARE UTC)

INCIDENT

Aircraft Type and Registration:	DHC-8-402 Dash 8, G-JEDR
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2003
Date & Time (UTC):	3 March 2011 at 1255 hrs
Location:	Exeter Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 39
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right main landing gear inboard wheel detached
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	6,778 hours (of which 3,417 were on type) Last 90 days - 103 hours Last 28 days - 24 hours
Information Source:	AAIB Field Investigation

Synopsis

After takeoff from Exeter Airport, as the landing gear was retracted, the inboard wheel of the right main landing gear separated from its axle and fell to the ground within the airport boundary. The crew entered a holding pattern to the east of the airport and carried out the 'Alternate Landing Gear Extension' procedure. The aircraft returned to Exeter where it landed safely. The investigation found that the wheel's outer bearing had seized. This was most likely as a result of the bearing cage and cup having come into contact due to excessive movement of the cage, probably due to wear. This caused the bearing to fail catastrophically. Consequential damage had allowed the wheel to detach. Safety actions have been taken with the intention of preventing a recurrence.

History of the flight

The aircraft was on the final sector of a four sector rotation which had commenced at Newcastle Airport at 0705 hrs that morning. The commander had performed the pre-flight inspection, which included a visual examination of the right landing gear. Nothing unusual was noted.

During the takeoff from Runway 08 at Exeter a single "ding" audio signal activated between 80 kt and V_1/V_R. The co-pilot checked for any indications on the relevant instruments but there were none and he reported "spurious, continue". The takeoff was continued and the landing gear was selected up once a positive rate of climb was established.

A number of passengers seated on the right side of the aircraft noticed sparks emanating from the right inboard wheel area during the takeoff roll and saw the right inboard wheel fall from the aircraft as the landing gear retracted. They did not inform the cabin crew at this point. The flight crew were advised by ATC shortly after takeoff that the aircraft may have lost a wheel. The climb was continued to FL030 and a right turn was made to join the hold at the Exeter NDB. The FMS was programmed to fly the hold and the autopilot was engaged.

The commander contacted the Senior Cabin Crew Member (SCCM) on the interphone to inform her of the situation and asked her to inspect the right landing gear area. The passengers informed the SCCM of the loss of the wheel and she could see that the gear was retracted and the landing gear doors were closed, but parts of the landing gear mechanism were protruding. She reported her observations to the commander. The co-pilot then spoke with a company engineer who was a passenger on the flight and confirmed for himself the SCCM's observations.

The flight crew reviewed the 'Landing Gear Malfunction' and 'Emergency Landing' sections of the Abnormal and Emergency Checklist and agreed that the landing gear should be extended using the 'Alternate Landing Gear Extension' procedure. On actioning this, the left main and nose landing gear indicated down and locked but the right landing gear did not indicate any movement. The company engineer advised the flight crew that the right landing gear had not lowered. Following a discussion with the engineer, the pilots prepared to use the landing gear manual lowering procedure but the right landing gear then lowered and indicated it was down and locked. This was visually confirmed from the cabin by the engineer and the co-pilot.

The commander transmitted a MAYDAY which was acknowledged by ATC and the emergency transponder code of '7700' was set. The pilots reviewed the 'Emergency Landing' procedure and discussed their options. They agreed that although the landing gear had lowered and indicated locked down, there was a possibility that the right outboard wheel may detach in the air or on landing and they should also be prepared for the right landing gear to collapse on touchdown. They considered shutting down the right engine for the approach and landing but agreed to keep it operating in order to reduce the asymmetric effects of selecting the propeller to disc or reverse.

The commander gave the Nature, Intentions, Timings and Special instructions (NITS) briefing to the SCCM, who then briefed the other cabin crew member. The passengers were then individually briefed. Following the commander's instructions, they also moved passengers on the right side away from the propeller area, distributing them evenly forward and aft.

The co-pilot contacted the operator's Chief Pilot by radio to discuss the most appropriate landing procedure. It was decided that they would use a left-wing-down technique ensuring that the left mainwheels touched down on the runway first, then lowering the remaining right mainwheel onto the runway as gently as possible. The flaps would be set at 35° and the touchdown would be at or just below the V_{REF} of 112 kt calculated for their landing weight of 24,000 kg. No wheel braking would be used during the landing roll.

The approach was flown manually with the co-pilot calling out check altitudes, airspeed and rate of descent. At 1,000 ft on the radio altimeter the passengers were instructed to adopt the brace position.

The aircraft touched down on the left mainwheels at or about V_{REF} and the right mainwheel was lowered onto the runway. The aircraft then veered to the left and the commander had to apply significant amounts of right rudder in order to regain the centreline. The pilots had briefed not to use the toe brakes during the landing roll and as the aircraft slowed to a walking pace the commander made a gentle application of the emergency brake, bringing the aircraft to a stop and the parking brake was set. Once the AFRS was in position, the commander instructed the SCCM to disembark the passengers; this was carried out through the front left door. The co-pilot and the SCCM used the public address system to make announcements before the aircraft electrical systems were isolated. The SCCM had briefed a number of Able Bodied Persons (ABPs) to ensure the safe containment of the passengers following the disembarkation. The passengers were taken to the terminal in buses.

Flight recorders

The aircraft was fitted with a flight data recorder (FDR) and a cockpit voice recorder (CVR) and these were downloaded by the AAIB. Given the nature of the incident, the FDR data was of limited use to the investigation. The CVR recordings confirmed the crew's description of events following the incident and for the landing but the event was overwritten with later recordings from when the aircraft was on the ground at Exeter Airport.

The CVR had a two-hour recording duration of which the last 40 minutes were when the aircraft was on the ground with electrical power on. The loss of the event on the CVR occurred despite the operator having made efforts to preserve the recordings. The first action on the part of the operator was to ask the crew (via the radio) to pull the circuit breakers (CBs) as soon as they landed. The crew asked for the "coordinates" of the CBs as they were unsure where they were but this information was not relayed back to them. Once on the ground, the crew's primary concern was to shut down the aircraft and ensure that all passengers and crew were safely disembarked. As the commander disembarked he asked an aircraft engineer, who was about to board the aircraft, to pull the CBs. This was not done and when the engineer then turned the aircraft's electrics on, the CVR started to record again until the aircraft was shut down 40 minutes later.

Initial examination

The detached main wheel and bearing debris found on the runway were recovered for AAIB inspection. Initial examination of the aircraft revealed that the wheel nut was still in position on the axle with its locking devices correctly installed. The brake unit was loose on the axle and had sustained damage to the heat pack, Figure 1. The wheel nut and brake unit were then removed from the axle along with the remains of the failed wheel bearings. The axle had light scoring to its bearing surfaces and there was minor flailing damage to components close to the brake unit.

Figure 1

Wheel axle as found

The right main landing gear inboard door showed evidence of contact with the rotating wheel assembly and its rear hinge attachment had been torn away from the door. The door remained attached to the aircraft by the other hinge and operating linkage, Figure 2. The nacelle above the door was slightly damaged by the door.

Figure 2

Inboard main gear door showing detached hinge

General arrangement of wheel bearings

Each mainwheel is fitted with a pair of taper roller bearings arranged with their smaller rolling diameter towards the centre of the wheel. Figure 3 shows the general arrangement of the mainwheel, brake unit and bearings.

Each wheel bearing consists of a cup located in the wheel and an inner cone, roller and cage assembly which locates on the axle, Figure 4. The bore of the outer bearing cone is of a slightly smaller diameter than the inner bearing to prevent misassembly. The rollers and cups are common to both bearings. The bearings are lubricated on installation with specified high quality grease.

Figure 4

New wheel bearing cone assembly showing rollers located in the cage

The correct wheel installation process involves tightening the wheel nut to a specific torque loading to seat the bearings initially before backing off the nut and then tightening it to a lower in-service torque loading. The wheel must be rotated by hand throughout the process to ensure the correct pre-loading of the bearings is achieved.

Detailed examination of failed parts

The remains of the wheel bearings and the wheel were examined with representatives of the bearing manufacturer, the wheel manufacturer and the operator present. There was evidence of sufficient grease of the correct type. The seven recovered rollers, Figure 5, were examined and these showed there was minimal heat generation and the roller bodies and spherical thrust large end showed minimal wear or distress prior to the incident. As these rollers were found on the runway, it cannot be certain which bearing these came from as the same part number roller is used in both bearings.

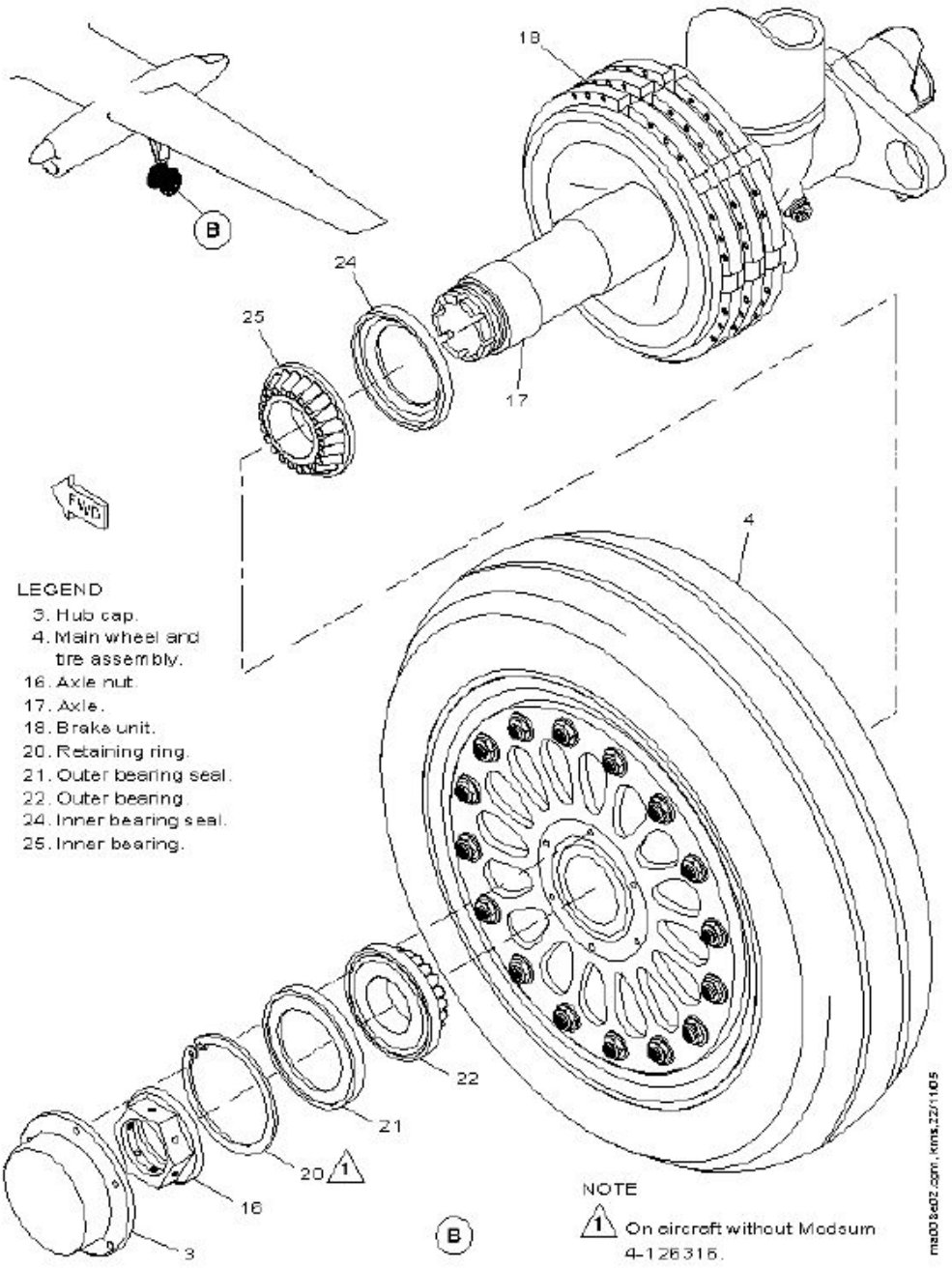

Figure 3

General arrangement of the mainwheel and bearings

Figure 5

Recovered bearing rollers showing signs of mechanical rather than heat damage

Both inboard and outboard bearings had suffered significant damage. The outboard bearing (closest to the wheel nut) showed that it had failed first and its cone thrust rib had been pushed flat by the forces of the failure, Figure 6, allowing the wheel to detach. The outboard bearing appeared to have suffered a cage trapping episode, where the cage became trapped between the rotating cup and the rollers, instantaneously locking the bearing and causing catastrophic failure. The inboard bearing suffered consequential, low temperature damage as the spinning wheel became unsupported by the severely damaged outboard bearing.

Figure 6

Outer bearing cone, showing deformed thrust rib

Inspection of other similar bearings

Two other wheel bearings from a mainwheel that had been recently removed from an aircraft for overhaul were examined. Both bearings were found to have cage clearance, due to cage wear, that made them unserviceable. One bearing showed evidence that the cage had just started to make contact with the cup raceway.

Two new bearings were taken from stores and examined; both showed near maximum allowable new manufacture cage clearance.

Wheel and bearing history

The last inspection of the inner and outer wheel bearings was in the operator's workshops in October 2010, when the wheel assembly was removed from service to allow a tyre change to be completed. The wheel assembly was refitted to the aircraft and had completed 570 landings before the bearing failure. The outer bearing was first fitted in June 2009 and the inner bearing in 2006.

In-service history of this wheel bearing design

These part number bearings are known by their manufacturer to be sensitive to increasing cage clearance. Proper inspection techniques are highlighted in their publication, 'Aircraft Landing Wheel Bearing Maintenance Manual', and in their training courses which emphasise the need to check for evidence of cage wear and cage-to-cup contact. The same part number bearings have been used extensively in other aircraft types over a long period of time without any significant in-service issues. There have been a limited number of other bearing failures on this aircraft type, but these have been attributed to either incorrect installation or the use of inappropriate grease.

Potential causes of the failure

The bearing manufacturer advised that the typical causes of a bearing cage becoming trapped in an aircraft wheel application are, listed roughly in order of probability in this instance:

- Loose or worn cage bearing returned to service
- Inadequate flying nut torque, incorrectly applied nut torque or loss of nut torque
- Heavy landings or rough terrain inducing radial shock-loads and cage wear
- Contamination or loss of bearing grease causing cage wear
- Excessive wheel shimmy due to worn linkages
- Brake judder or vibration causing cage wear

There was insufficient evidence to determine which, if any, of these potential causes initiated the failure.

Safety actions

Engineering

As a result of this event, several safety actions were initiated with the intention of preventing a recurrence.

The bearing manufacturer's representative has reiterated to its quality and production departments the need for the cage on these part number bearings to be 'close' to the low end of the manufacturing tolerance to ensure the maximum possible cage-to-cup clearance exists from new.

The wheel manufacturer has reviewed the bearing inspection section of the Component Maintenance Manual for the wheel to ensure that all the inspections recommended by the bearing manufacturer are included. They have also recommended to the aircraft manufacturer that the roller bearing and cage assembly is replaced at each tyre change.

The aircraft manufacturer has considered the wheel manufacturer's recommendation and notes that some operators already replace their wheel bearings on this basis. It also considers that proper bearing inspection and maintenance practices will ensure satisfactory bearing performance and they intend to reiterate these practices to their operators.

The operator, as a result of its internal investigation, is intending to take the following actions:

1. All engineers involved in the repair and overhaul of wheels and their associated wheel bearings will receive the bearing manufacturer's inspection requirements and techniques training.
2. The bearing manufacturer's Aircraft Landing Wheel Bearing Maintenance Manual will be available in their wheel and brake workshop as a reference document for the inspection process.
3. All new bearings received from suppliers will be fully inspected.

The operator is also considering the introduction of a fixed operating life for these bearings rather than the 'on-condition' basis used at present.

Operations

The operator has reminded flight crews of the need to pull the CVR/FDR circuit breakers following an incident to prevent the loss of data.

Analysis of operational issues

The commander, when performing the pre-flight inspection of the right main landing gear, had not noticed any abnormalities and given the nature of the bearing failure, it is unlikely that any would have been visible.

After ATC had notified them of the loss of the wheel, the crew took up a holding pattern at the Exeter NDB. This gave them a safe environment in which to analyse the problem. Having an engineer onboard, licensed on the aircraft type, was beneficial and his knowledge was used to good advantage.

The flight crew's incremental approach to solving the problem and effective Crew Resource Management (CRM) contributed to a safe outcome.

Conclusions

It is most likely that the outer wheel bearing suffered a trapped cage which caused it to fail catastrophically. Consequential damage deformed the outer bearing cone, allowing the inboard wheel of the right main landing gear to detach from its axle during landing gear retraction. It was not possible to determine the cause of the trapped cage.

ACCIDENT

Aircraft Type and Registration:	PA32-301FT, N116KY
No & Type of Engines:	1 Lycoming 10-540 SER piston engine
Year of Manufacture:	2004
Date & Time (UTC):	1 July 2011 at 0800 hrs
Location:	Gatwick Aviation Museum, Vallance By-Ways, Gatwick
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to left flap, right wing, propeller, engine and cowling
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	34 years
Commander's Flying Experience:	1,156 hours (of which 19 were on type) Last 90 days - 102 hours Last 28 days - 38 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed at Vallance By-Ways airstrip, failed to stop before the end of the runway, and collided with a truck and another aircraft parked as a museum exhibit.

History of the flight

The aircraft was on a private flight from Full Sutton Airfield, York to Vallance By-Ways airstrip, near Gatwick. The pilot contacted Gatwick Tower whose ATCO cleared him to enter the Gatwick zone for landing at Vallance By-Ways. The ATCO also gave the pilot headings to assist him in finding the strip. After three orbits, the pilot located the strip and commenced an approach in a westerly direction. The approach appeared to the pilot to be normal and the aircraft passed close to the tops of the trees on the approach. Shortly after touchdown, the pilot realised that the aircraft would not stop before the end of the strip and attempted to steer the aircraft left to avoid an Avro Shackleton parked at the end of the strip as a museum exhibit. The aircraft yawed to the left but skidded. Its right wing hit a truck, severing the wingtip, and the aircraft spun to the right and came to rest with its nose under the engine of a second Shackleton. The pilot shut down the aircraft and the occupants vacated without injury.

Airstrip information

Vallance By-Ways is a grass strip 600 m north of, and broadly parallel to, the main runway at Gatwick and

is part of an aviation museum. The strip is 465 m long with a row of trees at the eastern end, the tallest of which is 55 ft high. Several aircraft, including two Shackletons, are parked at the western end of the strip. The museum website showed an extract from a guidebook that contained details of the strip and shows the presence of trees 50 ft tall at the western end of the strip. However, the guidebook stated incorrectly that the strip is 553 m long.

Analysis

The Pilots Operating Handbook (POH) indicated an unfactored landing distance required (LDR), of 527 m, less than the published strip length of 553 m but greater than the actual strip length of 465 m. Aeronautical Information Circular (AIC) 127/2006 – *'Take-off, Climb and Landing Performance of Light Aeroplanes'* and Safety Sense Leaflet 7 – *'Aeroplane Performance'*, published by the CAA, recommend applying a safety factor of 1.43 to all landing distances and applying an additional safety factor of 1.15 for landings on dry grass. With these factors applied the LDR would have been 867 m, greater than both the published and actual strip length.

The LDR calculated using the POH assumes that the aircraft crosses the start of the landing strip at 50 ft aal. This was not possible when landing on the westerly runway due to the tall trees on the approach. Crossing the end of the strip higher than 50 ft would have increased the LDR.

Safety action taken

The museum has amended its website to reflect the actual strip length.

Conclusion

The pilot landed the aircraft on a strip that was shorter than both the published length and the unfactored LDR. Although the published strip length was greater than the LDR obtained from the POH, it was less than the LDR with recommended safety factors applied.

ACCIDENT

Aircraft Type and Registration:	Agusta A109A II, N2NR
No & Type of Engines:	2 Allison 250-C20 SER turboshaft engines
Year of Manufacture:	1986
Date & Time (UTC):	23 October 2010 at 1448 hrs
Location:	Shanlieve, Mourne Mountains, Northern Ireland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - 1 (Fatal) Passengers - 2 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	12,733 hours (of which 1,634 were on type) Last 90 days - 50 hours Last 28 days - 21 hours
Information Source:	AAIB Field Investigation

Synopsis

The helicopter was on a VFR flight from a private site near Londonderry, Northern Ireland, to Caernarfon Airport in Wales. Radar data showed that the aircraft was established on a direct track for Caernarfon, flying at an altitude of about 1,600 ft. As the helicopter approached Newry it turned onto an easterly heading and climbed to about 2,000 ft. Some 6.5 nm later the helicopter turned onto a south-easterly track towards Caernarfon Airport, followed by small track changes to the left and right. The groundspeed throughout the flight was about 150 kt. Hill walkers close to the accident site heard the helicopter impact the west face of Shanlieve. All three people onboard were fatally injured in the impact.

History of the flight

A co-owner of the helicopter, and a friend, were to attend a shoot on a private estate near Newtownstewart, County Tyrone. They departed in N2NR on 22 October 2010 from a private site near Bagshot, Surrey, routing through Ronaldsway Airport, Isle of Man, where the helicopter was refuelled before continuing on to St Angelo Airport (EGAB), Enniskillen, arriving at 1650 hrs. There was a delay with the refuelling at Ronaldsway and this delayed their arrival at St Angelo. For this reason it was decided to refuel at Caernarfon Airport (EGCK) instead of Ronaldsway on the return flight.

On the morning of the accident, the pilot arrived at St Angelo airport at about 0830 hrs. He went to the ATC

tower and faxed the General Aviation Report required for flights from Northern Ireland and also filed a VFR flight plan for the return flight to Bagshot via Caernarfon Airport. He also ensured that ground staff refuelled the helicopter's fuel tanks to full. This was recorded in the refuelling log as being complete at 1110 hrs. The pilot then carried out a daily inspection of the helicopter and was later seen in the café and flight planning areas, mainly reading a book. It was not possible to establish what meteorological information the pilot had obtained prior to the flight.

At about 1350 hrs the pilot was seen speaking on his mobile telephone and, shortly afterwards, informed the ground staff that he was departing. He contacted ATC and was passed the aerodrome QNH of 1005 mb and the QFE of 1000 mb. He started the helicopter, ground taxied to Runway 33 and departed to the northeast. He informed ATC that he was changing frequency but it could not be ascertained which frequency he changed to. A review of ATC tapes from other Air Traffic Service Units (ATSUs) did not identify any other unit being contacted. The helicopter arrived at the estate to pick up the two passengers, who seated themselves in the rear forward-facing seats. A guest, who went to the helicopter to see the passengers before they departed, took a photograph and noted "lots of paperwork" on the unoccupied left front seat. The pilot started the helicopter and witnesses estimated that it departed at about 1420 hrs.

The helicopter was first recorded on radar at 1425 hrs and was seen transiting to the south-east. The pilot was flying in Class G airspace and was not required to contact any of the available ATSUs, such as Belfast International or City airports. It is possible that he monitored the Belfast International approach frequency of 128.500 MHz. A replay of that frequency, covering the duration of the flight, revealed that on three occasions the Belfast controller passed the aerodrome QNH of 1006 mb to departing or arriving air traffic. There were, however, no transmissions specifying the Belfast Altimeter Setting Region (ASR) QNH of 1001 mb.

Radar data showed the helicopter maintaining a constant altitude of about 1,600 ft and a track of 130°, with a groundspeed of approximately 150 kt. With about 8 nm to run to Newry, the helicopter turned left onto a heading of 090° and climbed to 2,000 ft with a coincident reduction in airspeed to 130 kt, before it levelled off and accelerated back to 150 kt. It maintained this for a further 6.5 nm. This revised track would have taken the helicopter 2 nm north of the northern edge of the Mourne Mountains and the coastal town of Newcastle, County Down. However, after 6.5 nm the helicopter turned right to resume a track 130°. It maintained this for a further 3.5 nm before carrying out a series of minor heading changes to the left and right.

Three hill walkers on Castle Bog, approximately 0.75 nm from the accident site, were in fog and heard a helicopter pass overhead. One of them saw what he thought was the silhouette of the helicopter in, or possibly above, the cloud. A lone hill walker, also in cloud 0.8 nm north-north-west of the accident site and north of the helicopter track, also heard the helicopter but could not see it due to poor visibility. He and the other hill walkers heard an impact and, after reporting a possible accident to the police on mobile phones, commenced a search. Despite difficult terrain and 100 m visibility they located the still burning wreckage of the helicopter near the summit of Shanlieve. All those onboard had been fatally injured.

At about 1500 hrs a police helicopter was tasked to search for the missing helicopter. It departed Belfast International Airport at 1505 hrs and arrived in the area of Leitrim Lodge at 1521 hrs. Its pilot described the weather

during the flight as mainly broken cloud at about 2,000 ft with good visibility below the cloud with occasional light rain in showers. He flew at 1,500 ft, on the QNH of 1007 mb, down the road towards Rosstrevor and attempted to fly up the valleys towards the higher slopes of the mountains. However, he was prevented from doing so by cloud "tumbling down the valleys" and was only able to reach the northern end of Castle Bog, and climb to a height of about 1,400 ft, approximately 1,500 metres from, and some 500 ft below, the accident site.

Witness evidence of observed weather

As noted above, there were four people walking in the general area of the accident site, a group of three and one individual.

The lone individual planned to walk from Leitrim Lodge to Rocky Mountain, Hen Mountain, Cock Mountain, Slievemoughanmore, Eagle Mountain, Shanlieve, Pierces Castle returning to Leitrim Lodge. When he departed Leitrim Lodge at 0945 hrs the weather was "fine, dry and sunny". These conditions continued as he climbed the summits of Rocky Mountain and Hen Mountain. On his arrival on the summit of Cock Mountain, the cloud had moved in quite quickly. He took a series of photographs at 1138 hrs, two of which are shown at Figures 1 and 2.

From the photographs, the cloudbase at that time was later estimated at 1,600 ft to 1,700 ft. As he continued, the cloudbase descended, with visibility in the cloud reduced to approximately 150 metres. He descended from Slievemoughanmore into the saddle of Windy Gap (elevation 1,377 ft) and could not recall being clear of the cloud at that height. He arrived at the summit of Shanlieve with the visibility still about 150 metres and at about 1415 hrs he descended towards Pierces Castle. He was approximately 300 metres north of Pierces Castle when he heard a helicopter pass overhead, followed by the sound of an impact. He did not see the helicopter but notified the police using his mobile telephone and commenced a search. He met up with the three other walkers, who had been on Castle Bog and had also heard the helicopter pass overhead. They eventually located the accident site in the cloud.

Figure 1

View from Cock Mountain, looking southeast towards the coast at 1138 hrs

Figure 2

View from Cock Mountain at 1138 hrs, looking west towards the direction from which N2NR approached at about 1445 hrs

Meteorology

An Aftercast provided by the Met Office following the accident was produced from surface charts, satellite imagery, and TAF and METAR information for Belfast International and Belfast City airports.

The Aftercast showed an area of low pressure located over the North Sea, with an associated occluded front lying from the Humber through Manchester to Donegal at 1200 hrs, moving south with an unstable north-easterly flow to the rear of the front. By 1800 hrs this front had moved south and was along a line from Norwich to Luton to Cardigan Bay.

As a result, the showery occluded front had passed over the Mourne Mountains from north to south at about 1300 hrs, introducing a cloudy moderately unstable north-easterly flow at the time of the accident at 1450 hrs. Also a trough of low pressure was very close to the Mourne Mountains and some light to moderate rain showers were evident on the radar imagery.

Broken or overcast amounts of cloud were in evidence over the area with a base of 1,200 ft to 2,500 ft amsl and likely tops of between 5,000 and 8,000 ft. Light to moderate showers of rain were in the locality. The freezing level was estimated at between 3,000 and 4,000 ft with icing a hazard within the cloud layers and there was a risk of hill fog.

The surface wind would have been between 010°/5 to 10 kt, with the 2,000 ft wind estimated at 030°/15 kt. A representative temperature at the surface would have been +7°C, with a dewpoint of +6°C.

The weather at Belfast International Airport at 1450 hrs was surface wind 040°/09 kt, visibility 10 km, cloud FEW at 1,300 ft and BKN at 4,400 ft, temperature +7°C, dewpoint +5°C and the QNH 1006 mb. The elevation of the airport is 268 ft amsl.

The weather at Belfast City Airport at 1450 hrs was 010°/10 kt, visibility 10 km with showers in the vicinity, cloud FEW at 1,200 ft, SCT 1,900 ft and BKN at 2,500 ft, temperature +8°C, dewpoint +5°C and QNH 1006 mb. The airport elevation is 15 ft amsl.

The Belfast Regional Pressure Setting at the time of the accident was 1001 mb.

Recorded data

Two sources of recorded data giving positional information for the helicopter during the accident flight were available for the investigation.

Radar data

Radar data, recorded every five seconds from Belfast's secondary surveillance radar (SSR), recorded the helicopter's position and time, and Mode C pressure altitude (with ±50ft resolution).

GPS-based 'Spidertracks' tracking system

The second source of data was from the GPS-based Spidertracks aircraft locator system carried on the helicopter. This transmitted position, altitude and groundspeed information to a ground station every 60 seconds. The combined 'Spidertracks' and radar tracks of the helicopter are shown at Figure 3.

The altitude, groundspeed and track data are shown in Figure 4.

The Spidertracks data started at 1420:30 hrs with the helicopter hovering shortly before takeoff and ended at 1446:30 hrs just as the helicopter reached the Mourne Mountains. The radar data started at 1425 hrs as the

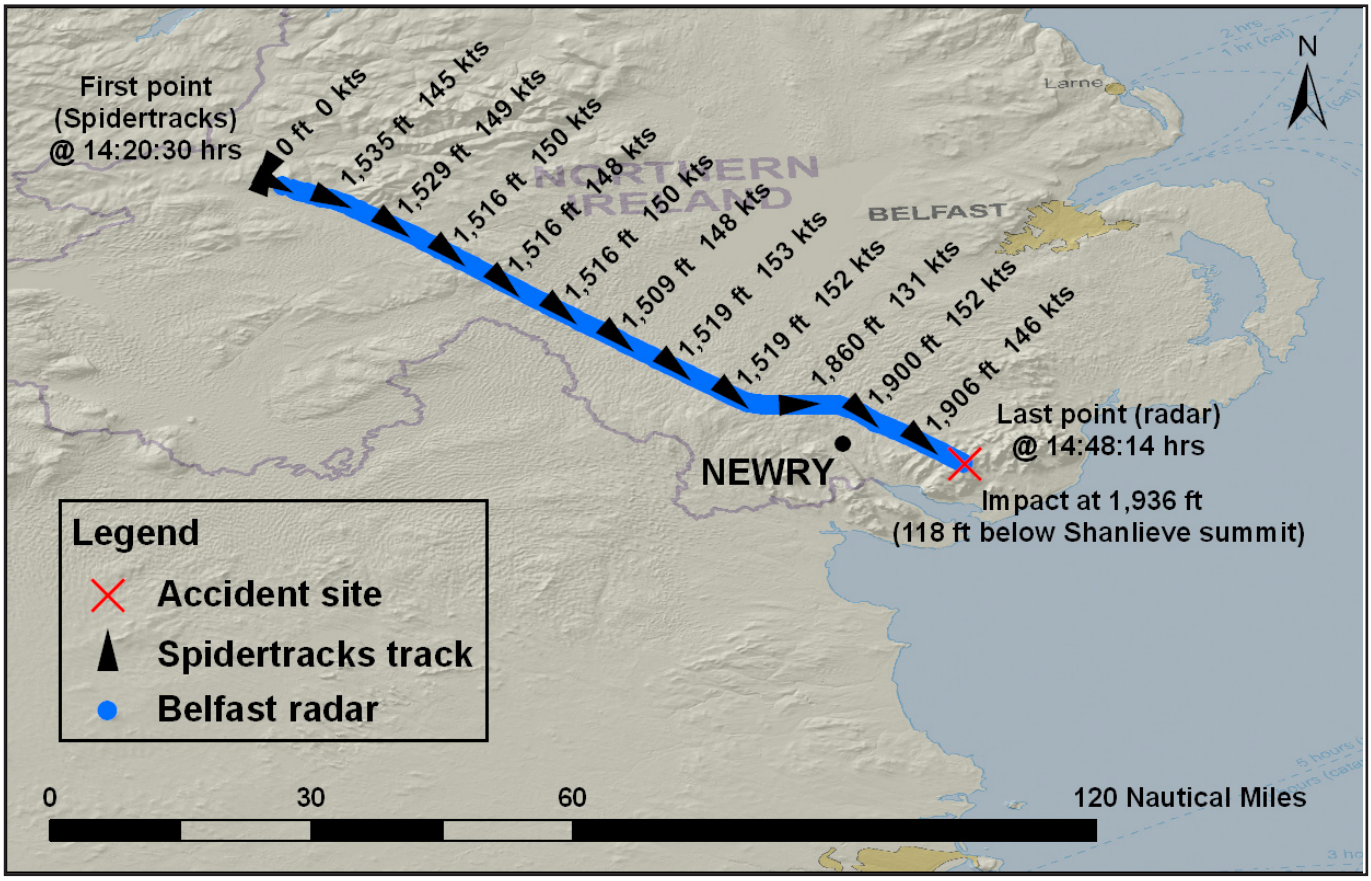

Figure 3

Accident track of N2NR from radar and GPS sources
(showing height amsl & groundspeed, at two-minute intervals)

helicopter climbed through 1,400ft (based on 1007mb) and ended at 1448:14 hrs, just before the impact into Shanlieve.

The initial track, towards Newry, was flown at 1,630 ft[1] (based on 1007 mb) with a groundspeed of about 150 kt. At 1440:45 hrs, approximately 8 nm from Newry, the helicopter started a turn left through 40° onto an easterly track. The helicopter also climbed to 2,030 ft (based on 1007 mb) during which the groundspeed reduced to 130 kt before returning to 150 kt after the level off. The helicopter maintained this track for about 6.5 nm before turning right back onto a track of 130° (ie parallel to the initial track). Apart from small deviations to the left and right, the helicopter remained on this track, at 2,030 ft (based on 1007 mb) and 150 kt groundspeed until impact, just below the summit of Shanlieve. The final portion of the track is illustrated in Figure 5, superimposed onto a Google representation of the local terrain.

Footnote

[1] The GPS altitude (amsl), as recorded by the Spidertracks system, was about 110 ft less than the pressure altitude corrected to 1007 mb throughout the flight.

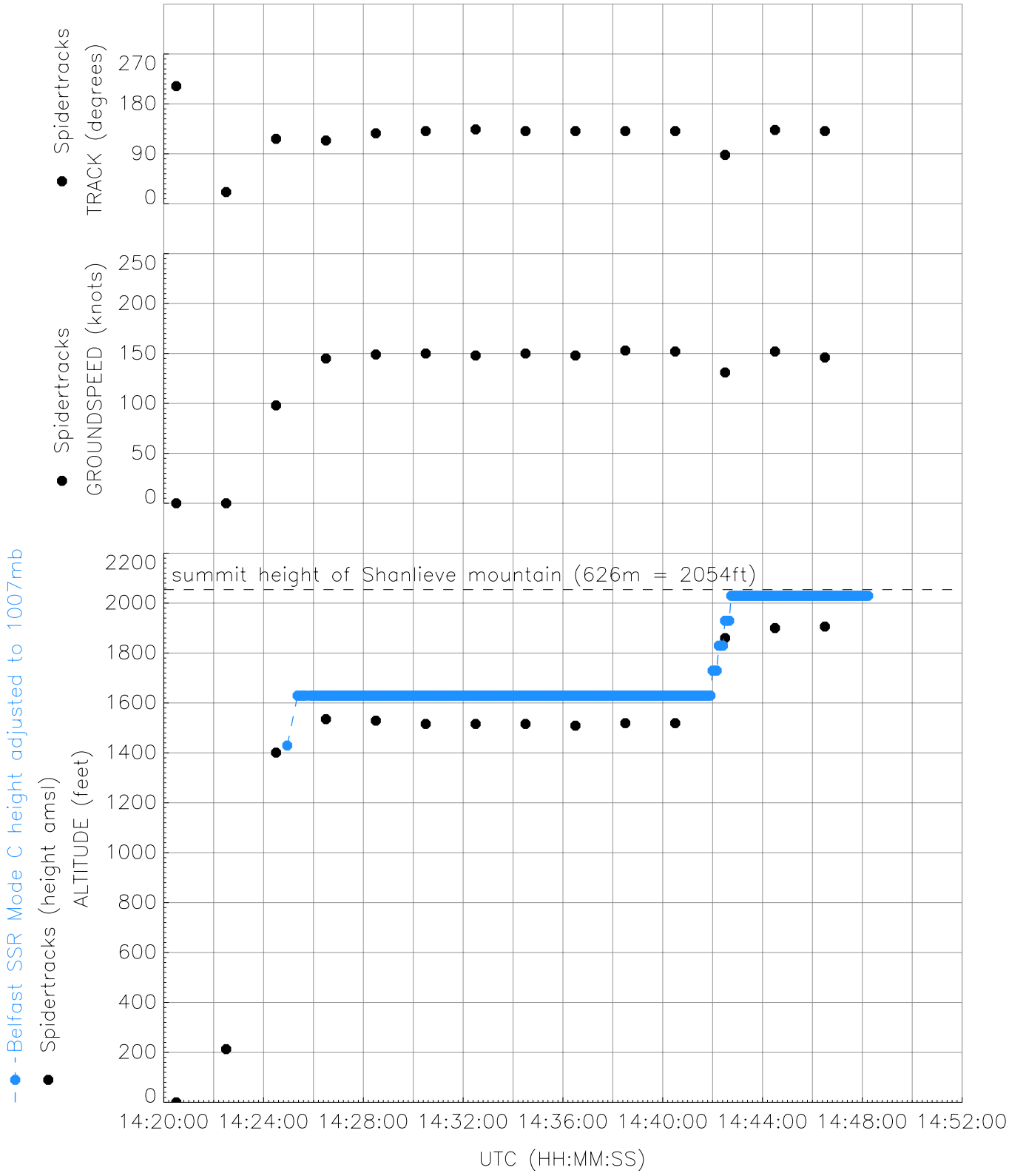

Figure 4

Recorded data from the Spidertracks GPS during the accident flight, with Mode C pressure altitude, corrected to 1007mb

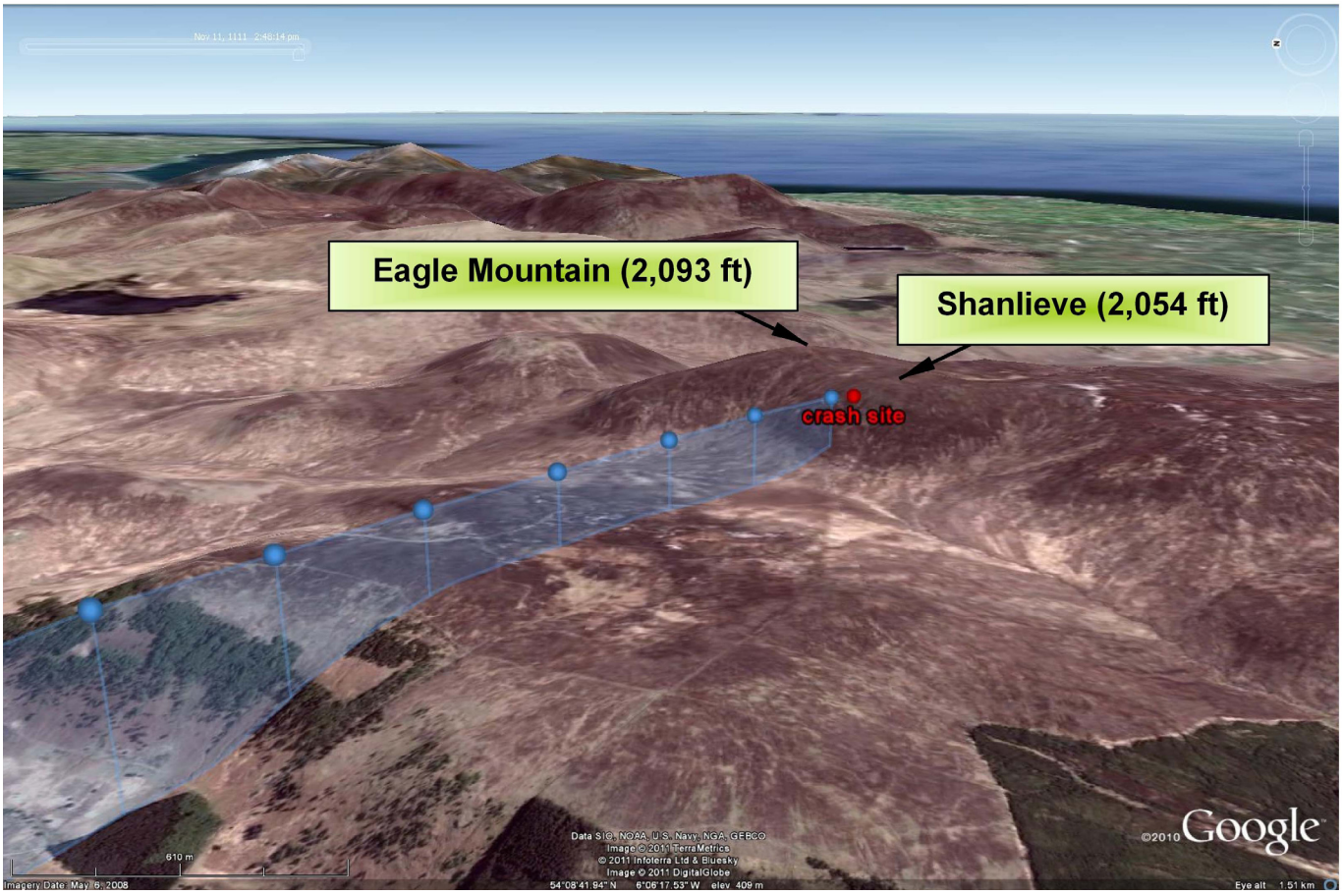

Figure 5

Final portion of the accident track, based on radar data, and crash site

Enhanced Ground Proximity Warning System (EGPWS)

The helicopter was equipped with a Honeywell Mk XXI Enhanced Ground Proximity Warning System (EGPWS) that sustained sufficient damage during the crash impact to require assistance by the manufacturer to download the data stored in its internal memory[2]. The download was conducted on 8 November 2010 in the United States, during which it was found that the unit had not been powered-up since the unit had been reconfigured with a new software release and terrain database. From the maintenance records for the helicopter, this reconfiguring probably occurred during October and November 2009, when this particular replacement Mk XXI unit was installed. The associated KMD-540 multifunction display was too damaged to determine whether it was switched on or off.

Pilot information

The pilot started flying training in the Army in 1970 and graduated as a helicopter pilot in February 1971. During his Army service he was a squadron pilot and became a Qualified Helicopter Instructor (QHI). He transferred to the Royal Air Force (RAF) in September 1985 and became a squadron QHI on the Puma

Footnote

[2] This unit was capable of providing aural 'terrain' warnings to the crew and also provided data to a Bendix/King KAC-502 EGPWS module that could generate terrain images and visual warnings to the Bendix/King KMD-540 multifunction display (MFD) that was also installed on the helicopter.

helicopter. He served in Northern Ireland in both the Army and the RAF and was familiar with the area of the Mourne Mountains. He left the RAF in January 1999 and flew as a commercial pilot, before rejoining the RAF for two years, leaving in January 2006. His last flight in Northern Ireland had been in April 2004 and after leaving the RAF he flew commercially, both as an instructor and charter pilot.

Licence privileges

The pilot held a UK CAA ATPL(H) which permitted him to operate the US Federal Aviation Authority (FAA) registered helicopter within United Kingdom airspace. This is covered in Code of Federal Regulations, CFR 14, Part 61.3 (1) which states:

> ***'61.3 Requirement for certificates, ratings, and authorisations.***
>
> *(a) Pilot certificate. No person may serve as a required pilot flight crew member of a civil aircraft of the United States, unless that person-*
>
> *(1) Has a pilot certificate or special purpose pilot authorization issued under this part in that person's physical possession or readily accessible in the aircraft when exercising the privileges of that pilot certificate or authorisation. However, when the aircraft is operated within a foreign country, a pilot license issued by that country may be used.'*

The pilot's licence and log book were normally in his possession but were not recovered at the accident site, probably due to the intense post-impact fire. A review of the CAA records confirmed that the pilot's licence, instrument rating and medical certificate were in date. A check of the technical logs of helicopters recently flown by the pilot, and a summary of his hours provided to a client, were used to establish the flying hours stated in this report.

Medical and pathological information

A post-mortem examination carried out on the pilot, and a review of his medical history, did not identify any pre-existing disease or condition which might have contributed to the accident. Toxicological examination showed no evidence of drugs or alcohol.

Aids to navigation

The helicopter was approved for flight under the Instrument Flight Rules (IFR) and was equipped with avionics capable of displaying VOR, DME and NDB information. In addition, there were two moving map displays: a Bendix/King Skymap IIIC and a Garmin GPS Map 695. The Garmin GNS 430 navigation/communication control heads were also capable of displaying GPS-derived navigation information.

A CAA Northern England and Northern Ireland, ICAO air navigation chart scale 1:500 000, Edition 33, was also onboard the helicopter and was recovered from the accident site; the relevant area of the pilot's chart is shown at Figure 6. On this chart, the Maximum Elevation Figure (MEF) is shown in quadrangles bounded by graticule lines for every half-degree of latitude and longitude. They give the elevation of the highest known obstacle within that graticule square and are calculated using the highest figure from either:

- The highest obstacle, rounded up to the next 100 ft, or
- The highest ground level plus 300 ft, rounded up to the next 100 ft.

MEF symbology shows elevation in thousands of feet, represented by a large figure and hundreds of feet represented by a smaller, superscript figure. The MEF for the western area of the Mourne Mountains was 2,700 ft, increasing to 3,100 ft to the east. In this case 1,000 ft is added to the MEF to obtain the Minimum Off-Route Altitude (MORA).

From discussions with people who knew and flew with the pilot, his normal method of navigation when operating in visual conditions was to use the chart as his primary means of navigation and the Skymap IIIC as an additional aid.

He generally used the Garmin GNS 430s primarily as NAV/COM control heads, but also for displaying navigation information. No evidence was identified to indicate that the Jeppesen database installed into the Garmin GNS 430s had been updated since the systems were installed in 2003. The database supplier confirmed that the database at the time of installation included a region of South Armagh designated as a Prohibited Area, EG P436. Therefore, if the database had not been updated this Prohibited Area would have been included in the depicted airspace. At the time of installation the GNS 430 was not capable of displaying terrain information.

The Skymap was located on the instrument glare shield in front of the pilot, convenient for use as an additional aid during visual flight. The Garmin GPS Map 695 had been installed on a temporary mounting at the bottom left of the left windscreen for the co-owner to evaluate and was not accessible from the commander's seat, on the right side.

Figure 6

The pilot's 1:500 000 map showing terrain colouring and spot heights with Maximum Elevation Figures

The database operating in the Skymap IIIC was Version 1.22 software containing the Atlantic International Region with a database cycle dated July 2009. The South Armagh Prohibited Area (EG P436) was cancelled in 2007, was not included in the 2009 database and was therefore not displayed on the Skymap IIIC. It was also not depicted on the 1:500 000 map carried onboard the helicopter, although it was shown on a chart, of an earlier edition, displayed in the flight planning room at St Angelo. The pilot's chart, recovered from the wreckage, did not have any route or track lines drawn on it and its condition, when recovered from the accident site, prevented a positive determination of how the chart had been folded.

Skymap IIIC display

The manufacturer of the Skymap IIIC assisted the investigation by demonstrating the use and presentation provided by the display. The display in N2NR was set up in the landscape mode and used a helicopter icon to represent the position of the helicopter. The map and icon were orientated in the 12 o'clock position which indicated the direction of flight. The projected track of the aircraft (example, Figure 7) is shown extending from the helicopter icon with terrain, towns and airspace depicted on the map using lines, icons and colour coding. The default scale was set at 8 nm and this could be adjusted in set stages reducing or increasing the scale of the map. There are various display modes but the one normally used for navigation was the map mode with the TOPO (topographical) data displayed; the colour coding is based on terrain elevation AMSL and is shown at Figure 8.

The information displayed on the Skymap IIIC system is prioritised to show aviation information, such as

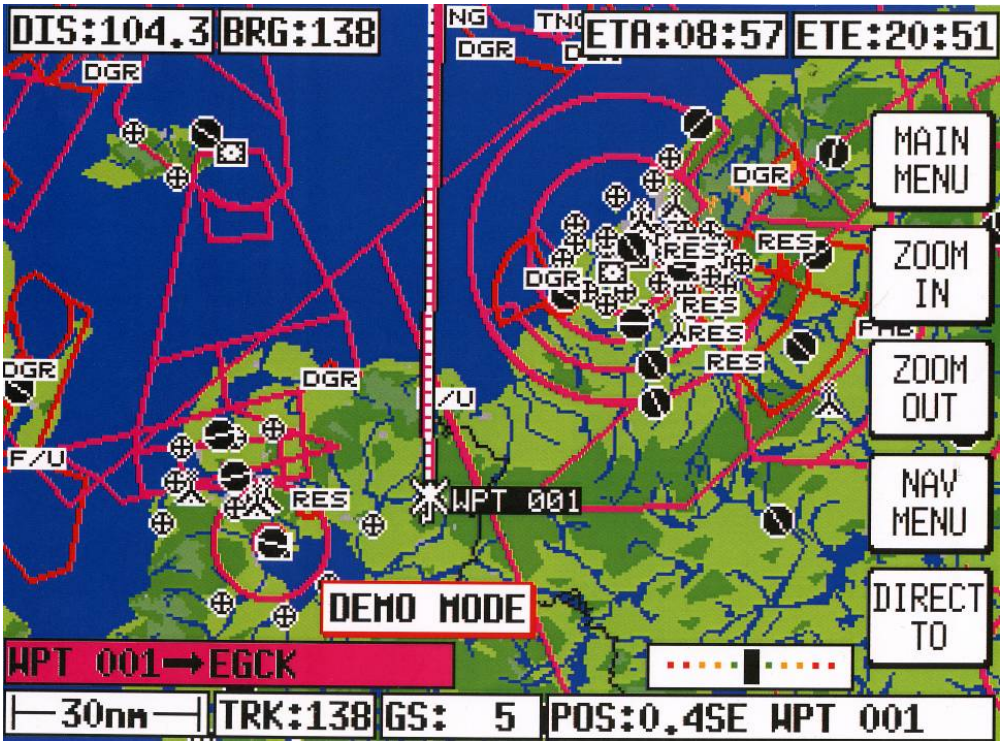

Figure 7

The screen print of the Skymap IIIC on 30 nm range, showing a projected track immediately prior to the left turn onto an easterly heading

Figure 8

The Skymap IIIC colour coding for the terrain elevations

airspace boundaries and airfields. The Skymap IIIC is a supplemental aid to navigation, and the data storage in the system is limited, so the terrain mapping is a representation of only the main features and, for capacity reasons, the terrain over 2,000 ft is not modelled in the database.

The two 'screen prints', Figures 7 and 9, are examples of the information provided. Figure 7 shows the helicopter at the point of the first left turn with a 30 nm scale set and a direct track to Caernarfon selected. Figure 9 shows the position of the helicopter immediately prior to impact with an 8 nm scale selected. It should be noted from both screen prints that the area of the Mourne Mountains is depicted using two shades of green. The shaded areas do not contain any spot heights, or the brown colour representing the terrain between 2,000 ft and 3,000 ft, which is shown on the CAA Northern England and Northern Ireland chart. It is not known which page the pilot had selected.

It is not known which scale or scales the pilot was using during the flight but Figure 7 shows that, had the helicopter continued on the direct track towards Caernarfon, it would have transited Irish airspace. In order to remain clear of Irish airspace, the pilot would have had to route to Newcastle, County Down, from where a direct track to Caernarfon would have remained in UK airspace.

The Skymap IIIC cannot be coupled to the helicopter's autoflight system. Any track-following is achieved by changing the aircraft heading, either using the helicopter flying controls directly or the 'heading select' mode of

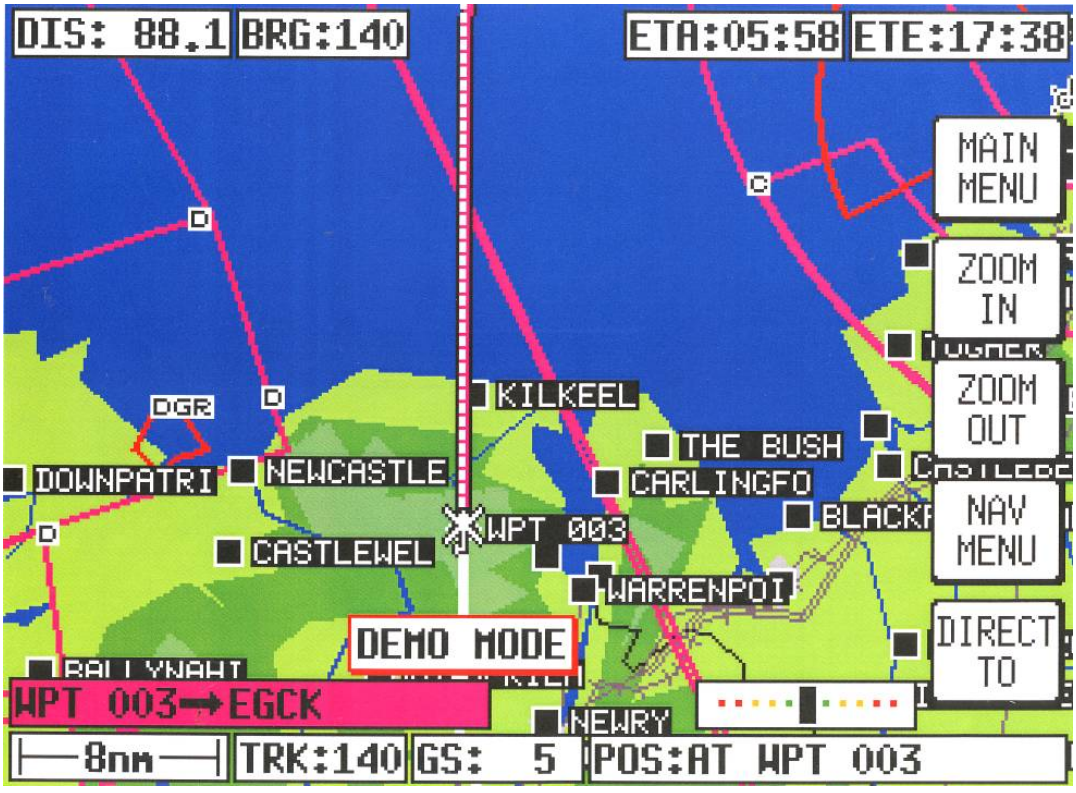

Figure 9

Skymap IIIC screen print on 8 nm range, showing no terrain above 2,000 ft, immediately prior to the impact with Shanlieve

the autopilot (AP). The pilot normally flew the helicopter in the cruise using the AP in the 'heading' and 'altitude' modes.

The Pilot Guide and Operating Manual for the Skymap system includes a Warning:

> *'Whenever you are using the unit for navigation in the air you should treat it as a **supplemental navigation system.** You should always carefully compare indications from your Bendix/King equipment with the information available from all other navigation sources including NDBs, VORs, DMEs, visual sightings, charts, etc. For safety, any discrepancies observed should be resolved immediately.'*

It also adds:

> *'This equipment is not a replacement for your chart. It is intended as an **aid to VFR navigation only.'***

Prohibited Area EG P436

Prohibited Area EG P436 was removed for the 2008 air navigation chart and was not included in the Skymap IIIC database, or on the pilot's chart. It was, however, displayed in the flight planning area at St Angelo airport and, as noted above, was probably included in each of the Garmin GNS 430 navigation displays. Figure 10, below, plots the aircraft track in relation to EG P436 and the airspace boundaries.

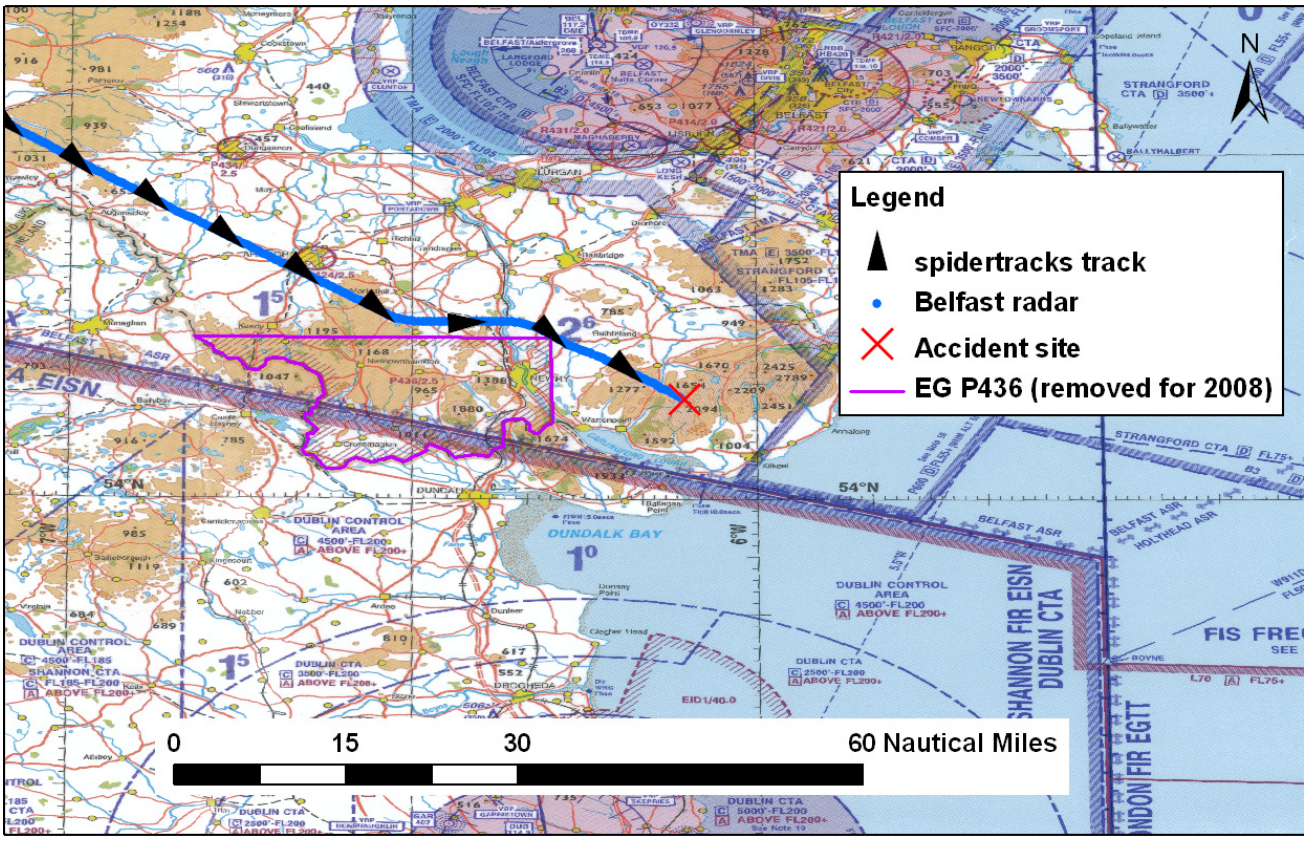

Figure 10

The former Prohibited Area EG P436 and the Dublin CTA boundary

Engineering investigation

The aircraft

N2NR was an Agusta A109A II helicopter which had received a number of modifications since delivered new, mainly a general upgrade to the avionics, including three GPS-based navigation systems and the installation of an Enhanced Ground Proximity Warning System (EGPWS), fitted by a previous owner. It was equipped from new with an autopilot. Examination of the technical records indicated that the aircraft had been maintained to the appropriate schedule.

Crash site

The site was first visited by the AAIB the day after the accident. The helicopter had almost completely disintegrated on impact with Shanlieve mountain at 590 metres (1,936 ft) amsl on a rocky incline of roughly 38° slope: debris had been thrown about 60 metres up and across the slope. The tailboom and tail rotor had detached in one piece and was found about 32 metres from the point of impact whilst the engines, main rotor gearbox and rotor head were located a further 20 metres up the slope. The engines and gearbox were badly affected by a localised fire and it was evident that there had been a fireball on impact through which many parts had passed, some continuing to burn after coming to rest.

The initial impact area contained the nose landing gear wheel and fork and the remains of some avionic boxes. A substantial rock jutted out from the slope just before the impact area and this rock bore no signs of contact; from this it was concluded that the helicopter must have been flying level, or possibly in a slight descent, for contact with the rock to be avoided. The degree of disruption of the cockpit and cabin indicated that the aircraft had been flying at high speed. No main rotor blade slashes could be positively identified due to the rocky nature of the terrain and the fact that some of the rocks had been dislodged by impact, but the disintegration of all four blades indicated that the main rotor had been turning at speed.

Further examination

Due to the weather and terrain, recovery of the wreckage was protracted but it was eventually despatched to the AAIB facility at Farnborough for further examination. All the debris was examined in conjunction with two representatives of the helicopter manufacturer and no anomalies were discovered, albeit the extreme disruption of the airframe and flying controls rendered a fully satisfactory inspection impossible. The following observations were, however, made during the course of the examination.

An initial subjective assessment of the disruption suggested that the helicopter had been travelling at a high groundspeed of approximately 150 kt. This speed was confirmed when the radar and Spidertrack information were processed.

The EGPWS AUD switch was found in the OFF position. Since it is necessary to pull the toggle before the switch can be moved from its detent, this is considered a reliable indication of pre-impact selection. The damage to the Skymap IIIC was such that it could not be positively determined that it was switched on at the time of the accident.

A barometric altimeter subscale mechanism was recovered (it is unclear which altimeter it was from). This suggested that the setting had been 1007 mb ±1 mb.

The engines were given an initial appraisal by a representative of the engine manufacturer and then

despatched to an approved overhaul shop for strip examination in the presence of the AAIB and a further representative from the manufacturer. Evidence of rotation was found on both engines and no pre-impact mechanical failures were discovered. It was, however, noted that the first stage turbine nozzle guide vanes on both engines were in poor condition, possibly due to 'hot' starts at some time in their history (the engines were those which were delivered with the aircraft when new). This would not have caused a failure of either engine but would certainly have required replacement when the hot sections were dismantled for replacement of the gas generator turbine wheels, which was scheduled to take place in another 125 flying hours.

Flight trial

During this investigation, the final track of the accident flight was flown using a Sikorsky S-76C helicopter. The flight was conducted with a visibility in excess of 10 km and cloud overcast at about 3,000 ft with patches of light rain. The peaks and ridges of the Mourne Mountains were all clearly visible. The purpose of the flight was to understand the likely view available to the pilot of N2NR.

When approaching the mountains from the northwest (Figures 11 and 12), the ground rises up in two stages. The first stage is from the Shankys river valley to the summits of Altataggart mountain (1,377 ft) and Tievedockaragh (1,551 ft). At the top is the relatively level area of Castle Bog (1,410 ft). The second stage is the steeply rising ground to the ridge formed by Eagle Mountain (2,093 ft) and Shanlieve (2,054 ft). At the northern end of the ridge, which was to the left in the direction of flight, the saddle of Windy Gap has its lowest point at 1,377 ft before rising up to the summit of Slievemoughanmore (1,833 ft). Figure 11 shows the terrain described taken from a distance of 3 nm and an altitude of 2,000 ft amsl with the relevant stages of rising ground annotated.

At this range, and with the rising ground leading up to Castle Bog and the upper slopes and ridge of Shanlieve visible, the Northern England and Northern Ireland chart (Figure 6) can be related to the terrain ahead. This shows a spot height of 1,277 ft, rising initially to 2,094 ft and 2,209 ft on the projected track. With the upper heights of the terrain obscured by cloud, from and including Castle Bog, use of the chart becomes more difficult. As the distance to Shanlieve reduces, and the helicopter passes over the Altataggart mountain area as shown in Figure 11, the Shanlieve ridge becomes the dominant feature (Figure 12). From 2,000 ft, the area of Castle Bog is some 600 ft below and, providing the helicopter position is accurately known and the spot heights have been checked, the pilot would be aware that there is higher ground still ahead.

Spot heights were not displayed on the Skymap and the green colour coding would not have indicated that there was ground above 2,000 ft. If the spot heights on the projected track of the helicopter were not noted, and the Skymap were used for navigation, then with the upper slopes and Castle Bog obscured it could have been possible for the pilot to believe that he had overflown the high ground.

The hill walker witnesses were in cloud and it is not known how extensive the cloud cover was or whether any of the upper slopes or ridge were visible to the pilot; there may have been layers of cloud producing a false impression of the upper limits of the terrain. Whilst the terrain was clearly visible during the flight trial, if the upper slopes were obscured by cloud and the height of the terrain was known, it would have been apparent that it would not be possible to continue on the final

Figure 11

The first and second stages of rising ground, seen from a distance of 3 nm in the direction of flight

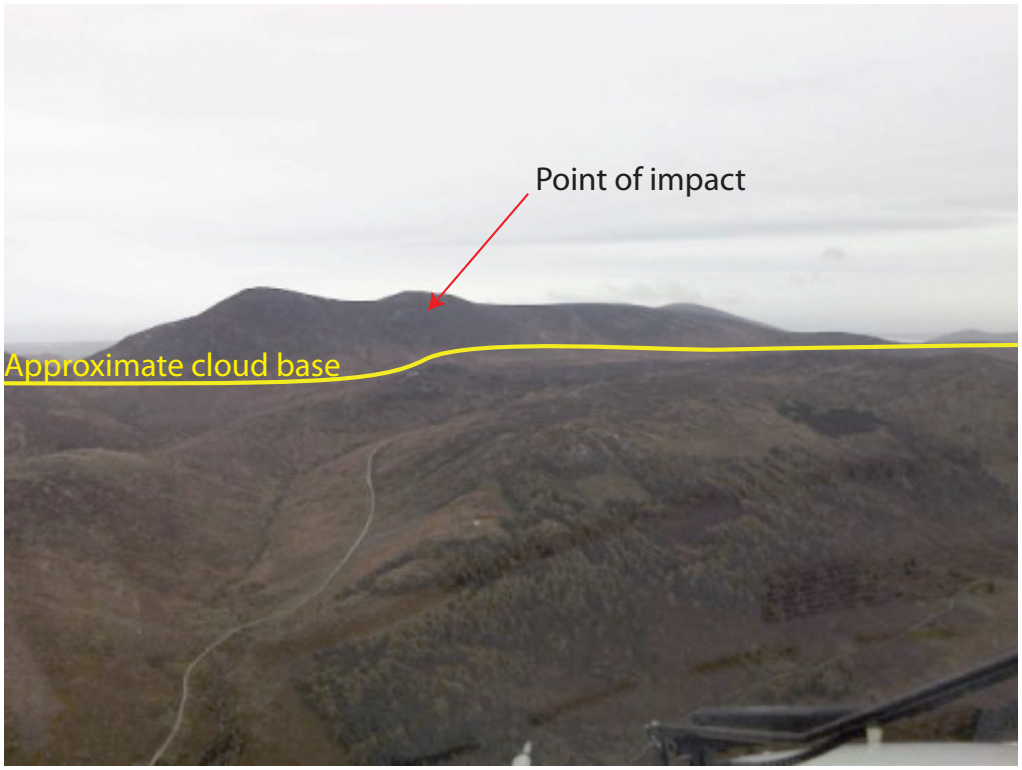

Figure 12

The Shanlieve ridge, showing the point of impact and the approximate cloudbase described by the witnesses

heading. An alternative route around the mountains would have been necessary.

The Sikorsky S-76C used for the flight trial was equipped with an EGPWS similar to that in N2NR. During the trial the EGPWS provided accurate and compelling warnings during the approach to Shanlieve.

Analysis

General

The pilot was properly licensed and qualified to operate the helicopter under VFR and IFR providing he remained within UK airspace.

Evidence of flight path

The helicopter was not fitted with a CVR or FDR and therefore no evidence of the activity in the helicopter, or onboard recorded flight data parameters, was available to the investigation. The flight path evidence was derived from the radar data and information available from the owner's onboard Spidertracks system. The evidence of weather conditions in the Mourne Mountains close to the accident site was based on the Met Office aftercast and the evidence provided by the four hill walkers in the area at the time of the accident. The photographs taken by one of them clearly showed the weather conditions some three hours prior to the accident, but these had changed significantly by the time of the accident, and the police helicopter pilot who attended the site provided a concise description of the weather some 30 minutes after the event. He had been able to transit along his route VFR, encountering some light rain but with good visibility and a cloud base at about 2,000 ft until he reached the mountains.

Pre-flight activity

The pilot had submitted the required General Aviation Report and a VFR flight plan from St Angelo (EGAB) to Caernarfon (EGCK) with the routing given as direct. It could not be established what flight planning the pilot had carried out, or what weather briefing he had received, but a computer terminal was available in the flight planning area with a link to the Met Office website. From the information provided in the Met Office aftercast, the weather was suitable for the planned flight under VFR, subject to routing.

The accident flight - track

The initial track of the helicopter was direct from the private estate to Caernarfon. This routing would have taken the helicopter into Irish airspace which was not permitted under the FAA regulations. The initial left turn took the helicopter towards Newcastle, County Down, from where a direct track to Caernarfon was possible remaining clear of Irish airspace and it climbed from 1,600 ft to 2,000 ft. The helicopter then turned right to resume the direct track for Caernarfon but, again, this routing would have infringed Irish airspace. The investigation plotted the track and turns in relation to the cancelled Prohibited Area P436 (Figure 10) and the left turn took the helicopter along the northern boundary, with the right turn resuming the Caernarfon track as the eastern edge of P436 was cleared.

This Prohibited Area did not appear either on the Northern England and Northern Ireland CAA chart or the Skymap presentation but was marked on the chart in the flight planning area at St Angelo and was probably in the Garmin GNS 430s. The pilot was likely to have been aware of it from his earlier Service flying in Northern Ireland. If the Jeppesen database in the Garmin GNS 430 had not been updated Prohibited Area P436 would have been displayed, without terrrain information, and the pilot may have manoeuvred the helicopter around it. It is also possible that the turns were to route around weather.

The accident flight - altitude

Whilst the pilot was experienced and qualified for IFR flight and the helicopter was equipped for IFR operation, the freezing level was given in the aftercast as between 3,000 ft and 4,000 ft *'with airframe icing a hazard in the cloud*.' The pilot's Minimum Off-Route Altitude (MORA) in the area of the Mourne Mountains was 3,700 ft, increasing to 4,100 ft on the track being flown, which would have placed the helicopter in icing conditions without an airframe icing clearance. Had he been using the chart, as opposed to the Skymap IIIC or Garmin GNS 430, the height of the ground ahead would have been clearly apparent, as marked, including the MEF on which to base the MORA. With cloud either fully or partially obscuring the high ground, the need to remain in visual contact with the surface at a cruising altitude of 2,000 ft would have been evident and paramount.

If the Skymap IIIC or Garmin GNS 430 was being used, there would have been no spot heights or sector heights indicated and, with the two shades of green displayed on the Skymap, the pilot could have been led to believe that the highest ground ahead was between 1,000 ft and 2,000 ft.

The accident flight – visual conditions

The groundspeed derived from the radar data indicated a steady cruising speed of about 150 kt, which only reduced to 130 kt during the climb. There was no reduction in speed up to the point of impact, which suggests that the pilot was content with the visibility ahead and that he was in VMC, or that he believed he had cleared the high ground. It is unlikely that a pilot of his experience would deliberately fly in IMC at 2,000 ft in an area of high ground, which might be up to 2,000 ft and with spot heights exceeding that.

If the helicopter was flying between layers of cloud, the pilot's visual picture may have been such that, having passed over the first stage of rising ground, he believed that he had already passed over the highest terrain and there was no high ground ahead. This possible scenario may have been combined with distracting activity within the helicopter such as refolding the chart or looking up information in a document, believing the way ahead was clear. He may also have been focussed on avoiding the Prohibited Area and unaware of the high ground ahead.

Although there was no evidence of any pre-existing disease or condition that may have contributed to the accident, subtle incapacitation of the pilot could not be entirely ruled out. The fact that shortly before impact the helicopter was making small track changes to the left and right suggests the pilot was not totally incapacitated.

The helicopter was equipped with an EGPWS but it had not been in use at least since the replacement unit was fitted in 2009. An EGPWS has significant safety benefits when operating under Instrument Meteorological Conditions (IMC), particularly overland. However, the EGPWS is not a requirement for helicopter operation and the alerts it provides in VMC can become considered as 'nuisance' alerts, as the system will frequently initiate "TERRAIN" alerts due to the proximity of ground which is already visible to the pilot. For this reason the EGPWS may be selected OFF and examination of the data by the manufacturer showed that the system in N2NR had not been powered up since the particular unit had been installed in late 2009. Had the system been in use on the accident flight, the presence of the high ground ahead of the helicopter should have initiated a "TERRAIN" alert activated by the Shanlieve feature.

Conclusion

The accident occurred when the helicopter flew at a near constant height, heading and groundspeed into the western slope of Shanlieve. No technical fault was identified in the examination of the wreckage, but given the extreme disruption of the airframe and flying controls, a full inspection was not possible and therefore a technical fault cannot be completely ruled out. The helicopter impacted the terrain some 100 ft below the summit height of 2,054 ft.

Without clearer evidence of the pilot's actions or intentions, no conclusive causal factors for the accident could be established. However, as possible contributory factors, it is likely that the upper slopes of the ridge were obscured by cloud and some combination of visual or distracting factors led the pilot to consider that he was clear of terrain. Whilst there was no evidence of any pre-existing condition or disease, subtle pilot incapacitation could not be ruled out.

ACCIDENT

Aircraft Type and Registration:	Aero AT-3 R100, G-SKAZ
No & Type of Engines:	1 Rotax 912-S2 piston engine
Year of Manufacture:	2010
Date & Time (UTC):	3 June 2011 at 1257 hrs
Location:	Denham Airfield, Buckinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to wings, fuselage, landing gear and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	117 hours (of which 33 were on type) Last 90 days - 15 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft bounced while landing on Runway 06 at Denham, in gusty conditions. The pilot elected to go around from the bounce, selecting full power. During the bounce the aircraft had developed a left wing low attitude and the pilot believes that, due to his attempt to recover from the developing left roll with aileron, he was slow applying rudder to counteract the increased torque from the engine. The torque resulted in the aircraft yawing left, with an increasing left roll, from which the pilot was unable to recover, despite full right aileron. The left wing touched the ground and the aircraft cartwheeled.

There was damage to both wings, the fuselage, the landing gear, propeller and canopy. However, there was no fire and the pilot was uninjured.

ACCIDENT

Aircraft Type and Registration:	Beagle B121 Series 1 Pup, G-AXPB
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	1969
Date & Time (UTC):	3 July 2011 at 1400 hrs
Location:	Near North Weald Airfield, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Nose landing gear broken, propeller bent
Commander's Licence:	Private Pilot's Licence
Commander's Age:	78 years
Commander's Flying Experience:	1,338 hours (of which 928 were on type) Last 90 days - 6 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot reported that the passenger's door opened shortly after takeoff and that consequently the aircraft was unable to maintain height. It was damaged during the subsequent forced landing.

ACCIDENT

Aircraft Type and Registration:	Cessna 152, G-BNSM
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1981
Date & Time (UTC):	29 June 2011 at 1015 hrs
Location:	Bodmin Airfield, Cornwall
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose gear, propeller and wingtip
Commander's Licence:	Student
Commander's Age:	40 years
Commander's Flying Experience:	43 hours (of which 43 were on type) Last 90 days - 6 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The student pilot, who was on his second solo flight, was attempting to land on Runway 31. The aircraft bounced and touched down again heavily, causing the nose gear to collapse. The student pilot was uninjured. He considered that his lack of experience and the wind conditions may have been contributory factors to the accident.

ACCIDENT

Aircraft Type and Registration:	Cessna 182, D-ERKX
No & Type of Engines:	1 Lycoming T10-540-AK1A piston engine
Year of Manufacture:	2005
Date & Time (UTC):	30 July 2011 at 1400 hrs
Location:	Lands End Airfield, Cornwall
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to nose landing gear, propeller and engine cowling
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	470 hours (of which 96 were on type) Last 90 days - 20 hours Last 28 days - 9 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft had completed a local sightseeing trip in good weather conditions and was positioned to land on grass Runway 25 at Lands End, Cornwall. The wind was reported as being from 260º at 8 kt. The aircraft touched down on a small hump in the runway and bounced back into the air. The pilot was unable to prevent the nose from dropping and the aircraft landed heavily on its nosewheel, which collapsed. The aircraft came to a halt on the centreline of the runway and the pilot and his passenger, who were uninjured, vacated the aircraft normally.

The pilot assessed his approach as slightly too fast, which, with the aircraft being light and there being an upslope in the area of his touchdown, contributed to a high bounce on initial touchdown. He considered that the accident could have been avoided if he had initiated a go-around, either from the fast approach or after the aircraft bounced.

ACCIDENT

Aircraft Type and Registration:	Jodel D18, G-BWVV
No & Type of Engines:	1 Volkswagen 1834 piston engine
Year of Manufacture:	1997
Date & Time (UTC):	26 June 2011 at 1534 hrs
Location:	North Coates Airfield, Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	385 hours (of which 4 were on type) Last 90 days - 9 hours Last 28 days - 4 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilot was returning to land at his home airfield because of a rough running engine. He was poorly positioned for his first approach so he went around and flew a circuit at low level. While attempting to line up on final approach the aircraft stalled and spun into the ground. The pilot was injured but was able to evacuate the aircraft unassisted. He had little experience on type and it is probable that he mistakenly operated the choke instead of the carburettor heat causing the fuel / air mixture to become too rich.

History of the flight

The pilot arrived at North Coates in the early afternoon and prepared his aircraft for flight. He refuelled the front tank to full with AVGAS, from a container he had brought with him to the airfield. He also had a conversation with another pilot discussing the aircraft's fuel selector, its orientation and which end was the pointer; the other pilot offered to fly with him as he seemed a little unsure about the selector, but this offer was not taken up.

The pilot booked out for a local flight and noted that the aircraft's endurance was 3½ hours. The aircraft was not equipped with an electric starter so he hand swung the propeller and the engine started immediately. He successfully carried out a radio check, on the North Coates frequency of 120.15 MHz. After takeoff from Runway 23 he turned to the left and flew to the south. At 1405 hrs he made a radio call to Humberside on

frequency 119.125 MHz. ATC answered the call but the pilot did not receive the reply. Over the next five minutes he made five further attempts to contact Humberside. Then, at 1417 hrs, he tried again and this time established two-way contact. He reported that he was en route from North Coates to Boston at 3,000 ft amsl and that the aircraft was not fitted with a transponder. At 1430 hrs he gave a position report overhead St Leonards and was asked to report at Boston. The next contact from the aircraft was at 1513 hrs when he advised that he was abeam Alford at 2,800 ft and planning to route north across the River Humber to Beverly before returning to North Coates.

At 1527 hrs the pilot was flying northbound at 2,800 ft when he noticed that the engine was running roughly. The Humberside controller then contacted the pilot and requested his current position. The pilot advised the controller that he was returning to North Coates and the controller asked him to confirm that he was about three miles from there. The pilot confirmed that and was given the North Coates frequency. This R/T exchange lasted 24 seconds. The pilot then changed frequency and made a radio call to North Coates but did not receive a reply.

The pilot reported that the aircraft dropped a wing and descended rapidly. He managed to recover, by using opposite rudder and stick neutral, and levelled out at 400 ft amsl. He then flew a wide left-hand circuit for Runway 23, crossing the coast and flying over the shore in case the engine stopped. In the later stages of the final approach he realised he was too high and could not land safely. He flew along the runway at about 200 ft aal and entered a close-in low-level circuit. The engine continued to run roughly and he pumped the throttle in an attempt to keep it running.

Witnesses on the ground saw the aircraft carry out the low-level circuit and noted that the aircraft was flying relatively slowly and wobbling. They watched it turn onto a close-in base leg and turn left towards the runway crossing the extended centreline. It continued turning left re-crossing the runway centreline, turned right, climbed a little and stalled. Some of the witnesses heard the engine power increase then decrease. The aircraft recovered briefly into a climb, before stalling again and, from a height of approximately 50 ft it entered an incipient spin and impacted the ground.

The pilot suffered face, head and neck injuries in the accident but nevertheless was able to extricate himself from the wreckage unaided and move away to a safe distance. Bystanders ran to assist and gave first aid until an ambulance arrived.

Airfield information

North Coates Airfield is located close to the coast in north-east Lincolnshire. Grass Runway 23 / 05 is 650 m long and 20 m wide. The airfield elevation is 17 ft amsl and the circuit height is 500 ft aal. The extended final approach for Runway 23 is over the sea.

Meteorological information

When the aircraft departed from North Coates the weather conditions were fine with a surface wind from 210°M to 220°M at 10 kt. By the time the pilot returned, the wind had changed to a more southerly direction of 170°M at 10 to 15 kt. The 1102 hrs TAF for Humberside, 15 nm to the west-north-west, showed the forecast surface wind was from 180°M at 10 kt. The 1520 hrs METAR for Humberside was surface wind from 180°M at 10 kt, varying between 150°M and 210°M, visibility more than 10 km, scattered clouds at 3,500 ft, temperature 28°C, dewpoint 18°C and pressure 1018 HPa.

The surface weather conditions were unusually warm. However, the Met Office examined the data from radiosonde ascents in the area and estimated that at 3,000 ft the air temperature was 15°C, the dew point was 11°C and the relative humidity was 75%. There was therefore a notably steep temperature gradient above ground level, suggesting that the warm surface temperature was largely due to surface heating.

Reference to the Civil Aviation Authority Carburettor Icing Prediction Chart, published in Safety Sense Leaflet No 14 shows that, in the prevailing conditions, serious carburettor icing was possible at descent power but, if the 3,000 ft temperatures are plotted, serious carburettor icing was possible at any power setting.

Pilot information

The pilot started his flying on microlight aircraft and qualified for a PPL Microlight (restricted) in January 2005. He acquired his own aircraft, a Rans S6, in November 2004. In April 2005, whilst flying the Rans, he was involved in an accident which destroyed the aircraft, although he was uninjured. After that he converted his licence to an NPPL with Simple Single Engine Aircraft (SSEA) rating. He recorded, in a new logbook, that he had 185 hours of microlight flight time and he commenced training for a NPPL in January 2006. His training was carried out in a Cessna 150 aircraft and was completed in March 2007. In October 2008 he bought a Piper PA-38 Tomahawk aircraft and then, in April 2009, a Piper Cherokee 140. At the beginning of June 2011 he bought G-BWVV, having sold the Tomahawk in 2009 and the Cherokee in March 2011.

The pilot had not flown a tailwheel aircraft before so he was required to carry out differences training with an instructor before he could fly solo in G-BWVV. It is left to the instructor to decide on the appropriate course content as there is no specific syllabus for this training.

On 7 June 2011 he started his differences training at North Coates. The instructor reported that during this session general handling familiarisation was carried out in the local area and some time was spent teaching the pilot to sideslip the aircraft. The instructor thought this was important because G-BWVV was not fitted with flaps. They then returned to the circuit for takeoff and landing practice. At the time however, there was a crosswind on Runway 23, making it difficult to carry out the training, so after one hour the session was ended. On 9 June 2011 a further one and a half hours of intensive takeoff and landing training was carried out. The surface wind was calm and both runways were used. Each landing was to a full stop. After this session the instructor signed the pilot's logbook confirming that the tailwheel conversion was complete, although he considered that the pilot would not be able to cope with a crosswind landing. They discussed this and made a verbal agreement that the pilot should get some solo practice, without any crosswind, and then fly more dual circuits in a crosswind. The accident flight was the pilot's first solo flight since the dual training.

Description and history of the aircraft

The aircraft is an established homebuilt deign which is constructed of wood with a fabric covering. It was operated on an LAA Permit to Fly and featured side-by-side seating for two people. The aircraft was fitted with a tailwheel landing gear.

The engine was derived from a Volkswagen four cylinder air-cooled car engine. The engine was fitted with carburettor heat and a choke to provide mixture enrichment for cold starting. The controls for these were mounted either side of the throttle control knob in the cockpit, see Figure 1.

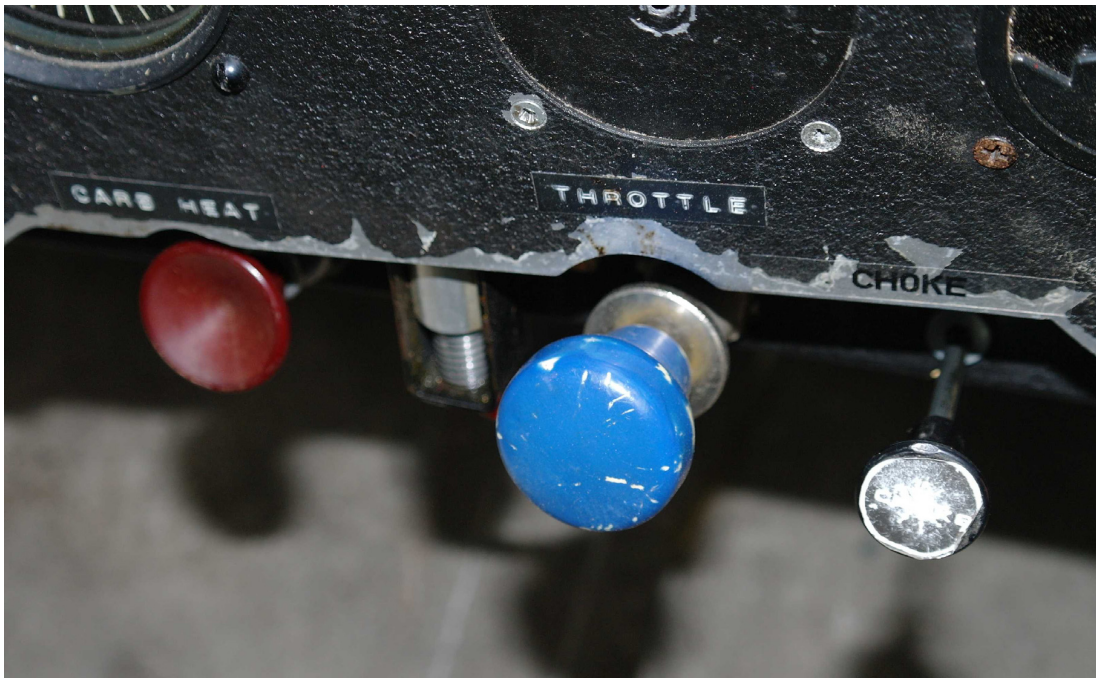

Figure 1

Detail of engine controls in cockpit shown in the 'as found' position

Fuel was contained in two fuel tanks, each fitted with its own filler cap and vent. The 35 litre forward tank was located between the firewall and the instrument panel. The 30 litre rear tank was located behind the rear cockpit bulkhead. Fuel from each tank was fed to a selector valve located under the front tank to allow the pilot to select the fuel supply to the engine from either tank. The forward tank was normally used for takeoff and landing. From the selector valve the fuel passed through a gascolator and an engine-driven pump before reaching the carburettor.

G-BWVV was completed in 1996 and operated by the builder until 2003 during which time it flew approximately 255 hours. Ownership then passed to a new owner and during his conversion training the aircraft was damaged in a takeoff accident, see AAIB report EW/G2003/04/15 published in the July 2003 Bulletin. The aircraft was repaired and flew again in 2006. The second owner then flew it until 2009 completing a further 65 hours. The aircraft was returned to flying condition in 2011 when it was sold to the third and current owner.

The pilot bought the aircraft at the beginning of June 2011. The most recent Permit to Fly check flight was carried out in August 2010. It was recorded that the stall occurred at 48 kt IAS together with notes that there was some pre-stall buffet and a wing drop to the right at the stall.

The airspeed indicator had a V_{NE} marked at 132 kt as required by the LAA Type Acceptance Data Sheet. No other speeds were marked nor required to be marked on the instrument (shown in Figure 2). The aircraft was not equipped with a stall warning system. The pilot did not have any formal handbook for the aircraft but he had some handwritten notes regarding approach speeds and other data which he carried with him in flight. These notes cited a stall speed of 46 kt, a best angle glide speed of 60 kt and a final approach speed of 65 kt.

Figure 2

Airspeed indicator

Examination of the accident site

The accident site was in a field close to the extended centre line of Runway 23 and approximately 150 m short of the threshold; the soil was dry and compact and therefore quite hard. Evidence indicates that the aircraft was descending in a steep right wing-down and nose-low attitude whilst rotating to the right at a low forward speed. The all-moving tailplane was in the full aircraft nose-up position. The right wingtip struck the ground first causing the right wing to fail and the fuselage to separate from the wing structure. From initial ground contact to the time the aircraft had come to rest, it had turned through approximately 180 degrees. There was no fire.

Initial examination of the wreckage

All parts of the aircraft were at the accident site indicating that nothing had detached from the aircraft in flight. The flying controls were examined and all were found correctly connected and there was no sign of any restriction. The engine and firewall/instrument panel were detached from the fuselage, but the disruption between the firewall and the engine was limited. The throttle control was found in the fully forward (full power) position, the carburettor heat was in the fully forward (cold) position and the choke control was in the fully out (starting) position. Due to the limited deformation in this area it is most likely these were the positions at the time of the impact. Fuel had been leaking from the aircraft due to impact damage but members of the flying club managed to save sufficient fuel from both the front and rear fuel tanks to rule out fuel exhaustion. The fuel selector had been moved in an attempt to stop the fuel leakage but, before this was done, the position of the selector was noted and marked.

The lap straps of the pilot's harness had pulled away from their mounts and both sides of the lap strap were attached to the buckle. The removable part of the lap strap was attached to one of the buckle slots meant for the shoulder harness, see Figure 3. The pilot's shoulder straps and their mounting point were undamaged and were found separate from the lap strap and buckle.

The wreckage was recovered to the AAIB facilities for a more detailed examination.

Figure 3

Close up of pilot's harness lap strap and buckle

Detailed examination of the wreckage

The pilot reported that the engine had started to run roughly and therefore the investigation focused on the engine and its ancillary systems.

Fuel system

Approximately 15 litres of fuel had been recovered from the front fuel tank which appeared to be a mixture of AVGAS and MOGAS and approximately 10 litres of AVGAS was recovered from the rear tank. The fuel system was checked and apart from the accident damage no defects were found. Fuel was present in the gascolator, the engine fuel feed pipe, engine-driven pump and carburettor float bowl. There was a small quantity of fine debris in the carburettor float bowl but the jet appeared clear. There was also some debris in the gascolator bowl but this was separated from the engine by the filter screen in the gascolater. The engine driven pump operated normally.

Fuel selector

The fuel selector had been replaced by the pilot prior to this flight and it appeared to have been correctly installed and was working normally. Although the work was recorded in the aircraft log book, it had not been cleared by an appropriately qualified LAA inspector as required.

Engine

It was not possible to conduct a test run of the engine due to damage sustained to the mounting points. The engine was inspected and no pre-accident defects were identified. It turned over normally by hand and all four cylinders had good compression.

Analysis of photographs taken at the time of the accident show the engine was rotating at approximately 2,000 rpm at impact.

Ignition system

The two magnetos were removed so they could be tested on a bench rig; both operated normally. It was not possible to test the wiring to the magneto switches on the instrument panel as it had been disrupted in the impact and subsequent recovery. Inspection of the wiring did not identify any pre-accident defects. Both magneto switches were found in the ON position.

Radio

The active frequency selected on the radio was 121.15 MHz with a standby of 119.12 MHz (Humberside).

Engine controls and indications

It was noted that although the carburettor heat control and the choke control knobs were of slightly different diameters they were very similar in shape and different in colour, see Figure 1. The carburettor heat control had a long travel and a feature that allowed it to be locked by twisting its knob through 90 degrees. The choke control had a much shorter travel and could not be locked out. The pilot reported after the accident that he had used the carburettor heat control several times during the flight. He commented that the quarter turn locking out mechanism had not always worked.

The engine rpm gauge was two inches in diameter and had a small scale which covered an arc of approximately 90º of which approximately 45º covered the normal operating range of 800 to 3300 rpm, see Figure 4.

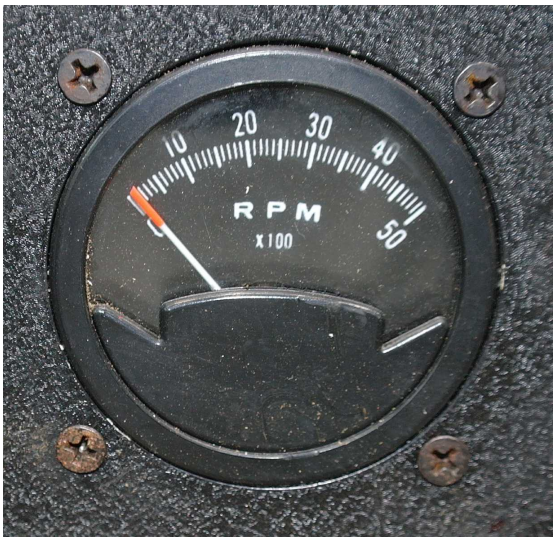

Figure 4
Rpm gauge

Fuel selector valve

The fuel selector operating lever had a small pointer on the opposite side to the operating handle, see Figure 5. The selected position was indicated by a placard on the instrument panel, see Figure 6.

Analysis

The pilot reported that the engine had started to run roughly while he was on a cross-country flight. He could not recall exactly his last action before the rough running started.

The aircraft appeared to be in good condition and no defects were found with the engine or its ancillaries that would cause it to run roughly.

The rpm gauge had only a small scale making it more difficult to determine any rpm drop during either magneto or carburettor heat checks. Discussions with other pilots who had flown the aircraft revealed that it needed frequent applications of carburettor heat and that the rpm drop, when it was selected during the pre-takeoff checks, was more noticeable aurally than on the rpm gauge. A larger scale may have given a clearer indication of the effect of using carburettor heat.

The fuel selector and its placard made it difficult to confirm which tank had actually been selected and the pilot had discussed the fuel selector indication at length with another pilot prior to his departure. The placard is also misleading in that there is only one detented position for the front tank and one for the rear tank and not an arc of 90º as indicated.

Figure 5
Fuel selector in OFF position

Figure 6
Fuel selector placard

CS-VLA is a design code for similar size aircraft[1] and it states in CS-VLA778 (g) (ii), for mechanical fuel selectors:

> *'The position indicator pointer must be located at the part of the handle that is the maximum dimension of the handle measured from the centre of rotation'*

The fuel selector in G-BWVV used the small pointer opposite the much larger handle to indicate the selected position, see Figure 5. Instructions for other homebuilt aircraft using similar selector valves recommend filing off the small pointer and using the large handle as the indicator to avoid any confusion.

There are several possible reasons for the initial rough running. One is that it was caused by a fuel selection change by the pilot, whereby he unintentionally selected the fuel to OFF. The selected position was not easy to determine and he had been uncertain before the flight about the indications. However, the engine continued to run throughout the rest of the flight so this seems unlikely. It is also possible, given the atmospheric conditions which were conducive to serious carburettor icing at any power setting, that the engine suffered carburettor icing.

A more likely reason is that the pilot mistakenly selected the choke control when attempting to use the carburettor heat, while carrying out a routine check for icing. The carburettor heat control and choke controls fitted to G-BWVV were of a similar shape and the choke control was found in the fully out (starting) position after the accident. The carburettor heat control is dark red in colour. Red is more usually associated with the mixture control and although a mixture control was not fitted to this aircraft, the pilot would have used one on previous aircraft he flew. This may have diverted his attention to the other similarly shaped, but black coloured, choke control instead of the carburettor heat control. In the fully out (starting) position, extra fuel is introduced into the inlet manifold to provide a rich mixture. Pulling the choke control fully out with the engine operating at its normal temperature would cause rough running and a loss of power due to the over rich mixture.

Whatever the original cause of the rough running, the choke control was found to be fully out after the accident. The design of the control is such that it is not likely to have moved during the accident. Thus, at some time during the flight, it is likely that the pilot inadvertently applied choke to the engine causing it to run roughly.

The engine started to run roughly when the aircraft was at 2,800 ft amsl. At the time the pilot was contacted by Humberside ATC, asking for a position update, he had already decided to return to North Coates to land. He reported to them that he was returning to North Coates but he did not mention an engine problem. He was advised to change frequency and noted afterwards that although he had done so, he had not received any response. The reason for this was that the selected frequency was 121.15 MHz instead of the North Coates frequency of 120.15 MHz. It appears that while he was engaged on making these radio transmissions the airspeed reduced and shortly afterwards the aircraft stalled, losing some 2,400 ft before control was regained.

The pilot's use of rudder when the wing dropped during the stall probably prevented a spin from developing but the aircraft would not have recovered until the angle of attack was reduced. A standard stall recovery would have prevented such a significant loss of height.

Footnote

[1] Although CS-VLA is not directly applicable to this aircraft, the guidance it contains is considered to reflect best practice for this size of aircraft.

The aircraft recovered at 400 ft aal and the pilot joined the circuit from a wide downwind position. He was not in a position to land safely on the first approach so he repositioned for a second attempt. The aircraft was now at about 200 ft aal and he was unable to climb. He flew a close-in circuit pattern but the southerly wind would have tended to tighten the circuit and in particular the base leg. Thus, when he attempted to turn onto final approach he flew through the runway centreline. He then attempted to turn back towards the runway, but the turn was tight and at a very low level. The bank angle increased and the aircraft stalled. He made a partial recovery but the aircraft stalled again and spun into the ground.

Survivability

The pilot reported that, with the shoulder straps fastened, he was unable to reach all the controls properly and as a result he flew with just the lap strap fastened. During the impact his shoulders were not restrained and he was therefore thrown forward through the top of the canopy, striking his head on the ground. He was very fortunate not to suffer more serious injuries from either the ground impact or as he recoiled back through the shattered canopy. The lap strap attachment fittings broke away from the structure during the break-up sequence.

Conclusions

The engine was operating at a reduced power, probably because the choke was pulled out and the mixture was too rich. The pilot continued to try to land at North Coates Airfield but ended up flying a low-level circuit. The aircraft stalled while he was attempting to line up on final approach having flown through the extended runway centreline. The aircraft had no stall warning system and little natural buffet to warn of the approaching stall.

A lack of familiarity with the aircraft and an attempted approach at an unfamiliar circuit height in crosswind conditions were all circumstances which contributed to the accident. Although the pilot had undergone some tailwheel differences training this did not cover all aspects of operating the aircraft.

Safety action

The LAA intend to highlight the learning points from this accident to their members via their magazine. This will include the importance of having clear and unambiguous markings on all controls and selectors, always correctly fitting and adjusting the seat harness provided and the importance of becoming fully familiar with the operation and function of all controls in an aircraft before attempting a flight.

Each homebuilt aircraft is an individual aircraft and therefore potentially different, even from others of a similar design. These types of aircraft may have handling characteristics that require different skills to larger factory built aircraft. The LAA has identified that there is an increased risk of accidents in homebuilt aircraft during a pilot's first few hours on type. The LAA run a Pilot Coaching Scheme for its members whereby they can fly with experienced instructors to provide conversion training to different types of aircraft.

ACCIDENT

Aircraft Type and Registration:	Luscombe 8E Silvaire Deluxe, G-BTCJ
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	1941
Date & Time (UTC):	11 July 2011 at 1730 hrs
Location:	Bidford-on-Avon Airfield, Warwickshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Propeller, canopy, firewall, fin and possible shock-loading to engine
Commander's Licence:	Private Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	186 hours (of which 18 were on type) Last 90 days - 18 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

In good weather, with reported winds of 2 kt from 240º, the pilot made an approach to Runway 24, a grass runway with a slight downslope. After a three-point touchdown and rolling out approximately 80 m, the aircraft nosed over onto its back when the pilot applied the brakes. He received minor injuries but the aircraft sustained extensive damage.

The pilot assessed the cause to be associated with a light load, a forward centre of gravity position and a possible relaxing of the stick back pressure.

ACCIDENT

Aircraft Type and Registration:	Pioneer 300, G-EWES
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2004
Date & Time (UTC):	31 May 2011 at 1230 hrs
Location:	Charlton Myers Farm Strip, Northumberland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Left landing gear
Commander's Licence:	Private Pilot's Licence
Commander's Age:	78 years
Commander's Flying Experience:	809 hours (of which 366 were on type) Last 90 days - 8 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot selected the landing gear up after takeoff and then noticed that the circuit breaker for the gear had tripped, preventing the gear from retracting. He attempted to raise the gear using the hand operated system, but was unable to obtain a green light for the main gear. He returned to Charlton Mires and during the subsequent landing the aircraft veered to the left as it slowed down. The pilot exited the aircraft and was uninjured.

The damage caused to the main gear during the landing made it difficult to determine why it had failed to retract fully. However, the tripping of the circuit breaker may have been indicative of a mechanical failure or jamming of the gear mechanism.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28R-180 Cherokee Arrow, G-AVWO
No & Type of Engines:	1 Lycoming IO-360-B1E piston engine
Year of Manufacture:	1967
Date & Time (UTC):	10 August 2011 at 1750 hrs
Location:	Biggin Hill Airport, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Left wing, flap and aileron damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	249 hours (of which 100 were on type) Last 90 days - 15 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent enquires

Synopsis

During approach the pilot observed that the three landing gear green 'DOWN AND LOCKED' lights were illuminated. On touchdown the left main landing gear collapsed and the 'IN TRANSIT' light illuminated. Subsequent investigation revealed that wear on the left main landing gear actuator piston prevented the complete engagement of the downlock hook on the lock-pin. However, the partial engagement had actuated the limit switch that illuminated the 'DOWN AND LOCKED' light.

History of the flight

After joining the circuit the pilot extended the landing gear on the downwind leg and observed three green lights on the landing gear position indicator panel, indicating that all three landing gears were 'DOWN AND LOCKED'. During his pre-landing checks the pilot confirmed that the three green landing gear indication lights remained illuminated. Immediately after touchdown, the left wing of the aircraft began to drop and the pilot observed that the landing gear 'IN TRANSIT' light on the instrument panel had now illuminated. With the aircraft's speed decaying rapidly, the pilot raised the left wing using aileron inputs whilst shutting down the engine and electrical systems. As the speed decayed the left wing made contact with the ground and the aircraft came to a halt on the runway. The pilot was uninjured and was able to leave the aircraft through the normal exit.

Investigation

The PA-28R-180 is fitted with three hydraulically actuated retractable landing gears. Each gear is fitted with a mechanical downlock. These consist of a pivoting hook attached to the upper drag link which rotates, as the landing gear extends, to engage on a lock-pin on the lower drag link. When the downlock hook begins to engage the lock-pin, it actuates a limit switch mounted on the lower drag link. Actuation of the limit switch illuminates the green 'DOWN AND LOCKED' light and when all three landing gear limit switches are made the landing gear 'IN TRANSIT' light is extinguished and the hydraulic pump stops.

Examination of the main landing gear limit switches confirmed that they were correctly rigged. A test of the landing gear extension and retraction system confirmed that it appeared to operate normally, with all three landing gear downlocks being engaged when the landing gear was extended. A detailed examination of the left main landing gear actuator identified a small hydraulic leak from between the actuator piston and the seal when the piston was in the extended position. The position of the leak corresponded to an area of wear on the chrome plating of the actuator piston.

Further tests revealed that when the left main landing gear was extended against a load, it would extend sufficiently to allow the downlock hook to actuate the landing gear limit switch but the downlock hook would not fully engage on the downlock pin. Examination of the approved maintenance programme for the aircraft confirmed that there is no requirement for the routine removal of the landing gear actuator for overhaul. The aircraft records showed no evidence that the main landing gear actuators had been removed for overhaul.

Conclusion

The wear on the left main landing gear actuator piston prevented the left main landing gear from extending fully against flight loads. The downlock hook did not fully engage the downlock pin, despite providing an indication to the pilot that the gear had extended normally. On landing, the forces on the left landing gear caused the partially engaged downlock hook to disengage from the downlock pin, allowing the left main landing gear to collapse.

ACCIDENT

Aircraft Type and Registration:	Societe Menavia Piel CP301A Emeraude, G-BBKL
No & Type of Engines:	1 Continental O-200-A piston engine
Year of Manufacture:	1958
Date & Time (UTC):	5 August 2011 at 1130 hrs
Location:	Near East Fortune, Lothian, Scotland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Undercarriage mounting blocks cracked
Commander's Licence:	Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	1,035 hours (of which 900 were on type) Last 90 days - 27 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was flying a normal approach to Runway 24 at a private airstrip. The weather was fine, with a surface wind of about 210º/10 kt. In the latter stages of the approach, the airspeed reduced unexpectedly quickly, resulting in a landing which was heavy but in a normal attitude. Damage to the undercarriage mounting bolts was later found, which was consistent with a heavy landing.

ACCIDENT

Aircraft Type and Registration:	Robinson R22 Beta, G-JERS
No & Type of Engines:	1 Lycoming O-320-B2C piston engine
Year of Manufacture:	1990
Date & Time (UTC):	15 July 2011 at 0924 hrs
Location:	Cumbernauld Airport, Scotland
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Extensive and beyond economic repair
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	40 years
Commander's Flying Experience:	1,987 hours (of which 1,846 were on type) Last 90 days - 164 hours Last 28 days - 45 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Whilst practising running landings on a grass area adjacent to the runway, the instructor asked the student to lift the helicopter into the hover with forward motion. The student initiated the manoeuvre by applying a forward cyclic input. The instructor reported that as the helicopter slid forward along the ground, it moved into an area of longer grass causing the front of the skids to become caught. The student raised the collective in an effort to pull the helicopter free, but this caused the skids to dig in and initiated a forward rollover. The instructor instinctively applied aft cyclic to stop the main rotor blades hitting the ground, but this resulted in the blades striking the tail boom and disengaging the tail rotor drive. The helicopter then yawed rapidly and rolled over, finally coming to rest on its left side. The occupants exited the aircraft unaided and without serious injury. The instructor added that in his opinion, the lack of a dedicated helicopter training area at the airport was a contributory factor to the accident.

ACCIDENT

Aircraft Type and Registration:	Robinson R44 II Raven, G-GDJF
No & Type of Engines:	1 Lycoming IO-540-AE1A5 piston engine
Year of Manufacture:	2006
Date & Time (UTC):	31 May 2011 at 1602 hrs
Location:	Private site near Skegness, Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - 1 (Minor)
Nature of Damage:	Rotor blades, tail and skids
Commander's Licence:	Private Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	1565 hours (of which 228 were on type) Last 90 days - 2 hours Last 28 days - None
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent enquiries

The accident occurred on the owner's property whilst hovering to dry the helicopter after washing it. The weather was reported by the pilot as clear with 20 km visibility and a WNW wind of 10 to 20 kt with gusts up to 20 kt. During the hover the helicopter yawed suddenly to the right. To avoid a collision with nearby trees, the pilot landed in an adjoining field. The landing on the uneven ground was reported to be "abrupt" and the helicopter rolled over, damaging the rotor blades, tail and skids. The pilot was uninjured but the passenger sustained minor injuries.

The pilot stated that the initial yaw was probably caused by a gust of wind and that the helicopter rolled over due to landing too abruptly on uneven ground.

ACCIDENT

Aircraft Type and Registration:	Gemini Flash IIA, G-MTVJ
No & Type of Engines:	1 Rotax 503 piston engine
Year of Manufacture:	1988
Date & Time (UTC):	27 May 2011 at 1330 hrs
Location:	Netherthorpe Aerodrome, Worksop, South Yorkshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Keel and front strut
Commander's Licence:	Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	685 hours (of which 240 were on type) Last 90 days - 110 hours Last 28 days - 22 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot carried out an uneventful takeoff from Runway 24 at Netherthorpe Aerodrome where the forecast wind was 15 kt the from north. After a training flight, he returned to Netherthorpe and began an approach to the same runway. He reported that the conditions had deteriorated and that the windsock indicated gusts from a variable direction. Conscious of the crosswind limit of the aircraft as being 10 mph (8.7 kt), he continued the approach to Runway 24 with the intention of making a right turn as the aircraft approached the intersection with Runway 36, to land more into the wind.

During the approach, the pilot recalled encountering increasing turbulence and, when approaching 100 ft aal, noticed an increase in airspeed and rate of descent. At 40 ft aal, this descent rate increased further and the pilot decided to go around and applied full power. However, the aircraft continued to descend and touched down heavily, causing damage to the keel and front strut.

Both occupants, who were wearing lap and diagonal harnesses and protective helmets, were uninjured. The pilot considered that the aircraft had been affected by rotary airflow in the lee of nearby trees and buildings.

ACCIDENT

Aircraft Type and Registration:	Jabiru UL, G-BYNR
No & Type of Engines:	1 Jabiru Aircraft PTY 2200A piston engine
Year of Manufacture:	1998
Date & Time (UTC):	7 June 2011 at 1900 hrs
Location:	Rufforth Airfield, North Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Damage to wing and landing gear
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	1,046 hours (of which 750 were on type) Last 90 days - 33 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was seen to clip a tree at about 50 feet on final approach and dive into the ground. The pilot commented that he had allowed his need for a toilet call to blur his concentration.

History of the flight

The pilot had set off from Husbands Bosworth after a light meal and two mugs of tea. After about 45 minutes he decided that he might need a "toilet call" but had already passed Hedon, Sturgate and North Moor, all of which he visited regularly. He was considering landing at Breighton but decided that, with only 15 minutes to go, he would continue on to Rufforth.

At Rufforth, with the toilet call still on his mind, the pilot joined the downwind leg for Runway 23, knowing that the wind was blowing from the south. He remembers turning onto base leg and then lining up on finals, with the runway straight ahead, but nothing else until he was crawling out of the aircraft. Witnesses at the airfield saw the aircraft clip a tree at about 50 feet on final approach and "nose dive" into the ground. The pilot was taken to hospital with head and wrist injuries.

The pilot commented in his frank report that he considered a major causal factor in the accident to be that he allowed his need for a toilet call to blur his concentration during the final approach.

ACCIDENT

Aircraft Type and Registration:	Zenair CH 601UL Zodiac, G-CCVT
No & Type of Engines:	1 Rotax 912-S piston engine
Year of Manufacture:	2004
Date & Time (UTC):	2 September 2011 at 1730 hrs
Location:	Private airstrip, Glenmavis, Lanarkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Extensively damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	922 hours (of which 496 were on type) Last 90 days - 16 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Shortly after becoming airborne, the engine stopped and in the pilot's attempt to avoid a road and overhead electrical cables the aircraft landed heavily and was extensively damaged. The pilot was uninjured.

History of the flight

The pilot reported that on the morning of the accident, he replenished the aircraft with MOGAS and successfully carried out his normal pre-flight checks, which included a water sediment check of a sample of fuel taken from the drain at the bottom of the aircraft fuel tank.

Shortly after a light shower had passed over the airfield, the pilot started the engine and after approximately 10 minutes taxied to the end of the grass runway where he carried out his power checks during which the engine reached the expected maximum rpm. On completing the power checks the pilot immediately released the aircraft brakes and the aircraft quickly accelerated and became airborne at the expected distance along the runway. At approximately 30 ft the engine tone changed, the engine coughed, the rpm rapidly decreased and the engine stopped. In an attempt to avoid a set of electrical cables, and a road that ran across the end of the runway, the pilot banked relatively steeply to the right. The right wing and landing gear struck the ground and the aircraft bounced before landing heavily. While the pilot was uninjured, the aircraft was extensively damaged.

At the time of the accident, Glasgow Airport, which is 16 miles to the west of the airfield, reported that the temperature was 14°C, the dewpoint was 12°C and the humidity was 88%. Given the weather conditions and the fact that the aircraft was started and the power checks were carried out with the aircraft parked on wet grass, the pilot considered the possibility that the engine failure might have occurred as a result of carburettor icing.

Carburettor icing

CAA Safety Sense Leaflet 14 describes the causes of carburettor icing and notes that *'Carb icing is more likely when MOGAS is used'*. The graph from the Safety Sense Leaflet showing the likelihood of carburettor icing is reproduced at Figure 1. From the graph it can be seen that the conditions at the time of the accident would have given a serious risk of carburettor icing at any power setting. However, the pilot's report that there was a sudden reduction in engine rpm shortly after the aircraft became airborne is not characteristic of carburettor icing, which in this type of engine installation normally manifests itself as a gradual reduction in power.

The Rotax 912-S engine is equipped with two magnetos and two carburettors, each of which feeds two cylinders, and are positioned just above the engine exhaust, which keeps the carburettor bodies relatively warm. Consideration was given to the possibility that ice might have accumulated in the induction system while the engine was running prior to the power runs, without affecting the engine performance, and then released in flight causing the engine to suddenly stop. However, it was thought that this scenario was unlikely.

Discussion

While carburettor icing can not be ruled out, the reported symptoms were also consistent with fuel starvation.

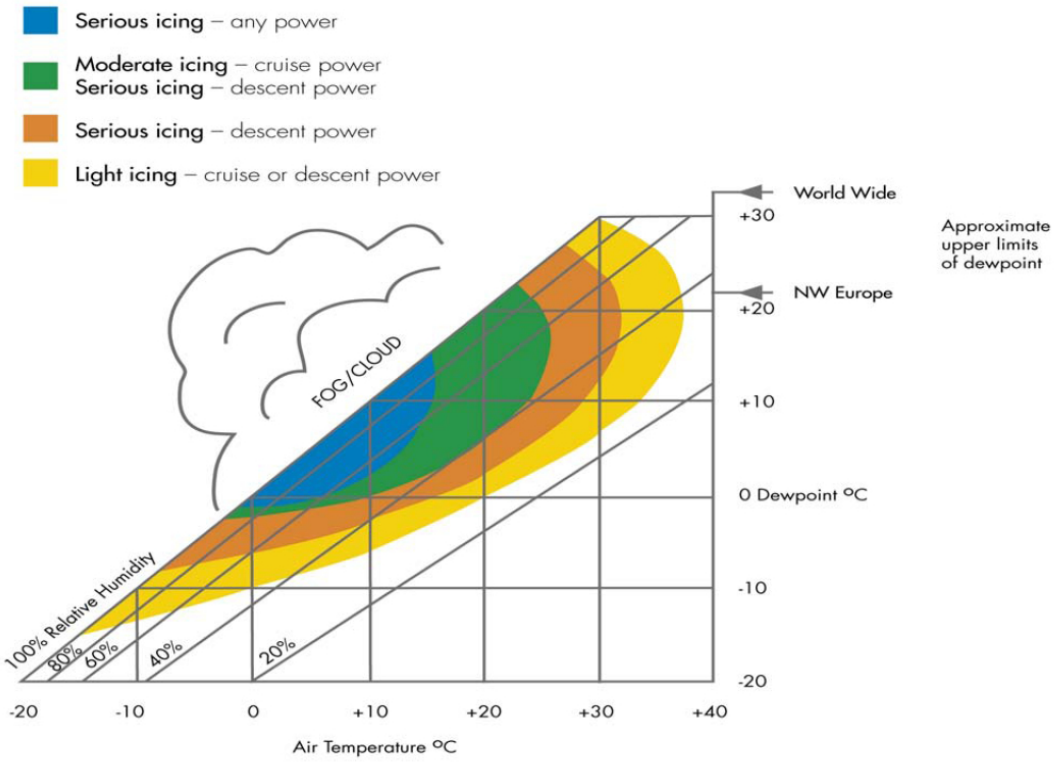

Figure 1

Carburettor icing chart

BULLETIN CORRECTION

AAIB File:	EW/C2010/06/05
Aircraft Type and Registration:	Boeing 777-736, G-YMMP
Date & Time (UTC):	14 June 2010 at 1617 hrs
Location:	Singapore International Airport
Information Source:	AAIB Field Investigation

AAIB Bulletin No 10/2011, page 34 refers

In the last paragraph of this report the date of the accident was referred to as 14 June 2011, this should have been **14 June 2010.**

BULLETIN CORRECTION

AAIB File:	EW/C2010/12/03
Aircraft Type and Registration:	Saab-Scania SF340B, G-LGNI
Date & Time (UTC):	16 December 2010 at 1555 hrs
Location:	Kirkwall Airport, Orkney Islands
Information Source:	AAIB Field Investigation

AAIB Bulletin No 9/2011, page 12 and 13 refer:

When this report was published, Lerwick was inadvertently stated instead of Kirkwall. Therefore the following corrections should be noted.

Page 12, under heading **History of the flight**

In the first paragraph,

'on a scheduled flight to Lerwick Airport' should read 'on a scheduled flight to **Kirkwall** Airport'.

Page 13, under heading **Analysis**

In the first paragraph,

'Slush covering the runway at Lerwick' should read 'Slush covering the runway at **Kirkwall**'.

BULLETIN CORRECTION

AAIB File: EW/C2011/01/01

Aircraft Type and Registration:	Cameron O-120 hot air balloon, G-BVXF
Date & Time (UTC):	1 January 2011 at 0947 hrs
Location:	Midsomer Norton, Somerset
Information Source:	Field investigation

AAIB Bulletin No 10/2011, page 113 refers

In the report published in Bulletin 10/2011, the supplementary oxygen system was mistakenly identified as being supplied with a cylinder pressure of '200 psi'. This was a typographical error – the system was supplied with a cylinder pressure of **200 bar**.

This was corrected in the online version of the report on 31 October 2011 and a correction will appear in the December 2011 Bulletin.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2010

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.

2011

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.

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