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ADDENDA and CORRECTIONS

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SERIOUS INCIDENT

Aircraft Type and Registration:	BN2T Islander, G-LEAP
No & Type of Engines:	2 Allison 250-B17C turboprop engines
Year of Manufacture:	1987
Date & Time (UTC):	27 August 2011 at 1130 hrs
Location:	5 nm south of Swansea Airport
Type of Flight:	Aerial Work (Parachuting)
Persons on Board:	Crew - 1 Passengers - 8
Injuries:	Crew - None Passengers - None
Nature of Damage:	None reported
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	2,882 hours (of which 440 were on type) Last 90 days - 51 hours Last 28 days - 20 hours
Information Source:	AAIB Field Investigation

Synopsis

Engine anti-icing was not selected ON prior to the aircraft entering engine icing conditions and both engines flamed out. After the aircraft exited these icing conditions, both engines were successfully relit and the aircraft landed without further incident.

History of the flight

The pilot was conducting his fifth lift[1] of the day in the incident aircraft. The weather conditions had been similar throughout the previous lifts, with about four oktas of cloud cover, the cloud being organised in lines with clear air in between.

The aircraft had been climbing, in the clear air, between two cloud lines. In order to position overhead the airfield for the parachute drop, the pilot commenced a wide turn which took the aircraft through the side of a cloud at about FL080.

The outside air temperature was about 0°C and, as the aircraft penetrated the cloud, the pilot reached down to select the engine anti-ice ON. Before he could do so, the aircraft was enveloped in what the pilot described as a "sleet storm". Almost immediately, both engines ran down. The pilot noticed the engine torque and fuel flow decreasing, the Turbine Gas Temperature (TGT) increasing by about 40°C from the climb setting of 700°C, and the turbine rpm (N_1) decreasing.

Footnote

[1] In skydiving each flight is generally referred to as a 'lift'.

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The pilot established the aircraft in a glide, at 120 kt, and completed the turn towards the airfield. The aircraft descended out of the cloud at about FL070 and the pilot selected the igniters ON and the power levers to idle. Both engines relit immediately. The pilot left both engines at idle power, to stabilise, while the aircraft descended a further 500 ft. He then slowly increased the power on both engines, noting no anomalies.

The parachuting lift was aborted and the aircraft returned to Swansea without further incident.

Met Office aftercast

The Met Office provided an aftercast for the weather in the area of the incident. They compared this with the forecast conditions provided on the Metform 215 (low level forecast) valid between 0800 hrs and 1700 hrs. They commented that:

> *'Reviewing the above information, the weather in the vicinity of the incident site was a showery north-westerly flow with good visibility and SCT/BKN cloud layers between 6000 FT and 10000 FT. The freezing level for the site is estimated to have been around 6500 FT based on the sonde data. The cloud layers were thick in places, indicated by the radio sonde balloon ascent, and capable of causing significant, moderate engine and airframe icing. The F214/F215 forecast charts issued were consistent with the actual information extracted for the time of the incident. '*

Power plant anti-icing system

The Turbine Islander Flight Manual describes the power plant anti-icing system as:

> *'An electrically heated engine air intake and application of compressor bleed air to the first stage of the compressor protects the engine intake system. The air intake, compressor bleed and propeller de-icing systems are operated by a single lever, for each engine, on the lower part of the centre pedestal.'*

Flight Manual operating procedure

The Turbine Islander Flight Manual states:

> *'At outside air temperatures of less than 5 deg C, in conditions where visible moisture exists, select Power Plant Anti-Icing ON for both engines and ensure that these services remain on during flight in such conditions. Caution ...The formation of intake ice may cause rapid power loss.*
>
> *CAUTION*
>
> *Due to thermal changes within the turbine, the gas producer section of the engine may lock up after inflight shutdown. This is a temporary condition which exists after the engine has been shut down for approximately one minute and which may continue for up to ten minutes... air starts may be attempted during the time period...but restart cannot be guaranteed.'*

Section 3 of the Flight Manual *Emergency Procedures* includes a procedure for the *Failure of both engines en-route*. It provides an immediate action to attempt a quick restart and a longer procedure should this be unsuccessful. This procedure also identifies the recommended gliding speed as 75 kt IAS.

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Previous Occurrence

In August 2007, a GAF Nomad N22B, N6302W, equipped with two Allison 250-B17 engines was engaged on parachuting operations. At an altitude of 8,500 ft, the aircraft entered icing conditions with the engine anti-ice selected OFF and the left engine ran down before the pilot was able to select anti-icing ON. He was unable to restart the engine and the aircraft was damaged in the subsequent single-engine landing.[2]

Analysis

The aircraft entered engine icing conditions, which were forecast, with the Power Plant Anti-Icing OFF. As the pilot was about to select the Anti-Icing ON, the engines flamed out. The Flight Manual states that engine anti-icing should be ON at any time the aircraft is in conditions of visible moisture and a temperature of less than 5°C. It also cautions that the formation of intake ice may cause rapid power loss. This incident illustrates the speed with which such a power loss can occur and that it can be total if Power Plant Anti-Icing is not selected ON before such icing conditions are entered.

Engine relight may be dependent on the removal of the condition which caused the failure. If the engine stopped due to an ice build up within the air intake, then a restart could require this blockage to be removed by descent to warmer conditions. This may take longer than one minute and could result in a restart being attempted during the period of time when a restart is not assured.

Conclusion

Power plant anti-icing was not selected ON before the aircraft entered engine icing conditions, resulting in the failure of both engines. In-flight restart is not assured on this engine type between one and ten minutes after shutdown. Once the aircraft had exited engine icing conditions, both engines were relit and operated normally.

Footnote

[2] Reported in AAIB Bulletin 8/2008

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ACCIDENT

Aircraft Type and Registration:	Hawker Hurricane IIB, G-HHII
No & Type of Engines:	1 Rolls-Royce Merlin 29 piston engine
Year of Manufacture:	1940
Date & Time (UTC):	28 August 2011 at 1200 hrs
Location:	North Weald Airfield, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Radiator scoop and propeller damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	7,000 hours (of which 1,500 were on type) Last 90 days - 120 hours Last 28 days - 43 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst landing at North Weald following a flying display at another airfield, the aircraft was observed to fly the approach and subsequent landing with the landing gear retracted, despite warnings from the control tower.

History of the flight

The aircraft was returning to its base at North Weald following a flying display; the pilot then intended to depart in his Spitfire PRXI for a second display. His usual approach for landing on the grass Runway 20 was to perform a 'run and break' along the runway, followed by a curved left-hand approach to land. In this instance he stated that he would be joining the circuit on the crosswind leg.

A controller in the control tower watched as the Hurricane joined the crosswind leg and climbed before turning left onto the downwind leg. The pilot stated that he then slowed the aircraft to the gear limiting speed and moved the selector to the U/C DOWN position (see Figure 1). However, at the point on the downwind where the controller expected to see the landing gear extend, he saw no sign of this happening, despite hearing the pilot call on the radio 'TURNING FINAL, GEAR DOWN' as the aircraft reached the end of the downwind leg. After the controller had transmitted the wind, 290°at 14 kt, and still unable to see the landing gear, he checked with binoculars and could see that both were fully retracted. He then called the aircraft and said 'HURRICANE, YOUR UNDERCARRIAGE IS NOT

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DOWN' but received no response. He tried to warn the pilot twice more as the aircraft completed the finals turn followed by the instruction 'HURRICANE GO AROUND I SAY AGAIN GO AROUND'. This call was also repeated but there was no response. The controller watched as the aircraft flared onto the runway on its belly and slid along the grass, coming to rest about halfway along the runway length. The controller pressed the crash alarm and broadcast to the fire crew that the Hurricane had landed wheels-up.

Before evacuating the aircraft, the pilot radioed the tower to express his incomprehension at what had happened. The controller replied that he had tried to warn him that his undercarriage was not down and had told him to go around. The fire crew arrived within three minutes and made sure the aircraft was safe. It was apparent that, apart from the extensive damage to the ventral radiator and the fuselage in that area, the airframe had been spared some of the typical consequences of a wheels-up landing. In particular, it appeared that some of the loads had been taken by the underwing bomb racks and damage to the extended flaps was slight. The metal propeller blades had been badly distorted.

Description of the Main Landing Gear (MLG)

The Hawker Hurricane has two retractable MLGs and a fixed tailwheel. Actuation of the MLGs and the flaps uses hydraulic power supplied by an engine driven pump. The selector in the cockpit is a combined flap and MLG lever working in an 'H' shaped gate, much like the selector in a four-speed manual gearbox car (Figure 1). When no flap or MLG selections are being made, the lever should be placed in the 'neutral' position. If flap selection is required, the lever is moved to the right and down and returned to neutral when the flaps have extended. If the MLG is then required to be lowered, the lever is moved to the left and down and returned to neutral when gear extension is confirmed by the illumination of two green lights on a unit to the left of the main instrument panel. A spring-loaded thumb-latch needs to be released each time the selector lever is moved from one of the operating positions but this is not the case when making a selection from neutral.

The MLG uplocks are released hydraulically upon a gear down selection and hydraulic jacks extend the legs until a geometric overcentre condition of the sidestays is achieved, effecting a downlock and closing two microswitches to illuminate the two green lights. If a failure of the engine-driven pump has occurred, then the pilot can use a hand pump to power the hydraulic system. Alternatively, there is also a foot-activated lever, directly linked to the uplocks, release of which should allow the MLGs to drop and downlock under gravity.

As a precaution against inadvertently landing with the landing gear retracted, an audio buzzer sounds when the throttle is less than about one third open without

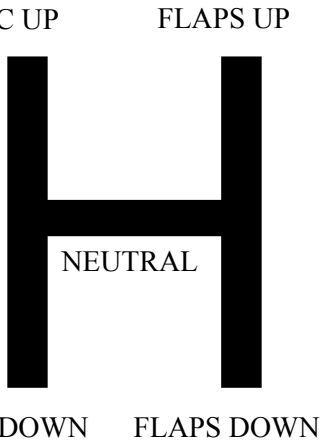

Figure 1

Schematic representation of the hydraulic selector lever gate

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the two green lights illuminated to indicate that both MLGs are down and locked. Some pilots have, over the years, apparently commented that this audio warning is not particularly loud or compelling and a modern modification is available to have the warning fed into the pilot's headset. G-HHII did not have this modification.

Investigation

The aircraft was found with the hydraulic selector lever in the U/C DOWN detent but the MLG was found in the locked UP condition. When the aircraft was recovered, the foot lever was activated to release the uplock and extension and downlock was achieved using the hand pump without any anomalies. No faults were found with the engine-driven hydraulic pump, the indicator lights or audio warning, although a detailed investigation of the hydraulic system is continuing.

The pilot, in his statement, said that he had slowed the aircraft to 110 mph to allow gear extension on the crosswind leg by climbing, as observed by the controller. He then made the landing gear DOWN selection as normal, just before selecting the flaps. He attributed the subsequent failure to extend as due to "a failure of a hydraulic link or system".

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ACCIDENT

Aircraft Type and Registration:	28-5ACF Super Catalina, N9767
No & Type of Engines:	2 x Pratt & Whitney R-1830 piston engines
Year of Manufacture:	1943
Date & Time (UTC):	24 September 2011 at 1205 hrs
Location:	Gublusk Bay, Enniskillen, Northern Ireland
Type of Flight:	Private
Persons on Board:	Crew - 3 Passengers - 4
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right elevator damaged
Commander's Licence:	Airline Transport Pilot's Licence (A)
Commander's Age:	62 years
Commander's Flying Experience:	18,000 hours (of which 400 were on type) Last 90 days - 50 hours Last 28 days - 20 hours
Information Source:	AAIB Field Investigation

Synopsis

The Catalina landed in the vicinity of Gublusk Bay, Lower Lough Erne, turned into wind and shut down its engines. It then drifted back into a yacht causing damage to the Catalina's right elevator. Despite a pilot's briefing, different expectations remained between the Catalina crew and marshal boat crews as to how the Catalina was intending to moor up, with the Catalina crew expecting that after they shut down the engines a 'tug boat' would tow them to the mooring, and the marshal boat crew expecting the Catalina to taxi to the mooring under its own power.

Background

The Fermanagh Seaplane Festival was held at Gublusk Bay, Lower Lough Erne, a World War II Catalina base, over three days, with the main event taking place on 24 and 25 September 2011. This was the second such event to be held at Lough Erne, with the previous event having taken place two years earlier. Eight aircraft participated in this year's event: five float planes, a Twin Seabee and two Catalina flying boats. One of the Catalinas was on the UK register and operated by a UK licensed crew; the other (N9767) was French owned, on the American register and operated by a French and Dutch crew. The UK Civilian Aviation Authority were content that the event, as advertised, did not constitute '*an airshow*', and so no permission was required for the organisers to hold the event.

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The UK operated Catalina arrived at St Angelo Airport, Enniskillen, before the event and the crew were taken on a marshal boat to familiarise themselves with the area that they would be using. The UK Catalina operated on the water in an independent manner; the crew's normal procedure involved water taxiing the aircraft under its own power to a mooring buoy, and then securing the aircraft to it. They did not normally require any assistance from tug boats. The UK Catalina had a modification which permitted the independent lowering of the landing gear legs, which increased the aircraft's manoeuvrability on the water. The crew spent some time before the event practising their procedures, whilst being observed by people who had agreed to participate in crewing boats for the main event.

The event organiser had arranged for a fleet of around ten marshal boats, and three divers, to be available. On the Thursday evening before the event, the Chief Marshal held a safety briefing for all the personnel involved in the water operations. This briefing included a look at the UK registered Catalina where the boat crews familiarised themselves with the position of the Catalina's mooring equipment and the divers became familiar with the position and operation of the doors and escape hatches. The boat crews also received training on how to provide assistance to float planes, should the need arise and were briefed to approach aircraft only in an emergency.

The French owned aircraft, N9767, and its crew, flew from France and arrived at St Angelo Airport, Enniskillen on the Friday afternoon before the event. The aircraft had recently been returned to an airworthy condition after a lengthy restoration program. The aircraft had not been operated on the water for more than ten years and, with the exception of the Dutch commander, the crew had limited experience of water operations. The commander gained his water experience when operating a Dutch Catalina. The standard operating procedure for the Dutch Catalina, in anything other than calm water conditions, was for the aircraft to taxi into a suitable location near its support boats, where it would shut down and then be towed by tug boat to the aircraft's mooring buoy. The tug boats would not approach the aircraft until the engines had been shut down. This was a passive procedure for the flight crew of the Catalina as the boat crew would attach the lines and then moor the aircraft to the buoy. N9767 and the Dutch Catalina did not have the aircraft modification which permitted independent lowering of the landing gear legs, and hence were less manoeuvrable on the water.

Weather

The weather situation over Northern Ireland was characterised by a moderate and partly unstable south-westerly flow, with the stability of the atmosphere decreasing towards the western side of Northern Ireland, this instability causing occasional showers. In the area of St Angelo, the observations indicated that there was scattered to broken cloud cover, with a main base at around 3,500 ft agl. Visibility was generally more than 20 km.

The wind at 2,000 ft was south-westerly at 25 kt with the surface wind being from 190º at 15 kt, with a risk of gusts of 20-25 kt around any showers.

Pilot's brief

At 0800 hrs on the Saturday morning, a brief for all the participants was held. The brief covered weather, ramp procedures, refuelling and any other business. Specific details on how the Catalina was to moor up were not covered during this brief. The participants

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were reminded that the boat crews had received training on the aircraft that were expected at the event throughout the day. The intention for the two Catalinas was for N9767 to take up its mooring on the water for 1030 hrs, and one hour later the UK registered Catalina would take up its mooring nearby. After the briefing N9767's commander completed a familiarisation trip on a marshal boat, with the Chief Marshal, around the area the Catalinas would be operating. It was agreed that one of the Catalina's French ground crew would accompany the Chief Marshal on his marshal boat, during the event. During the familiarisation trip the commander was shown the location of the mooring buoy, upwind access, departure routes and potential hazards but the need for a tug boat to tow the Catalina to the mooring, or how the Catalina was to be tied to the mooring was not discussed. N9767 was unable to make its planned mooring time, and so it was planned for it to arrive at the event about half an hour after the UK registered Catalina.

After briefings and discussions, the marshal boat crews expected that N9767 would taxi to the mooring buoy, in a similar manner to the UK registered Catalina, and that the French ground crewman would then assist the aircraft crew in securing the aircraft to the mooring. However, N9767's crew thought it was understood that they would shut down in the area of the moorings and be towed to the mooring buoy by the marshal boats.

History of the flight

The UK registered Catalina flew across to the festival areas, and self-moored as expected on its buoy at the agreed time of 1130 hrs. The flight crew described the conditions on the water as demanding, because of the prevailing wind.

N9767 was airborne shortly before 1200 hrs with seven persons on board: a crew of three, three journalists and in the co-pilot's seat, a war veteran, with over 1,200 hours as a commander of Catalinas. The aircraft performed a flypast of the festival, followed by a touch-and-go. The aircraft then landed again on the water and taxied into Gublusk Bay, towards the mooring buoy. When the Dutch commander could see small boats in his vicinity, he turned his aircraft into wind and shut down, to await the tug crews to tow the aircraft to the mooring buoy.

The marshal boat crews, the crew of the other Catalinas, and many other witnesses were surprised to see the engines on N9767 shut down and they assumed it must have a problem. The Chief Marshal with N9767's ground crewman were the first on the scene, and after a brief conversation they attempted to attach a line to N9767. The French ground crewman spoke limited English and the Chief Marshal could not speak French. Communications between the French ground crewman and the aircraft crew were predominately in French. Eventually a line was attached, but as they tried to take N9767 under tow, the line fell into the water and became tangled in the boat's propeller. The ground crewman then tried to prevent the boat from becoming separated from the Catalina, and ended up falling into the water. Another marshal boat arrived on scene and went to the aid of the ground crewman in the water, but its propeller also became tangled in the line, rendering the boat helpless. A third marshal boat arrived, but it was unable to prevent N9767 from drifting towards a moored yacht. Because of the proximity of small boats, N9767 was unable to restart its engines, and so it continued to drift backwards into the moored yacht, damaging its right elevator. (See Figure 1)

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Figure 1

The Catalina contacting the yacht

Recorded data

Video and photographic evidence shows N9767 entered Gublusk Bay at approximately 1205 hrs and, at about 100 m from its intended mooring point, it turned into wind, shutting down its engines at 1206 hrs. At this point there was a small rib in the vicinity of the Catalina, but this was not one of the dedicated marshal boats. Approximately one minute after the engines on N9767 were shut down the first marshal boat had arrived, and 15 seconds later the front hatch on the Catalina opened and the co-pilot began to communicate with the crew of the first marshal boat. Two minutes and thirty seconds later the Catalina's elevator made contact with the moored yacht.

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Figure 2

Damage to the Catalina's elevator

Comment

The accident was as a result of different expectations, by the Catalina crew and the marshal boat crews, on how the aircraft was to moor up following landing. This could have been resolved during the pilot's brief, held on the morning of the event.

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SERIOUS INCIDENT

Aircraft Type and Registration:	Agusta A109C, N109TK
No & Type of Engines:	2 Allison 250-C20 turboshaft engines
Year of Manufacture:	1991
Date & Time (UTC):	5 July 2011 at 0845 hrs
Location:	Near Kew Bridge, London
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Left windshield shattered
Commander's Licence:	Private Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	1,980 hours (of which 1,400 were on type) Last 90 days - 60 hours Last 28 days - 20 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further investigation by the AAIB

Synopsis

While the helicopter was cruising at 150 kt at 750 ft agl a bird struck and shattered the left windshield. The commander, seated in the left seat, suffered minor injuries so the co-pilot took control and made a successful emergency landing. The Agusta A109C's windshield is not designed to withstand bird strikes and the regulations do not require it to do so. The US National Transportation Safety Board has recommended to the US Federal Aviation Administration that the regulations covering helicopters of the Agusta A109C's category should require a birdstrike-resistant windshield.

History of the flight

The helicopter had departed from London Battersea heliport and was transiting along helicopter route H10 at 750 ft agl and 150 kt when a bird struck and shattered the left windshield. The commander, who was flying the helicopter from the left seat, was struck by pieces of windshield and parts of the bird. The co-pilot, seated in the right seat, took control of the aircraft and after declaring a MAYDAY made an emergency landing in a field near Kew Bridge. The commander had sustained a few cuts and grazes but did not require medical attention.

Damage to the helicopter

The upper portion of the left windshield, which was made of acrylic, had shattered into multiple sections

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(Figure 1). The maintenance organisation's engineer reported that the largest of these was about 30 cm by 45 cm, several pieces were about 15 cm by 15 cm, and many other pieces were much smaller. He reported that none of the pieces had broken into sharp fragments. The windshield was of a type that had a thickness of 3.81 mm ± 0.5 mm (part number 109-0310-27-3).

The photographic evidence revealed substantial blood spatter on the left door post adjacent to the commander's seat indicating that the bird probably struck this post after shattering the windshield. The bird, which was mostly intact, was found inside the helicopter and was identified as a Herring Gull. The bird was not sent for analysis but the typical weight of a Herring Gull is 690 to 1,495 g and the species is classified as 'High' on the Hazard Probability list[1].

Figure 1

Damage to the left windshield of N109TK

Previous incidents of A109 bird strikes

The aircraft manufacturer was aware of three previous birdstrike incidents involving the A109 type. One of these (A109E, registration N911UF) occurred on 3 May 2009 in Florida, USA and was investigated by the US National Transportation Safety Board (NTSB). The NTSB reported that while descending at 145 kt through 800 feet the windshield '*exploded*' and the pilot was '*pelted'* with pieces of windshield and other debris.

> *'The master caution warning light started flashing, but the pilot had difficulty reading the caution warning lights as the left lens to his eyeglasses was missing. The pilot was eventually able to determine that SAS[2] number 1 had been disengaged, and after resetting the switches, the master caution light extinguished.'*

Several circuit breakers and switches were broken off and some switches had moved to the OFF position. The pilot landed the aircraft safely and post-flight examination revealed that a 1 to 1.5 kg duck had come to rest inside the cabin. The NTSB report also noted that:

> *'there was no forward shielding of the overhead panel switches and throttles.'*

Another A109E suffered a bird strike in the USA in October 2006 but was not reported by the NTSB. The aircraft manufacturer stated that the bird strike created a 20 cm hole in the right windshield and the pilot sustained minor abrasions to his face but landed safely.

The third birdstrike incident occurred to an A109E in Mexico in November 2009 and resulted in most of the right windscreen being destroyed. The unidentified

Footnote

[1] The bird classification on the 'Hazard Probability List' for aircraft is made by the Food and Environment Research Agency (FERA).

[2] SAS is the stability augmentation system.

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bird came to rest to the right of the right rear passenger seat. The pilot suffered minor injuries but was able to land safely.

Birdstrike requirements

The Agusta A109C was certified to US Federal Aviation Administration (FAA) Regulation Part 27 (FAR 27) in 1989. FAR 27 applies to rotorcraft with maximum weights of 7,000 lb (3,175 kg) or less and up to nine passenger seats. The only requirement in FAR 27 for windshields is as follows:

> ***'27.775 Windshields and windows***
>
> *Windshields and windows must be made of material that will not break into dangerous fragments.'*

There are no requirements in FAR 27 relating to birdstrike resistance. The European Aviation Safety Agency (EASA) Certification Specification 27 (CS-27) contains the same windshield requirement as in FAR 27 and no additional requirements for birdstrike resistance. The use of acrylic (also known as Plexiglas™ or Perspex™) for the windshield material is accepted by industry for applications where breakage into dangerous fragments is not permitted.

Rotorcraft with a maximum weight greater than 7,000 lb or with more than nine passenger seats are certified to FAR 29 which includes birdstrike resistance requirements. FAR 29.631 '*Bird Strike*' requires that the rotorcraft is designed to ensure the capability of safe landing[3] after impact with a 1.0 kg bird when the speed of the rotorcraft is equal to the lower of V_{NE} or V_H[4] at altitudes up to 8,000 feet.

In November 2010 the US NTSB wrote to the FAA with safety recommendations following an investigation of a Sikorsky S-76C birdstrike accident which resulted in eight fatalities (registration N748P). The S-76C is certified to Part 29, but the NTSB's letter included the following statement:

> *'...no bird-strike requirements exist for CFR Part 27 normal-category helicopters, even though they are frequently used for commercial operations such as emergency medical services and sightseeing flights. The NTSB concludes that Part 27 helicopters should be held to the same safety standards regarding bird-strike resistance as Part 29 helicopters, particularly given the data accumulated by the military and civilian bird-strike databases.'*

This was accompanied by the following NTSB Safety Recommendation to the FAA:

> *'Revise 14 Code of Federal Regulations Part 27 to specify a bird weight and velocity of impact that the helicopter must withstand and still be able to land safely and that the windshield must withstand without penetration. Consider current military and civilian bird-strike database information and trends in bird populations in drafting this revision. (A-10-147)'*

The FAA responded to this recommendation in January 2011 by stating that they are reviewing

Footnote

[3] For Category A rotorcraft (greater than 20,000 lb and 10 or more passenger seats) there is an additional requirement of 'continued safe flight'.

Footnote

[4] V_{NE} is the 'never exceed' speed and V_H is the maximum speed in level flight with maximum continuous power.

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multiple bird-strike databases to determine whether Part 27 should be included in the rotorcraft regulatory and policy review, and that an updated response would be provided in December 2011.

In 2008/9, as part of its rulemaking activity, the EASA contracted a study, covering all aircraft categories, to investigate the adequacy of current aircraft certification requirements in relation to current and future risks on aircraft structures and windshields. The final report *'Bird Strike Damage & Windshield Bird Strike (EASA 5078609-rep-03)'* is available on the EASA website. The study included conclusions that airframe bird strikes are a relatively rare cause of accidents, that CS-27 category helicopters appear to have a higher accident rate due to bird strikes than the other aircraft categories and that a requirement that small helicopter windshields withstand collision with a 2lb/1kg bird would significantly reduce the birdstrike accident rate.

The study report recommended that CS-27 be enhanced, preferably to include a 2lb/1kg windshield birdstrike capability. EASA comments that this task has been added to the rulemaking programme, including evaluation of the cost and weight impact against the safety benefit of regulatory change.

Birdstrike-resistant windshields

The aircraft manufacturer offers a birdstrike-resistant windshield as an optional extra for newer versions of the A109 such as the E, K2 and Grand models. This windshield is made of a 5 mm thick polycarbonate material (Lexan Optigard VLG1000) which conforms to specification MIL-P-83310.

Analysis

This serious incident was caused by a Herring Gull striking the helicopter's left windshield at a relative speed of about 150 kt. The commander suffered cuts and grazes as a result of being struck by pieces of acrylic and bird remains, but the bulk of the bird appears to have hit the left door post to the left of the commander's head. The Agusta A109C's windshield is not designed to withstand bird strikes and the applicable Part 27 regulations only require that it does not break into dangerous fragments. Larger helicopters, certified to Part 29, are required to be fitted with a birdstrike-resistant windshield and the NTSB has recommended to the FAA that a similar requirement be developed for Part 27 helicopters. As of December 2011 the FAA had not published a decision on the recommendation.

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ACCIDENT

Aircraft Type and Registration:	Beech 76 Duchess, G-OADY
No & Type of Engines:	2 Lycoming O-360-A1G6D piston engines
Year of Manufacture:	1978
Date & Time (UTC):	17 September 2011 at 0915 hrs
Location:	Leeds Bradford Airport
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to the nose cone, nosewheel bay doors, both propellers and both engines
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	1,820 hours (of which 223 were on type) Last 90 days - 108 hours Last 28 days - 35 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The nose landing gear collapsed during the landing roll. The selection lever had been moved several times during the flight, as part of a training exercise, and may have been left slightly out of position, although no warning was generated.

History of the flight

The aircraft was being flown by a pilot undergoing instruction for a Commercial Pilot's Licence. One of the exercises carried out on the detail was to practise stalling in the landing configuration. The exercise was completed successfully and the aircraft was flown back towards Leeds Airport.

Shortly before joining the downwind leg of the circuit, the pilot-under-instruction noticed and commented to his instructor that, at 110 kt IAS, the airspeed was some 5 kt to10 kt lower than he expected. The power setting and flap positions were checked and it was noticed that the landing gear was down, with an indication of three green lights. The instructor had earlier heard the pilot-under-instruction call "gear up", after the last stall recovery, and seen him reach for the landing gear selector lever. He thought it was unusual that this was done but that the action was not, apparently, completed by selecting the landing gear UP. However, both pilots put it down to an inadvertent error by the pilot-under-instruction and gave it no further thought.

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The aircraft was about to join the circuit so the landing gear was left down. When downwind, the pre-landing checks were carried out, which included a verbal check of "gear down and check three greens": a further check of the landing gear was also made on final approach. The aircraft landed normally but about 100 m to 150 m into the landing roll the nose landing gear collapsed and the aircraft came to an abrupt halt. Before evacuating, the pilots noted that the landing gear lever was in the UP position.

Discussion

There have been a number of occasions when the landing gear on this type of aircraft has retracted during the landing roll as a result of a mistaken UP selection of the landing gear lever. The landing gear interlock depends upon an airspeed switch which becomes active at between 59 kt and 63 kt; there is no weight on wheels switch. If the landing gear is selected UP at an indicated airspeed greater than this, it will retract. The switch on G-OADY was tested following this event and found to operate within this speed range.

Further tests by the operator's maintenance organisation, using other aircraft of the same type raised on jacks, showed that when the landing gear has been locked down it is then possible to move the selector lever UP a small distance and break the hydraulic lock. However, they reported that this was difficult to do, because the landing gear lever has to be pulled out before it is moved up. The three green lights can remain ON in this condition but the landing gear is unsafe. It was impossible to get the three green lights indication when not fully lowering the landing gear because they do not come on until after the hydraulic lock has been made.

After the incident the Chief Flying Instructor, flying the same type of aircraft, was able to recreate the condition in flight, whereby the three green landing gear indication lights were ON but the landing gear was not locked down. He commented that it was difficult to achieve.

Both pilots were certain that the landing gear lever had not been selected UP during the landing roll. They thought that the lever could, perhaps, have been knocked upwards accidentally by contact with the pilot-under-instruction's knee during the landing. However, when testing this theory afterwards, they determined that, because the selector has to be pulled out before it is moved up, it could not have been knocked up accidentally from the locked down position. However, if the selector had been pulled out earlier, and thus was not locked-down, then it would have been possible to knock it up accidentally.

Safety action

The company's Standard Operating Procedures require flaps to be selected UP once the runway has been vacated and, in the event of a touch-and-go, the instructor to raise the flaps when the aircraft has decelerated to a safe speed. Since the accident the operator has added a requirement for a physical check of the landing gear lever position, as well as a visual observation of three green lights when confirming that the landing gear is down.

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ACCIDENT

Aircraft Type and Registration:	Piper PA-18-150 (Modified) Super Cub, G-BJIV
No & Type of Engines:	1 Lycoming O-360-A3A piston engine
Year of Manufacture:	1965
Date & Time (UTC):	30 August 2011 at 0950 hrs
Location:	Yorkshire Gliding Club, Sutton Bank, North Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Landing gear bracket fractured
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	29 years
Commander's Flying Experience:	934 hours (of which 400 were on type) Last 90 days - 44 hours Last 28 days - 29 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

The aircraft was being used as a glider tug. During the takeoff run for an aero-tow it experienced a failure within the right landing gear, causing the right wingtip to contact the ground. The pilot released the tow and shut down the engine to avoid damage to the propeller. The aircraft then turned through approximately 270° to the right before coming to rest with no further damage.

It was found that a steel bracket reacting the right gear bungee loads had developed a concealed crack, causing the bracket to fail, thereby unloading the bungee and allowing the wheel attachment to migrate upwards.

On this aircraft type each main landing gear is equipped with a cable to carry the normal suspension loads should a bungee failure occur. On this occasion, the cable on the right gear unit functioned as designed and was able to carry the support loads following the bracket failure. This limited the wheel travel and prevented extensive damage to the aircraft. It did not, however, prevent the wingtip from contacting the ground.

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ACCIDENT

Aircraft Type and Registration:	Piper PA-22-160, Super Pacer, G-BTLM
No & Type of Engines:	1 Lycoming O-320-B2A piston engine
Year of Manufacture:	1958
Date & Time (UTC):	13 November 2011 at 1330 hrs
Location:	Leicester Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Substantial
Commander's Licence:	Private Pilot's Licence
Commander's Age:	70 years
Commander's Flying Experience:	676 hours (of which 433 were on type) Last 90 days - 2 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The engine did not respond to the pilot's application of full throttle when he attempted fly a go-around from final approach. In an attempt to recover engine power he pumped the throttle, but this caused the engine to stop. A forced landing was conducted in a field during which the right wing stuck a small tree. The pilot vacated the aircraft via the rear door (on the left side of the aircraft) as the damaged right wing was blocking the front door, which is on the right side.

Discussion

The pilot reported that the rate of descent with full flap and a stationary propeller was much greater than he expected. His forced landing practice was usually started from a cruise configuration at around 2,000 ft with no flaps and the engine at idle.

He commented that carburettor icing was the most likely cause of the engine's failure to respond as the conditions were conducive to its formation following the clearance of recent fog.

CAA Safety Sense Leaflet 14, '*Piston Engine Icing'*, contains useful information on how to avoid induction system icing.

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ACCIDENT

Aircraft Type and Registration:	Piper PA-23-160, N100MC
No & Type of Engines:	2 Lycoming 0-320-B3B piston engines
Year of Manufacture:	1972
Date & Time (UTC):	16 December 2011 at 1500 hrs
Location:	Mount Airey Farm, South Cave, Humberside
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Landing gear and left wing extensively damaged. Both propellers bent and engines shock-loaded
Commander's Licence:	Private Pilot's Licence
Commander's Age:	44 years
Commander's Flying Experience:	374 hours (of which 12 were on type) Last 90 days - 31 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

Synopsis

The left engine lost power during the approach to land when the aircraft was configured with the landing gear and flaps extended. The pilot decided to carry out a forced landing in a field and the aircraft was extensively damaged during the subsequent heavy landing.

History of the flight

The aircraft, which was US registered, had recently been returned to an airworthy condition after having been stored for four years. The last annual inspection had been completed approximately 13 flying hours and 12 flights prior to the accident and during this period it had been refuelled on a number of occasions with unleaded petrol (MOGAS) obtained from a garage forecourt. The pilot stated that he would test the MOGAS for the presence of Ethanol, which is a type of alcohol, before refuelling his aircraft.

Prior to the start of the accident flight, the pilot refuelled the aircraft with around 60 ltr of unleaded MOGAS, which he strained through a filter to remove any water. The engine power checks were carried out satisfactorily, with magneto drops of less than 100 rpm on each engine. The flight in the local area was uneventful and after approximately 35 minutes, the pilot commenced a descent from 2,500 ft (agl) to land on Runway 07 at Mount Airey Airfield. Carburettor heat was selected ON and at a height of approximately 600 ft the landing

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gear and flaps were lowered. The aircraft was now approximately one nm from the runway threshold and the pilot noticed that there was some low cloud between the aircraft and airfield. He therefore decided to reposition the aircraft for a landing on Runway 25. The carburettor heat was selected to OFF, power was increased on both engines and the pilot commenced a turn to the left. At this point the pilot realised that he had lost power on the left engine and, with full right rudder applied, he experienced difficulty in maintaining directional control and returning the wings to a level attitude. The pilot stated that he was aware that with only one engine producing power the aircraft would only be able to achieve a significant climb rate with the flaps and landing gear retracted. However, there was only one engine-driven hydraulic pump on the aircraft, which was fitted to the left engine that had just failed. As he was now very close to his asymmetric committal height[1], and there were a row of electrical pylons ahead of him, he decided to carry out a forced landing rather than attempting to improve the aircraft handling and performance by manually raising the landing gear and flaps with the hand-operated hydraulic pump. The pilot stated that he flared slightly high, which resulted in the aircraft stalling at a height of approximately six feet, and the nose leg and left main landing gear collapsed during the subsequent heavy landing. The pilot and passenger where uninjured and vacated the aircraft through the aircraft door.

Examination of the wreckage

From the examination of the wreckage it was determined that neither propeller had been feathered. The damage and score marks on the propeller blades was consistent with the left propeller wind-milling and the right propeller being driven at low power when they struck the ground. Both engines turned freely, the spark plugs on the left engine were within the expected colour range and there was fuel in both wing fuel tanks. However, it was noted that fuel drained from the carburettor fuel inlet pipe on the left engine did not have the blue tinge associated with AVGAS 100LL. The nose landing gear had detached from the aircraft and the left main landing gear had collapsed. There was also some structural damage to the aircraft nose section, flaps and left wing. All the damage to the aircraft was consistent with a heavy landing.

Authorised fuel

The aircraft Flight Manual and the engine Type Certificate Data Sheet (E-274) permit the aircraft and engine to operate on aviation gasoline with a minimum grade of 91/96 octane (AVGAS 91/96). AVGAS 100LL is considered to be a suitable alternative to AVGAS 91/96, which is no longer available.

The engine manufacture does not approve the use of 'automotive fuels in their engines'. However, for 'N' registered aircraft, Supplemental Type Certificates (STC) have been approved by the Federal Aviation Authority for automotive fuels that comply with ASTM D-4814 to be used on the Lycoming 0-320-B engine. These STC normally place restrictions on the operation of the aircraft and may require modifications to be carried out to the aircraft fuel system. While no such STC had been obtained for N100MC, an STC was available to permit this aircraft and engine combination to operate with unleaded and leaded MOGAS that met ASTM specification D-439 or D-4814.

Footnote

[1] Asymmetric Committal Height is considered as the minimum height from which an asymmetric approach may be abandoned to achieve a safe climb at V_{yse}(Single engine best rate of climb speed).

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Aviation Gasoline (AVGAS)

General

Aircraft engines are designed to operate on a fuel with a specified octane rating. If a fuel with a too low an octane rating is used, then under an increasing engine power demand detonation may occur, which can cause damage to the engine and result in a loss of power. This detonation is also known as 'knocking' which is not always possible to hear above the noise from an aircraft engine.

Octane rating

The octane rating of a fuel is an indication as to how much the fuel can be compressed before it spontaneously ignites. There are four principal ways to measure Octane rating: Research Octane Number (RON), Motor Octane Rating (MON), Aviation Lean Mixture and Rich Mixture Rating. Motor Gasoline (MOGAS) is measured using the RON while Aviation Gasoline (AVGAS) is measured using the Aviation Lean and Rich Mixture Rating, which gives similar results to MON. As a result of these different ratings it is not possible to make a direct comparison between the published octane ratings for MOGAS and AVGAS. The equivalent minimum and typical octane ratings of AVGAS and MOGAS using the MON rating are shown in Table 1.

MOGAS

MOGAS is not intended for aviation use and in comparison with AVGAS has different physical properties and quality requirements. CAA Safety Sense leaflet 4 *'Use of Motor Gasoline (MOGAS) in Aircraft'* provides advice on the use of MOGAS, the additional quality checks to be carried out on the fuel, additional maintenance requirements and entries that have to be made in the aircraft and engine log books.

CAP 747[2] authorises the use of 4-star MOGAS, to BSI specification BS 4040: 2001, in low compression ratio non-supercharged engines provided it has been supplied from an airfield facility. The PA-23 and Lycoming 0-320-B aircraft and engine combination has not currently been approved by the CAA to operate on 4-star MOGAS, though they have approved the use in Lycoming 0-320-B engine on other aircraft. CAP 747 also permits[3] certain combination of aircraft and engines to operate with 4-star MOGAS obtained from filling station forecourts. Some aircraft types are also permitted to operate on unleaded MOGAS that meets BSI EN228:2004 (normal unleaded MOGAS) or BS7070 (leaded 4-star MOGAS). The PA-23 aircraft and Lycoming 0-320-B engine combination has not been approved to use either 4-star obtained from a forecourt or unleaded MOGAS.

Fuel	Minimum MON	Typical MON
AVGAS 100LL	99.6	101 to 103
AVGAS 91	90.6	93
High octane unleaded MOGAS	86	86.2
Unleaded MOGAS	85	85.2

Table 1

Footnote

[2] CAP 747, Section 2, Part 4, GC2, GC 3, GC 4 and GC 5.
[3] CAP 747, Section 2, Part 4, Schedule 1 to GC No3 and GC 5.

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MOGAS can contain alcohol in the form of Ethanol, the use of which is currently prohibited in aviation. Therefore, even when an STC has been obtained, or the CAA has authorised its use, MOGAS must be tested for the presence of alcohol before the aircraft is refuelled.

Factors to consider when using MOGAS

In comparison with AVGAS, factors such as the stability of fuel in storage are not as good for MOGAS. Consequently, over time MOGAS may suffer a loss of octane rating and form gum deposits that can cause intake and exhaust valves, and fuel metering valves to stick. The additives in the fuels are also chemically different and can cause corrosion and increase the amount of water in the fuel. Alcohol in MOGAS can also adversely affect seals and elastomers, and the fuel's vapour pressure[4] such that there is an increased likelihood of vapour lock occurring.

Lead additives are normally used to control the rate of combustion and in unleaded fuels these have been replaced with other components, such as aromatics. If the engine is not designed to operate on unleaded fuel then the different speed of combustion can result in hotter exhaust gasses that can damage the crown of the pistons, the exhaust valves and their seats. Aromatics can also damage seals in the aircraft and engine fuel systems.

Comment

The pilot was faced with a loss of power on the left engine while at a relatively low height during the approach to land. His difficulty in maintaining straight and level flight was probably due to the drag from the left propeller, which had not been feathered and continued to windmill. A single engine go-around from a low height contains a significant level of risk and with the landing gear and flaps extended the PA-23-160 has minimal single-engine climb performance. Approaching his asymmetric committal height, and with electrical pylons ahead, the pilot made the decision to conduct a forced landing in a field. However, there was a large dip in the first part of the field which, with his difficulty in handling the aircraft, might have contributed to his misjudging the height of the flare. The damage to the aircraft was consistent with the pilot's account of stalling at a low height.

It cannot be determined if the use of unleaded MOGAS contributed to the engine failure. The use of this fuel can damage the seals in the aircraft and engine fuel system, and cause long-term damage to the engine. The engine is also more prone to carburettor icing, vapour lock and a loss of power due to detonation 'knocking'. The presence of alcohol in the fuel can also damage seals and cause a loss of power.

Footnote

[4] Vapour pressure can be thought of as the ease by which a liquid turns into a gas.

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ACCIDENT

Aircraft Type and Registration:	Piper PA-24-250 Comanche, G-BYTI
No & Type of Engines:	1 Lycoming O-540-A1D5 piston engine
Year of Manufacture:	1963
Date & Time (UTC):	17 July 2011 at 1230 hrs
Location:	Field near Gamston Airport, Nottinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller, fuselage, flaps, right wing spar
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	394 hours Last 90 days - 14 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

Synopsis

Following takeoff from grass Runway 24 at Sherburn-in-Elmet Airfield, the landing gear failed to retract fully. The pilot was unable to lower the landing gear either by normal means or by using the emergency extension system. The pilot carried out a wheels-up landing in a crop field adjacent to Runway 21 at Gamston Airport. The propeller and lower fuselage skin were damaged during the landing, but the pilot and passenger were uninjured and vacated the aircraft without assistance.

It was determined that deflation of the right landing gear oleo had prevented full retraction of the landing gear. During subsequent attempts to lower the landing gear, a clevis pin in the landing gear operating mechanism had fouled against the edge of an access hole in a structural beam and jammed, preventing the landing gear from operating.

History of the flight

The aircraft was being flown by two qualified pilots who intended to conduct some circuits and local flying from Gamston Airport. After completing two circuits with full stop landings at Gamston, Pilot A flew the aircraft to Sherburn-in-Elmet Airfield. The approach and landing on grass Runway 24 and the taxi to the tarmac parking area at Sherburn were uneventful. After a short break at Sherburn, Pilot B (hereafter referred

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to as 'the pilot') elected to fly the aircraft back to Gamston. He reported that the aircraft walkround and pre-takeoff checks were completed normally. The pilot subsequently described the takeoff run on Runway 24 as somewhat bumpy, but no more so than he considered reasonable for a departure from a grass surface.

When the pilot selected the landing gear selector switch to UP at 500 ft, he observed that the amber indication light above the gear selector switch did not illuminate to indicate that the landing gear was up and locked. He also noted that the landing gear emergency handle was in approximately the 45º position. The pilot continued the climb to 2,000 ft and turned towards Gamston. He recycled the landing gear selector switch a number of times, but the landing gear did not move. On arrival at Gamston he declared a PAN and carried out two fly-pasts. ATC confirmed that the landing gear appeared to be partially retracted. Further attempts by the pilot to lower the landing gear were unsuccessful and he then operated the emergency landing gear extension system, also without success. He performed another fly-past and ATC reported that the landing gear was still in the same position. The pilot then departed the circuit to the south of the airfield in order to use up some fuel prior to landing. On returning to Gamston, he elected to land in a field of rapeseed crop to the right of asphalt Runway 21.

The aircraft landed in the field, coming to rest after a ground run of 27 m; the propeller struck the ground causing the aircraft to turn through approximately 300º. Both pilots were uninjured and were able to vacate the aircraft through the normal exit without assistance.

Maintenance information

Some weeks prior to the accident the pilot had noticed during a pre-flight walkround that the right landing gear oleo was slightly deflated. It was subsequently re-inflated to the correct extension by a maintenance engineer and no further problems were reported. The aircraft underwent a 6 month/50 hour check on the day prior to the accident and there were no findings related to the landing gear.

After the accident the right landing gear oleo was observed to be fully compressed.

Landing gear system description

The PA-24 Comanche has a fully retractable, electrically operated tricycle landing gear. The air-oil oleo struts of the main landing gear legs must extend in order to provide sufficient clearance to allow the wheels to enter the wheel well during the retraction cycle; the Pilots' Operating Handbook advises that it is important that the aircraft is not operated with flat or deflated oleos.

The retraction mechanism consists of an electric motor, transmission assembly and torque tube assembly, which actuate push-pull cables and rods to each of the landing gear legs. The motor is activated by a selector switch on the instrument panel. An anti-retraction switch on the left main gear prevents the electric circuit to the landing gear motor from being completed until the gear oleo is fully extended.

If the electric motor fails, an emergency extension system can be operated. This requires the pilot to move the landing gear electrical selector switch to the OFF position so that the motor does not oppose the movement of the gear mechanism when the gear is manually lowered. The pilot must then position the electrical release arm fully forward to disconnect

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the electric motor from the gear operating mechanism before opening the emergency extension handle. This moves backwards and forwards in normal operation as the gear is raised and lowered and therefore provides a coarse indication of gear position; the telescopic handle is extended to lower the landing gear manually.

Aircraft examination

The aircraft was examined by the AAIB after it had been recovered to a maintenance facility and the landing gear lowered. A small dent was noted on the right wing lower skin on the aft edge of the wheel well. The dent was consistent with the right main landing gear torque link having contacted the edge of the wheel well.

Examination of the landing gear retraction system revealed evidence that a clevis pin attaching the nose landing gear push-pull rod to the torque tube assembly had fouled against the web of a longitudinal beam and become jammed on the edge of an access hole in the web (Figures 1 and 2).

The web of the longitudinal beam was slightly bowed inboard. It was likely that this distortion resulted from attempts to lower the gear after the clevis pin had become jammed against the web.

Discussion

The pilot considers that the right landing gear oleo deflated during the takeoff run at Sherburn-in-Elmet. As a result the torque link became wedged against the edge of the wheel well during retraction, preventing the landing gear from retracting fully. The landing gear retraction motor would have continued to run, attempting to overcome the resistance caused by the jammed torque link. It is likely that the forces

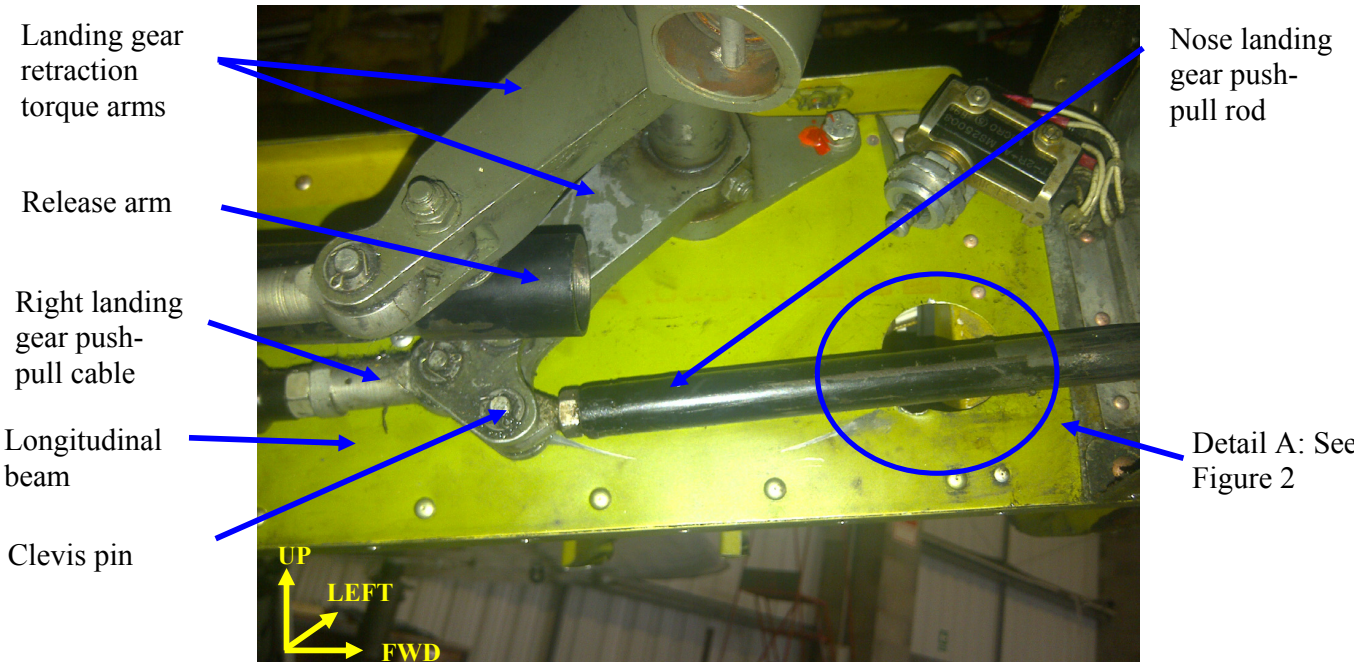

Figure 1

View looking left on landing gear retraction system, landing gear in extended position

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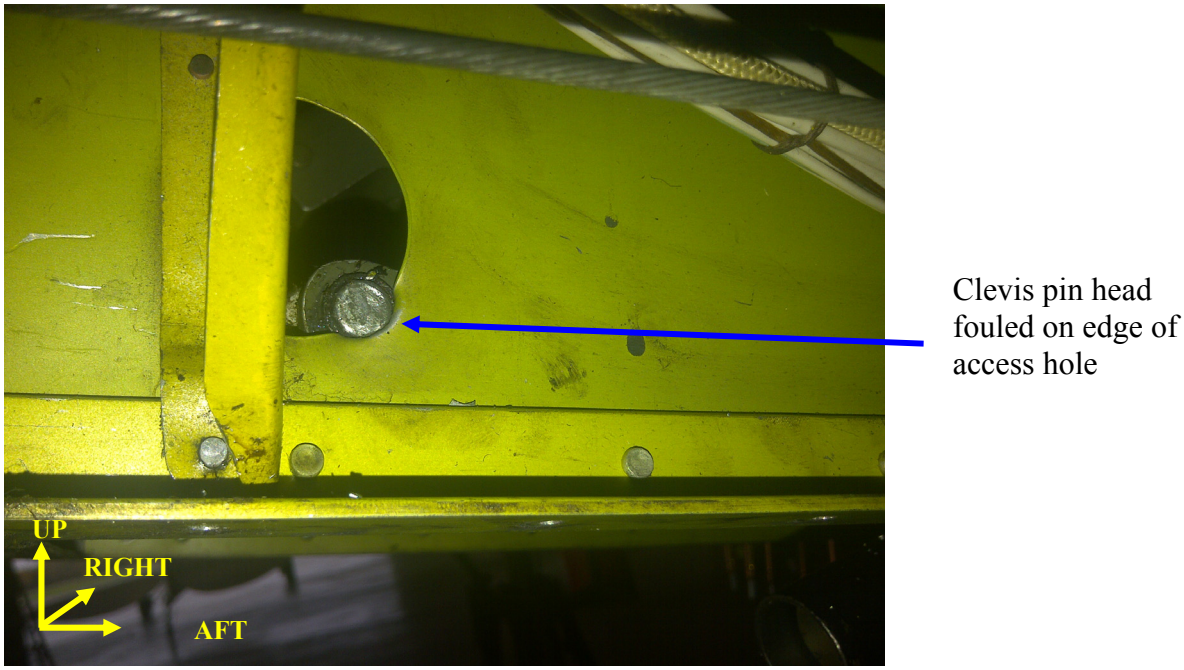

Figure 2

Detail A from Figure 1: Clevis pin fouled on edge of access hole in web of longitudinal beam, landing gear partially retracted

associated with this may have caused misalignment in the transmission assembly, sufficient to reduce the clearance between the nose landing gear push-pull rod and the longitudinal beam, leading to interference between the clevis pin and the beam. In this condition it was not possible to lower the landing gear either by the normal method or with the emergency extension system. The aircraft manufacturer was not aware of any previous similar occurrences of the clevis pin fouling on the longitudinal beam.

The reason for the right landing gear oleo deflation could not be determined from strip examination but all the seals were replaced as a precaution.

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ACCIDENT

Aircraft Type and Registration:	Piper PA-28-140 Cherokee, G-ZANG
No & Type of Engines:	1 Lycoming O-320-E3D piston engine
Year of Manufacture:	1972, Serial no: 28-7225178
Date & Time (UTC):	22 October 2011 at 1625 hrs
Location:	Netherthorpe Airfield, South Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Damage to propeller, engine, both wings, nosewheel, instrument panel and windows
Commander's Licence:	Private Pilot's Licence
Commander's Age:	35 years
Commander's Flying Experience:	203 hours (of which 127 were on type) Last 90 days - 8 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During takeoff from Runway 24 at Netherthorpe the pilot realised there was insufficient runway ahead. He aborted the attempt but was unable to prevent the aircraft from colliding with bushes beyond the end of the runway.

History of the flight

The pilot, who had flown from Netherthorpe on "three or four occasions", departed Blackpool earlier in the day with the fuel level described as "below tabs", meaning that the tanks would be approximately two-thirds full. The aircraft was not refuelled after arrival at Netherthorpe.

Runway 24, which has a takeoff run available (TORA) of 490 metres, was used for the intended return flight to Blackpool. The first stage of flap was selected for takeoff. In his short report, the pilot commented that the headwind component had reduced close to the anticipated takeoff point. Having reached the "point of no return" he assessed that there was insufficient runway remaining and decided to abort the takeoff. However he was unable to prevent the aircraft from colliding with bushes beyond the end of the runway, before crossing a road and coming to rest in a field on the far side.

Other information

A weather observation taken on the airfield before the accident recorded a temperature of 13ºC, CAVOK and a wind direction and speed of 180º and 8-10 kt. Conditions

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were reported as dry, although the pilot stated that the grass on the runway was damp.

Reference to the performance charts in a generic flight manual for this aircraft type revealed that, for an assumed aircraft weight of 1,500 lb (the maximum takeoff weight being approximately 2,150 lb) and a temperature of 13ºC, the required 'still air' takeoff distance from rest to a height of 50 ft was approximately 1,400 ft, or 427 m. This figure accounted for the 1.9% uphill gradient of Runway 24 and the airfield elevation of 250 ft but is otherwise valid for a dry 'Tarmac' surface and the flaps in the retracted position. Notes in the flight manual indicated that the derived value should be increased by 6.5% for a short, dry grass runway surface which gave a revised takeoff distance of 455 m. No data was provided for the flaps in their extended position, although most flying schools using PA-28 series aircraft tend to promote the use of the second stage of flap for 'short field' takeoffs.

The pilot did not provide sufficient information to enable an accurate assessment to be made of the aircraft weight, with the 1,500 lb value used above being a typical weight with two average-sized occupants and half to two-thirds full of fuel. Thus the derived takeoff distance of 455 m provides only an approximate guide, although the performance charts clearly indicated that there was insufficient runway length for a takeoff at maximum aircraft weight. In addition, grass length, soft ground and/or low tyre pressures, incorrect technique, degradation in engine and propeller performance would all serve to increase the takeoff distance.

In conclusion, this accident highlights the necessity of consulting the aircraft's flight manual or pilot's operating handbook prior to conducting a takeoff on limiting runways. In addition, the UK CAA's Safety Sense Leaflet No 7 contains relevant information on such topics as the use of performance data, performance planning and the application of safety factors.

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ACCIDENT

Aircraft Type and Registration:	Piper PA-32RT-300 Cherokee Lance II, G-RHHT
No & Type of Engines:	1 Lycoming IO-540-K1G5D piston engine
Year of Manufacture:	1978
Date & Time (UTC):	3 June 2011 at 1243 hrs
Location:	Wycombe Air Park, Buckinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 4
Injuries:	Crew - 1 (Minor) Passengers - 4 (Minor)
Nature of Damage:	Left wing severed, right wing attachment, stabilator and propeller damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	32 years
Commander's Flying Experience:	195 hours (of which 57 were on type) Last 90 days - 14 hours Last 28 days - 14 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft struck a hedge at the aerodrome boundary during an attempted takeoff. Its weight and centre of gravity (CG) were outside the flight envelope, and the runway length was marginal for takeoff. These factors probably combined to cause the pilot to over-control the aircraft in pitch resulting in the aircraft failing to gain height after takeoff.

History of the flight

The pilot had flown the aircraft with one passenger from its base at Sywell, Northampton to Wycombe Air Park with the intention of picking up three more passengers and flying to the Isle of Man (IOM). On arrival at Wycombe Air Park, the pilot consulted with the pilot of another aircraft flying to IOM and filed a VFR flight plan to Ronaldsway. The accident aircraft was refuelled to 60 USG. The pilot met his three passengers by the aircraft and loaded their overnight bags with his own in the rear baggage compartment. The passengers then boarded the aircraft and the passenger who had accompanied the pilot from Sywell re-boarded in the front right seat. One passenger sat in a mid-row seat which was rear-facing and the other two passengers sat in the two rear seats.

The pilot started the aircraft and taxied to Runway 06 for takeoff, following the other IOM-bound aircraft. The first aircraft took off without incident, although the

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ATCO on duty recalled that the aircraft used most of the runway to get airborne. The accident aircraft lined up at the start of Runway 06 and commenced takeoff at 1243 hrs. The pilot used Flap 2, consistent with the short-field takeoff technique for this aircraft. Acceleration on the ground and engine indications appeared normal.

The pilot started to rotate the aircraft at 65 KIAS and, as it became airborne, he realised that it was no longer accelerating or climbing. He recalled that he felt a rumble or buffet and that the aircraft was "wallowing". He checked forward slightly on the control column to keep the aircraft in ground effect but still felt that it would not climb or accelerate. The aircraft then struck a hedge at the boundary of the airfield and came to rest inverted in the field beyond. The front seat passenger and pilot vacated the aircraft through the left window and the other passengers exited through the right door. One passenger required medical treatment for lacerations to his ear.

Witness information

The passenger occupying the right front seat recalled that the takeoff appeared normal until the aircraft rotated. She stated that the aircraft "did not feel right" and that it was not climbing. She remembered looking across at the airspeed indicator and seeing the speed drop from 67 to 60 KIAS. Two of the passengers sitting in the rear part of the aircraft recalled that, immediately after takeoff, a loud "buzzer", later identified as the stall warning horn, sounded and continued to do so until the aircraft struck the hedge[1]. One of the passengers in the rear of the aircraft commented that it seemed to adopt a steep "tail down" attitude just after takeoff and appeared to decelerate.

Two pilots witnessed the crash independently. Both recalled that the aircraft adopted a high nose-up attitude immediately after takeoff. One described the attitude as approximately 30° nose-up. One saw the aircraft "wallowing" in roll and both recalled that, after it reached a maximum height of approximately 4 m, it sank back to the ground in a nose-up attitude before striking the hedge.

Meteorological information

The ATCO recorded the weather at the time of the accident. The surface wind was from 030° at 10 kt, there were few clouds at 3500 ft, temperature was 22° C and QNH 1031 mb. The ATCO had passed a surface wind of 040° at 14 kt when he cleared the aircraft for takeoff.

Aerodrome information

Wycombe Air Park has two runways aligned in the 06 direction, one grass and one asphalt which is designated Runway 06 hard. Runway 06 hard, used by this aircraft, has a declared takeoff run available (TORA) and takeoff distance available (TODA) of 735 m. The boundary hedge, into which the aircraft crashed, is approximately 15 ft high and 789 m from the start of the takeoff run. There is a single-track asphalt perimeter road between the runway and the hedge.

Wreckage and impact information

Physical evidence indicated that the aircraft had passed through the northern boundary hedge of the airfield, close to its eastern end. It came to rest inverted in a cultivated field with the fuselage orientated approximately 90 degrees to the direction of travel. The left wing had separated at the root attachment during impact with the hedge where it remained embedded. The right wing/fuselage joint experienced substantial disruption but the wing remained attached to the fuselage. The left flap

Footnote

[1] The stall warning system is intended to operate within 5 to 10 kt of the stall speed.

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came to rest between the left wing and the remainder of the wrecked aircraft. The fuselage, vertical stabilizer and engine mounting sustained relatively light distortion and minimal damage occurred to the engine cowlings. The stabilator suffered substantial damage.

The flap operating lever was found in the second stage (or flap 2) position. The design of the operating mechanism together with the nature of the impact and the aircraft disruption, do not suggest that the lever had moved from its pre-impact position.

Examination of ground markings short of the hedge revealed distinctive linear impressions crossing the perimeter road. Part of the GRP fairing from the rear end of the shallow ventral fin was found nearby.

Examination of the propeller revealed considerable evidence of repeated blade strikes and gross distortion together with leading edge impacts and surface scoring. Removal of the upper engine cowling revealed substantial quantities of cut foliage, similar to that in the hedge, distributed across the top of the engine and lodged between adjacent cylinders. The extent and nature of the propeller damage suggest that the engine was producing high power at the time of the impact with the hedge.

The quantity of hedge material lodged between the cylinders suggested that the propeller airflow drove the foliage into that position. External examination of the engine did not reveal any evidence of mechanical failure. Internal boroscope examination did not reveal any indication of internal damage. All valves and the inertia magneto operated correctly when the propeller was turned.

There was no evidence to indicate other than correct operation of the engine, at high power, at the time of the impact.

The markings observed on the perimeter track and the presence of the fragment of the ventral fin identified close to those markings confirmed that the aircraft was in a tail-down attitude as it approached the hedge, which it struck slightly to the left of the extended centre-line of Runway 06 hard.

Take off performance

The unfactored takeoff distance required by the aircraft, at the all-up weight (AUW) calculated by the pilot and using flap 2, was 655 m. The CAA, in AIC 127/2006 and Safety Sense Leaflet 7, recommends that pilots increase unfactored takeoff distance by 33%; this would have given a takeoff distance required of 871 m; 136 m longer than the declared TODA.

Using the actual aircraft weight, the unfactored takeoff distance required with flap 2 was 731 m, 4 m within the declared TODA.

Weight and balance

The pilot stated that he did not have access to the actual passenger and baggage weights and therefore assumed values for his weight and balance calculation. He calculated a takeoff weight of 3,526 lb and a CG of 95.75 inches behind the datum. Analysis of aircraft weight and balance using the actual weights for the occupants and their baggage produced a takeoff weight of 3,786 lb and a CG of 99.34 inches aft of the datum, exceeding the weight limit by 186 lb, and CG aft limit by 3.34 inches. The CG range and weight chart, overlaid with these points, is shown in Figure 1.

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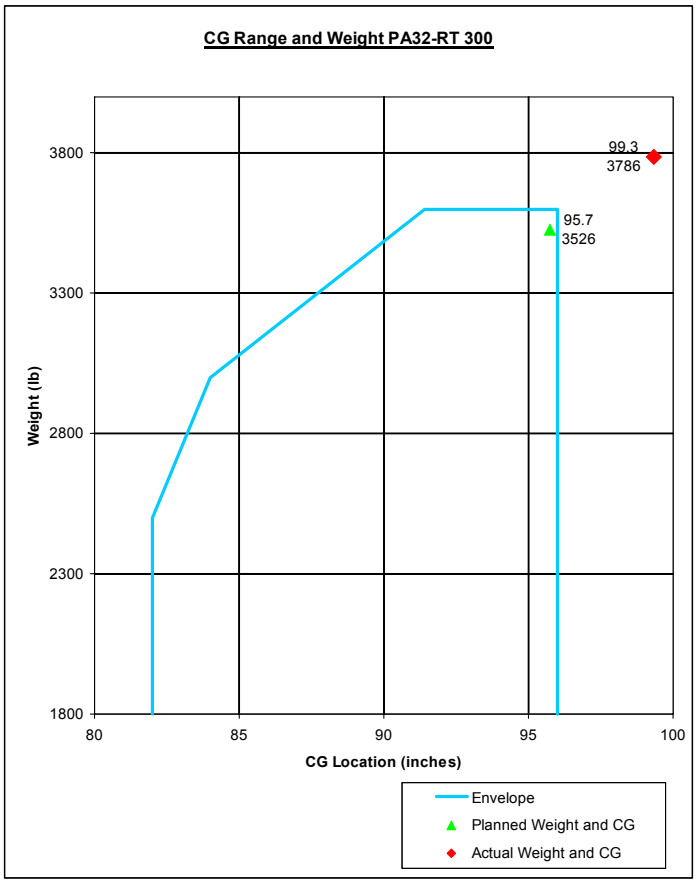

Figure 1,

Flight Envelope

Longitudinal manoeuvre stability

The longitudinal manoeuvre stability of an aircraft relates to the control force and displacement required to achieve a desired pitch rate. Optimum manoeuvre stability ensures that a predictable pull force is required to achieve this pitch rate. Movement of the CG has a very significant influence on the manoeuvre stability of the aircraft and, as the CG moves aft, the stability decreases and the pull force required to achieve the same pitch rate reduces. With reduced manoeuvre stability the aircraft will seem overly sensitive in pitch and the control forces will be unexpectedly light, both of which would adversely affect the ability of a pilot to control an aircraft in pitch accurately. The Pilots' Operating Handbook states:

> *'If the CG is too far aft, the airplane may rotate prematurely on takeoff or tend to pitch up during climb. Longitudinal stability will be reduced.'*

Analysis

Using assumed weights the pilot calculated that the takeoff weight and CG were within limits. Analysis of the weight and CG using actual weights showed that the weight and CG of the aircraft at takeoff were both outside the flight envelope.

The unfactored takeoff distance required was only 4 m less than the distance available. In order to take off in this distance the pilot would have had to employ the correct takeoff technique precisely. By not applying the CAA recommended safety factor, the end of the

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runway may have appeared abnormally close to the pilot as he rotated and this proximity may have caused him subconsciously to pull back on the flying controls slightly harder than he intended, in an effort to clear the obstacle.

The CG of the aircraft on takeoff was 3.4 inches aft of the rear CG limit. This CG position would have had a marked effect on the longitudinal manoeuvre stability of the aircraft, which would have been unusually sensitive and light to control in pitch. These handling qualities could cause the pilot to over-control the aircraft in pitch, leading to over rotation on takeoff.

The combination of unexpected handling qualities and runway length limited in relation to takeoff performance probably led the pilot to over-control the aircraft in pitch and adopt a nose up attitude significantly greater than that intended, resulting in a high angle of attack (AOA) and high aerodynamic drag on the airframe. The stall warning horn sounding, the buffet felt by the pilot through the airframe and the wallowing in roll are symptoms of an approaching stall and reinforce the assessment of high AOA.

The high drag generated by the high AOA would have caused the aircraft to decelerate. The scoring on the perimeter road, caused by the ventral fin, indicates that the high nose-up attitude was maintained until impact.

Conclusions

The pilot attempted to take off with the CG of the aircraft located more than 3 inches behind the aft limit, resulting in it having reduced longitudinal manoeuvre stability. This, together with the proximity to the end of the runway, probably lead to the pilot over-controlling in pitch. The consequent abnormally high nose-up attitude and high drag condition meant that recovery was impossible in the field length remaining. The CAA, in AIC 127/2006 and Safety Sense Leaflet 7, recommends factoring takeoff distances by 1.33.

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ACCIDENT

Aircraft Type and Registration:	Rockwell Commander 112B, G-BFPO
No & Type of Engines:	1 Lycoming IO-360-C1D6 piston engine
Year of Manufacture:	1976
Date & Time (UTC):	25 November 2011 at 1615 hrs
Location:	Coventry Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller blades and engine shock-loaded
Commander's Licence:	Private Pilot's Licence
Commander's Age:	41 years
Commander's Flying Experience:	349 hours (of which 138 were on type) Last 90 days - 38 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was on its first flight after maintenance to the right main landing gear microswitch. The pilot had cycled the gear in flight satisfactorily and was on approach to land. However, on selecting the gear down, only two green lights illuminated. Believing that the microswitch on the right main gear had shifted, he continued with the landing. After touchdown the aircraft's nose dropped, allowing the propeller to contact the runway and the pilot noticed that that it was the nose gear green light which was not illuminated. He applied full power and took off again with full flap, with some vibration. The flaps were retracted and the engine rpm was reduced in the climb out. The pilot cycled the gear twice and obtained three greens, before landing without further incident. Airfield fire service personnel, who had seen sparks during the initial touchdown, attended and the runway was searched and cleared of debris.

The pilot considered that the recent maintenance to the right gear had caused him to think there was a problem with the right gear, when in fact the problem was with the nose gear.

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ACCIDENT

Aircraft Type and Registration:	Guimbal Cabri G2, G-UIMB
No & Type of Engines:	1 Lycoming O-360-J2A piston engine
Year of Manufacture:	2011
Date & Time (UTC):	26 October 2011 at 1251 hrs
Location:	Cotswold Airport (Kemble), Gloucestershire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to skid bows, skid bow mountings and empennage
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	35 years
Commander's Flying Experience:	1,850 hours (of which 6 were on type) Last 90 days - 129 hours Last 28 days - 48 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During the approach into Kemble, just before touchdown, the pilot lost control of the helicopter in yaw. The engine then stopped, probably due to fuel sloshing due to the high yaw rate, and the helicopter landed heavily.

General

The Guimbal Cabri G2 is a two-seat helicopter manufactured in France. It features a 7-bladed fenestron in place of a conventional tail rotor and the 3-bladed main rotor rotates clockwise when viewed from above. It was awarded an EASA Type Certificate in December 2007 and G-UIMB was the first of the type to be registered in the UK, having been delivered in September 2011.

History of the flight

The helicopter was approaching to land at Cotswold Airport (Kemble) after a short flight to the north of the airfield. The pilot rejoined the circuit left-hand downwind for Runway 26; the wind was from 200° at 17 kt. He turned finals to the south of the runway and, as he passed the airfield boundary, turned the helicopter into wind. However, during the final stages as he levelled off at about 5 feet, the helicopter started to yaw gently to the left. The pilot continued applying right yaw pedal but, as it reached about 45-60° to the wind direction, the yaw rate increased dramatically and he pulled the collective to clear the ground. As anticipated, this increased the yaw rate and the helicopter turned through about three to six complete revolutions, during which time he checked

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that he was applying the correct pedal input. The engine then stopped. Still yawing left, he attempted to cushion the landing, but the helicopter landed heavily. The right skid collapsed completely and the front left skid bow also broke. The tailboom partially fractured just forward of the horizontal stabiliser but the pilot and passenger were uninjured and were able to vacate the helicopter normally.

The pilot stated that he believed that "slow application of right yaw pedal" was the cause of the accident. The manufacturer also believes that prolonged yawing can cause the engine to stop through fuel sloshing. It is understood that no pre-impact mechanical anomalies were found after inspection.

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ACCIDENT

Aircraft Type and Registration:	Thruster T600N 450, G-CCRN
No & Type of Engines:	1 Jabiru Aircraft PTY 2200A piston engine
Year of Manufacture:	2004
Date & Time (UTC):	31 July 2011 at 1845 hrs
Location:	Keal Coats, Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nosewheel and nose cone damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	Not known
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was on approach to land when the engine appeared not to respond to increased power demands. In the subsequent forced landing in a field, the aircraft flipped onto its back due to the soft soil and stubble.

History of the flight

The pilot had performed all the normal pre-flight checks on the aircraft and engine, including a magneto check, and everything was normal. He departed for a short local flight and then intended to perform a powered approach and started to descend slowly. He increased rpm to warm the engine once but, upon repeating this a short time later, he felt that the engine was not responding and saw that it was releasing fuel, apparently from the carburettor. He was on base leg for a landing on the easterly runway and descending but he judged that he had insufficient airspeed and height to turn onto finals and make the runway. He selected a stubble field straight ahead and touched down, but when the nosewheel contacted the ground, it dug into the soft, silty soil and broke off before pitching the aircraft onto its back. The pilot and passenger were uninjured and exited the aircraft unaided.

Possible reason for the loss of power

An engineer, who is experienced on Jabiru engines, advised that the fuel probably came from the overflow/vent pipe for the carburettor bowl. On this engine, it is connected to the air filter and, should the bowl become overfilled for any reason, this could result in rough running or even a cut due to an over-rich mixture. Also, in his opinion, the reason for

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the overfilling was most likely to have been caused by an abnormally high crankcase pressure which causes over-activity of the mechanical fuel pump. This results in an overpressure of the fuel supply which, in turn, overcomes the float valve in the carburettor bowl. Again, he believed that the limitations of the crankcase breather pipe in the Thruster installation had sometimes led to crankcase pressurisation.

The engineer also advised that, had the pilot opened the throttle fully, to increase the required fuel flow, the engine would have continued to deliver power, albeit running roughly due to the very rich mixture. The pilot stated that he did not try this, as he was instinctively inclined at the time to avoid large or sudden changes in throttle position.

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BULLETIN CORRECTION

Aircraft Type and Registration:	McDonnell Douglas Helicopters Hughes 369E, G-KSWI
Date & Time (UTC):	19 June 2011 at 1317 hrs
Location:	Glastonbury, Somerset
Information Source:	Field Investigation

AAIB Bulletin No 2/2012, page 100 refers

In the first paragraph on page 100, under the section headed, *Action by the FAA,* the third sentence reads:

On blades that passed this check the inside edge of the pocket was machined to provide a corner radius of 0.254 mm (0.01").

It should read:

On blades that passed this check the inside edge of the pocket was machined to provide a corner radius of **2.29 mm (0.090").**

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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.

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

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