Lake LA-4-200 Amphibian, G-SKID

AAIB Bulletin No: 5/2004	Ref: EW/C2003/08/02	Category: 1.3
Aircraft Type and Registration:	Lake LA-4-200 Amphibian, G-SKID	
No & Type of Engines:	1 Lycoming IO-360-A1B piston engine	
Year of Manufacture:	1975	
Date & Time (UTC):	1 August 2003 at 1155 hrs	
Location:	2 Miles South West of Hawarden Airport, Clywd	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 1 (Serious)	Passengers - 1 (Minor)
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Commercial Pilot's Licence	
Commander's Age:	60 years	
Commander's Flying Experience:	10,920 hours (of which 13 were on type)	
	Last 90 days - 140 hours	
	Last 28 days - 60 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The aircraft experienced a loss of engine power shortly after takeoff and struck power lines during an attempted forced landing, causing a loss of control. Both occupants were injured in the resulting impact. The most probable cause of the loss of power was determined to be water contamination of the fuel system due to the accumulation of moisture from condensation in the fuel tank. The aircraft had been used infrequently, having flown for only some eight hours between September 2000 and June 2002.

History of the flight

Hawarden Airport is operated by a large aircraft manufacturer that has extensive factory facilities on site. G-SKID was kept in a large hangar on the north side of the airport, where the general aviation activities are based. On the morning of the accident, the aircraft had been moved onto a hard standing outside the south side of the hangar and aircraft engineers working in the hangar remember seeing the pilot cleaning the aircraft. As they became absorbed in their duties, they were not aware of the subsequent movements of the aircraft until later that afternoon, when they learned that it had been involved in an accident.

The pilot, who sustained serious injuries in the impact, stated that he had no recollection of the flight, nor any of the events leading up to it. The following information was provided by the passenger on the flight. This passenger, who was paying a social visit to the flying club, saw the pilot at the aircraft outside the hangar, at about 1200 hrs local time and went over to speak to him. The pilot had planned a short flight in the local area and invited the passenger to come along so that he would not need to load ballast for the flight. The passenger accepted the offer. After lunch, the pilot returned to the aircraft and the passenger joined him there a short while later, by which time the pilot was already inside the aircraft making preparations for departure. The passenger, who was a PPL holder but took no part in the flight, recalled that the pre-flight checks were completed satisfactorily. He remembered the pilot selecting a switch on the lower left of the instrument panel during the pre-flight preparations, but could not see which switch it was. He also recalled that the flaps were selected down for takeoff and that the aircraft seemed to accelerate normally, lifting off at about 65 kt between a third and half way down the runway. The first indication of a problem occurred about 300 feet above the ground, when the pilot stated that he had a hydraulic problem. He began to operate the landing gear emergency hand pump, before directing the passenger to continue pumping in order to raise the gear. The pilot initially intended to perform low-level right hand circuit, but then decided that this would not be possible and prepared instead to make a forced landing. The passenger recalled that the approach to the chosen field had seemed satisfactory but, in the final stages of the approach, power lines became visible which the pilot was unable to avoid. The aircraft struck the cables and pitched violently nose down, impacting the ground and coming to rest inverted. Although injured, the passenger was able to release the pilot's seat belt and to extricate himself from the aircraft and attract the attention of rescuers. The pilot, who had suffered serious head injuries, was assisted from the wreckage by the emergency services.

Several eyewitnesses on the airport observed the aircraft during its short flight. Their accounts were consistent in that they all stated that the aircraft appeared to have difficulty gaining height, and that the engine sounded 'rough' and was producing 'popping' or backfiring noises, although both the pilot and passenger both later reported that a smooth loss of power occurred. It was observed to become airborne approximately half way down the runway and then settle a little, before climbing again slightly. It followed the runway heading for a short distance before turning right and descending out of sight behind a low ridge. One eyewitness in the village of Old Warren, to the south west of the airport, saw the aircraft descending and banking to the right towards a field, in what appeared to be the approach to a forced landing. He reported that the engine was 'spluttering' and saw the aircraft strike power cables adjoining the field. This produced a loud 'bang' and a blue flash, following which the aircraft pitched nose down into the field.

The duty ATC Officer (ATCO) in the tower at Hawarden had cleared the aircraft for takeoff at 1153 hrs. He observed it takeoff and, as it came abeam the tower, it was apparent that it was having difficulty climbing. The pilot requested and was cleared for a low-level right-hand circuit. Not having received a 'MAYDAY' call, the ATCO asked the pilot if he had a problem, to which he replied "Affirmative" but gave no details. As it was now apparent that the aircraft was in difficulty, the ATCO sounded the crash alarm and declared a full emergency. The pilot then reported that he had cleared his hydraulic problem, and when asked whether he still intended to perform the low-level circuit, he again replied "Affirmative". There were no further radio transmissions from the aircraft and, at approximately 1155 hrs, it descended below a ridge to the south west of the airport and failed to reappear. The ATCO re-established contact with a police helicopter that had departed Hawarden shortly before G-SKID and directed it in the search for the crashed aircraft. Some difficulty was experienced in locating the aircraft as it had crashed in a field containing a crop of six to seven feet high corn. Once the helicopter had located the aircraft, its crew were able to guide the emergency services, who were by this time very close by.

Accident site information

The aircraft crashed in a field located approximately 1½ miles to the south west of Hawarden Airport.

Analysis of photographs of the accident site taken by the Police confirmed that the aircraft had struck small power lines bordering the field, severing two of the cables. After striking the cables, the aircraft had pitched forward, striking the ground with the nose about 45 degrees below the horizontal, as evidenced by the angle of the swathes in the crop cut by the wings. As the aircraft became inverted, the engine and pylon contacted the ground and collapsed sideways, under the right wing, and this had protected the cockpit area from the full force of the impact. There was minimal fuel leakage from the aircraft and no fire.

Meteorological information

The METAR for Hawarden Airport at 1150 hrs was as follows: wind 320°/07kt, visibility in excess of 10 km, scattered cloud at 2,500 feet, temperature +21°C and dewpoint +15°C.

Aircraft description

The Lake LA-4-200 is a mid-wing single-engine amphibian aircraft powered by a 200 hp fuel-injected four-cylinder piston engine, mounted on a vertical pylon above the fuselage, and this drives a two-bladed constant-speed pusher propeller. The aircraft has a hydraulically-powered retractable landing gear and a strengthened boat-hull fuselage, which allows it to operate from both land and water.

The hydraulic system primary components include an accumulator, an hydraulic fluid reservoir and an hydraulic pump, driven by an electric motor. The accumulator is charged with nitrogen at 350 psi and the pump will operate when the system pressure falls below 900 psi, and shut off when the pressure reaches 1,200 psi. A gauge on the centrally located hydraulic panel indicates the available hydraulic pressure. An emergency hand pump enables hydraulic pressure to be generated manually in the event of an electric pump failure. The hydraulic system also powers the elevator trim and the wing flaps.

The fuel system comprises a 40 US gallon (USG) main tank mounted in the fuselage between the wings. Auxiliary fuel tanks in the wing floats allow an additional 34 USG of fuel to be carried. (These tanks were empty and not used on the accident flight.) The main tank has a 'vee'-shaped sump, at the base of which are located the fuel pickup pipe/strainer and the sump drain. An electric fuel boost pump, mounted below the tank, is used during takeoff and landing. Fuel passes from the boost pump to the fuel filter and thence to the mechanical engine driven pump, before being supplied to the mechanical fuel injection system. Individual fuel/water drains are provided for the fuel tank sump, the fuel line to the boost pump and the boost pump, which are at the lowest points of the fuel system. The fuel filter which is mounted horizontally and is not equipped with a drain valve, is mounted on the engine pylon and can only be accessed after removing the pylon leading edge fairing.

Aircraft history

The aircraft was purchased by the current owner in June 2002, with the intention of leasing it out for the purposes of flying training for the seaplane rating, in addition to his own private use. The owner had reportedly made an agreement with the pilot, who was an ex-CFI and based at Hawarden, whereby this pilot would be responsible for both the day to day running of the aircraft and the provision of flying instruction. In the event, it was flown very little during its current ownership and spent most of its time parked in a hangar and, as a result, the owner had recently decided to sell the aircraft. The most recent flight, recorded in the aircraft logbook, was made on 17 June 2002 and this indicated that it had flown a total of only eight hours in the period from September 2000 to June 2002.

Fuelling records

Records from the fuelling company at Hawarden Airport showed that the most recent fuel uplift on G-SKID had been on 8 July 2003, when 75 litres of Avgas 100LL were uplifted. Five other aircraft took on fuel that day, including a police air surveillance BN2 Islander, none of which reported any

subsequent problems. The previous fuel uptake on G-SKID was on 11 October 2002, when 24 litres of AVGAS were uplifted.

Maintenance history

The aircraft was required to have been maintained in accordance with the CAA LAMS/Aeroplanes/1999/Iss.1 maintenance schedule, and the last Annual Check was completed on the aircraft on 10 October 2002, at 1,339.2 flying hours. Following a survey of the aircraft, the Certificate of Airworthiness (C of A) was approved by the CAA for amendment to the Public Transport category, as required for providing flying training. The amended C of A was issued on 11 October 2002 and was valid until 20 September 2003. The Certificate of Release to Service issued on completion of the Annual Check reflected that the next scheduled maintenance was a 50-Hour Check, due either on 10 April 2003 or at 1,389.20 flying hours, whichever was soonest. Given the low utilisation of the aircraft, the 50-Hour Check fell due in April 2003. However, the work had not been accomplished at the time of the accident. In April 2003, the pilot reported a problem with a large loss of engine rpm when using the left magneto. This was removed and sent for repair, but the problem recurred after it was reinstalled. Further troubleshooting revealed that the ignition switch had been cross-wired. When this was rectified, the problem transferred to the right magneto. This was then removed and sent to a different vendor for repair, where it was found to be serviceable. Further troubleshooting identified dirt and tracking inside the ignition switch and minor defects with the spark plug wires, all of which required rectification. Following completion of this work, engine ground runs were performed by an engineer on 8 July 2003, during which the 'mag drops' were found to be acceptable. The engineer had dipped the fuel tank to check that there was sufficient fuel prior to commencing the ground runs but, during these runs, the engine began to 'cough'. He then proceeded to uplift 75 litres of fuel from the pumps and performed additional engine ground runs at high power settings, which proved satisfactory. It is understood that the pilot had performed additional ground runs on 31 July 2003, the day before the accident, and that these had been satisfactory.

Wreckage examination

Permission was given for the wreckage to be initially recovered to the hangar at Hawarden where a preliminary examination was later conducted by the AAIB. The wreckage was transported to the AAIB hangar at Farnborough for more detailed examination.

Engineers recovering the aircraft the morning after the accident recalled that the battery master, magneto and fuel boost pump switches were all ON, the fuel selector was in the ON position and that the landing gear was in the fully retracted position. Fuel was dripping from the fuel vents and, when the filler cap was removed, an estimated two to three gallons of fuel drained from the tank. When cutting the fuselage to facilitate transportation, the hydraulic lines in the tail were found to contain hydraulic fluid under pressure.

Inspection of the fuselage revealed that a 7 mm deep groove had been produced in the leading edge of the tail 'tie down' fitting Figure 1. Melted aluminium around the edges of the groove suggested that this damage was probably caused by the power cables becoming snagged on the fitting.

Figure 1: Tail tie down fitting damage due to contact with power cables

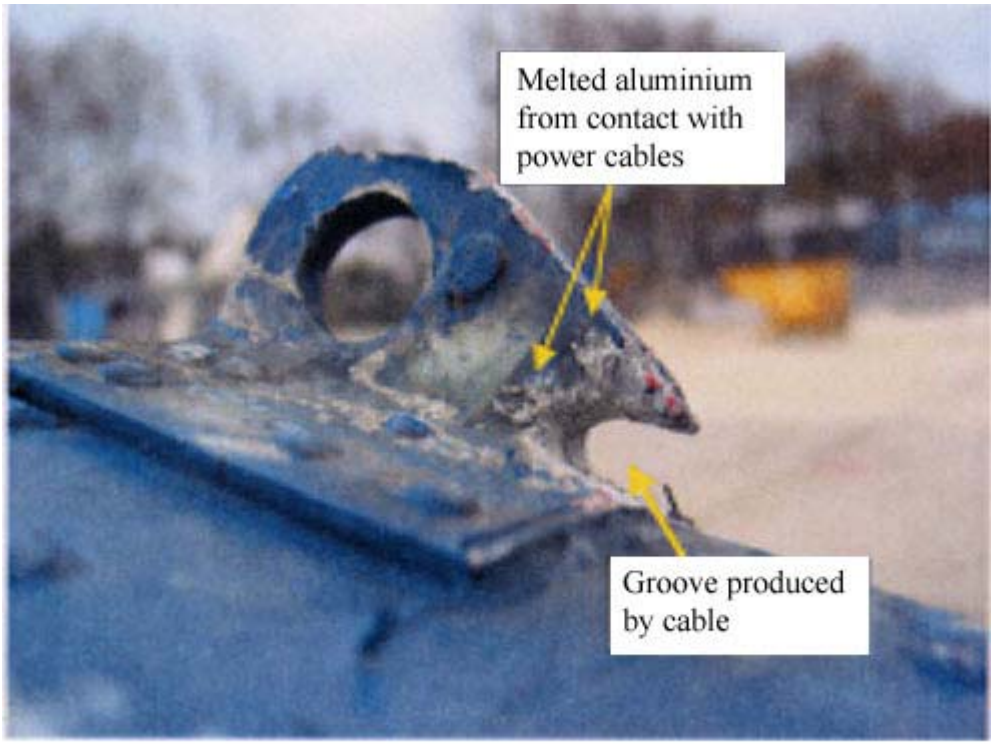

Figure 1: Tail tie down fitting damage due to contact with power cables

The electric hydraulic pump was removed and operated satisfactorily when connected to a battery and evidence of residual hydraulic fluid was found in the hydraulic lines. However, the hydraulic problem reported by the pilot was not investigated further as it was not considered to be central to the cause of the accident.

Examination of the fuel system revealed residual fuel in the fuel lines. A sample of fuel taken from the fuel filter was found to contain approximately 0.5 cc of brown-coloured water. The fuel filter bowl and the filter element itself, Figure 2, were heavily corroded and the filter element appeared to be partially blocked with corrosion products.

Figure 2: Corrosion on fuel filter element

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The mechanical fuel pump was also found to contain large accumulations of corrosion products and a thick white gel in the outlet chamber Figure 3. The electric boost pump failed to run when tested and, on disassembly, the pump rotor was found to have seized due to corrosion. Strip examination of the major fuel injection system components did not reveal any anomalies.

Figure 3: Corrosion products in mechanical fuel pump outlet chamber

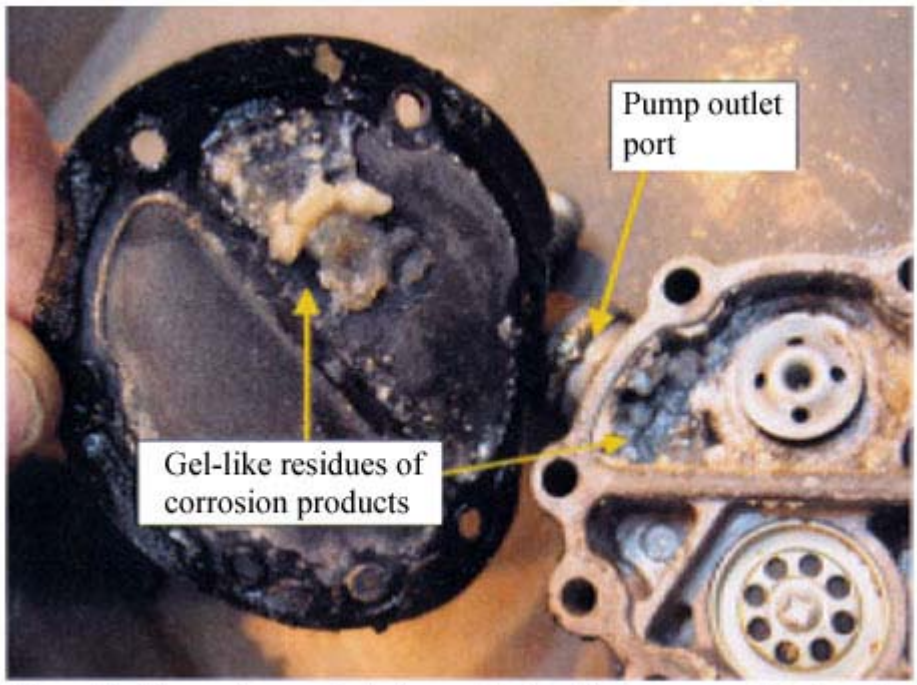

Figure 3: Corrosion products in mechanical fuel pump outlet chamber

On examining the engine, continuity of the valve train and the accessory drives was confirmed by turning the engine and good 'thumb' compression was obtained on all cylinders. A visible spark was obtained at the spark plugs supplied by the left (impulse) magneto. The spark plug electrode coloration was indicative of the engine having run in a lean condition. Damage to the propeller was limited to slight bending of the tips, indicative of the engine developing less than full power at the time of impact.

Discussion

The fact that the aircraft failed to climb, together with witness accounts of the engine "spluttering" appear to be indicative of a problem associated with either the engine or the fuel system.

It is reasonable to assume that the magneto problem had been resolved, given that the engine ground runs on 8 and 31 July were completed satisfactorily and the power checks prior to takeoff on the accident flight were apparently normal.

Given that a significant quantity of fuel was drained from the aircraft at the accident site and the fact that fuel was found in the fuel lines, it was concluded that the aircraft did not run out of fuel. None of the other aircraft that uplifted Avgas from Hawarden on 8 July 2003 reported any subsequent problems, which suggested that the uplifted fuel was of an acceptable quality. Detailed examination of the engine did not reveal any mechanical problems that would have prevented it from developing power.

The widespread evidence of corrosion in the fuel system, the sample of brown tinged water from the fuel filter bowl and the indication on the spark plugs of lean running, all suggested that water contamination of the fuel system was the most likely cause of the engine failing to produce adequate power. The extreme levels of corrosion found on the fuel filter element, the mechanical and electric fuel pumps shows that water had been present in the fuel system for a considerable period of time. Water can collect in the fuel tanks of an aircraft due to the long term accumulation of moisture from condensation, which can form on the tank walls when an aircraft is parked for long periods of time with the tanks partly full, or by coming out of solution, particularly in cold conditions. If not regularly drained, this water can accumulate in the fuel tank sump in increasing quantities and may eventually be drawn into the fuel lines, and would likely result in a significant power loss.

It was a requirement of the LAMS maintenance schedule for this aircraft that, on the Daily Check, a fuel sample was taken from the fuel system to check for water and other contaminants, and to ensure that the colour for the type of fuel permitted to be used in the aircraft was correct. The 50-Hour Check contained a requirement for inspecting the fuel filter in addition to sampling the fuel. As the pilot stated that he had no recollection of the flight or the events leading up to it, it could not be established if a fuel sample had been taken on the day of the accident. However, the pilot was sure that he would have made this check, as that was his normal practice so to do. Notwithstanding this, had the 50-Hour Check been carried out between April 2003, at which time the check would have been necessary for the aircraft to continue flying, and the date of the accident, then it is possible that the corrosion of the fuel filter and the presence of water in the fuel would have been identified.

It is important that aircraft owners and operators of low utilisation aircraft take precautions against the accumulation of water due to condensation in the tanks, by ensuring that regular water drain checks are performed during storage and by storing the aircraft with the fuel tanks full.