ACCIDENT

Aircraft Type and Registration:	Cessna F150l, G-YIII	
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine	
Year of Manufacture:	1972 (Serial no: 827)	
Date & Time (UTC):	14 June 2014 at approx 1225 hrs	
Location:	Near Hucknall Airfield, Nottinghamshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 1 (Fatal)	Passengers – 1 (Fatal)
Nature of Damage:	Aircraft Destroyed	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	70 years	
Commander's Flying Experience:	293 hours (of which 240 were on type) Last 90 days - 4 hours 30 minutes Last 28 days - 2 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The aircraft failed to reach normal circuit height after takeoff probably because of a partial loss of engine power. The aircraft continued flight at low altitude and airspeed before stalling, and an incipient spin entry resulted in the aircraft striking the ground vertically nose-down.

History of the flight

Both the pilot and passenger (who also held a PPL) had arrived at Hucknall Airfield in the morning. Separately they had met and spoken with other club members and it was reported that there was nothing unusual in their behaviour.

The accident pilot had initially gone to the club hangars, located on the north side of the airfield, to collect G-YIII. The chief flying instructor saw him conducting the daily 'Check A' with reference to a check list before taxiing the aircraft to the clubhouse located on the south side of the aerodrome.

Another pilot (Pilot B) took over the aircraft after having conducted a pre-flight inspection. He later informed the AAIB that he had not visually checked the fuel contents before his flights because: he was certain the accident pilot would have done so as part of the 'Check A', the aircraft were "always" refuelled before being put in the hangar and the fuel gauges were indicating full when he started his set of flights.

Pilot B then flew two separate flights of solo circuit training lasting 50 and 35 minutes respectively. He reported that the aircraft had no defects and had performed normally throughout these flights.

Immediately before the accident flight the chief flying instructor, who was talking to the passenger outside the club buildings, noted that the accident pilot was conducting a pre-flight inspection. The pilot and passenger then boarded the aircraft. The air-ground radio operator noted the off-blocks[1] time as 1215 hrs and watched the aircraft take off, apparently normally. He then immediately turned his attention to other aircraft and was later uncertain if G-YIII had completed a circuit. He was expecting a downwind radio call to be the next communication from G-YIII and, when no call was received, began to be concerned. He was visually scanning the circuit pattern when he received a radio call from a local Air Ambulance helicopter reporting that it was responding to an aircraft accident near the aerodrome.

Eyewitnesses

At 1225 hrs several eyewitnesses, primarily located in vehicles on the M1 motorway, contacted the emergency services reporting an aircraft accident. The eyewitnesses were later interviewed and their reports were broadly similar with none being significantly contradictory. The condensed eyewitness statements included below are representative.

Eyewitness A was on a footpath in a field to the west of Hucknall Airfield near the end of the disused concrete runway. Initially he saw the aircraft very low, tracking from his left to right towards the south. The engine noise was constant and did not sound unusual to him. The aircraft appeared to be gaining height gradually but when it was to the south of him it commenced a left turn which progressed through 360° while the aircraft descended. The aircraft then pitched down and continued nose first into the ground.

Eyewitness B and C were outside farm buildings to the west of the M1 motorway. Eyewitness B had some experience of single engine piston aircraft as a passenger and thought the aircraft engine sounded “weak, as if there was no power”. B and C then saw the aircraft low to the east and believing it was in distress and likely to crash ran to cross the motorway via a farm access bridge. When they reached the crest of the bridge, a distance of about 280 m from their original location, the aircraft was still airborne, low and to the east of them, before it disappeared from view. They assumed the aircraft had crashed and commenced a search for the accident site, arriving shortly after eyewitness D.

Eyewitness D was on the motorway bridge later crossed by Eyewitness B and C. He saw the aircraft and heard the engine noise which he described as normal throughout. The aircraft was initially heading towards him before turning through 360° to the left. He then lost sight of the aircraft before hearing an “odd” noise at the same time as the engine noise stopped. He assumed the aircraft had crashed and ran to the scene of the accident. He arrived within minutes of the crash and with other witnesses attempted to render first

Footnote

[1] Indicating the time at which the aircraft first moved under its own power.

aid to the occupants, but it was obvious that both occupants had sustained fatal injuries. Having alerted the emergency services, and noting a strong smell of fuel combined with electrical noises from the aircraft, they withdrew a short distance to await professional assistance.

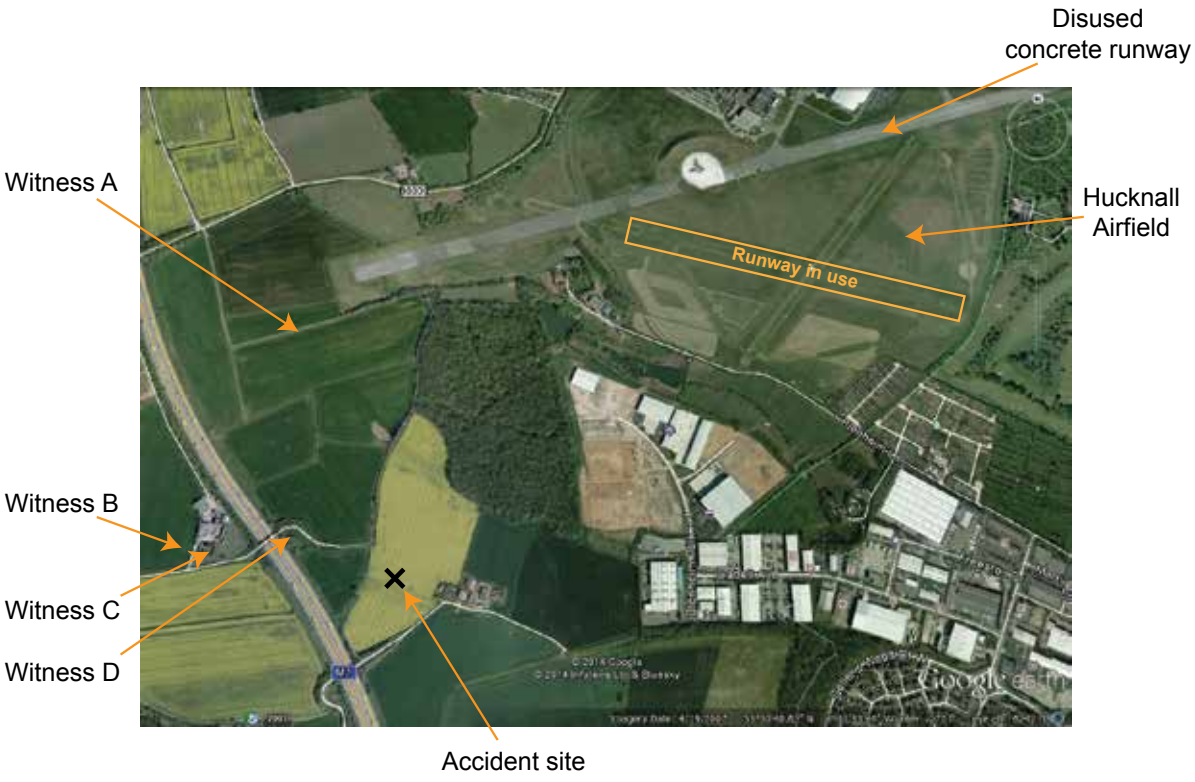

Figure 1
Overview map

Aircraft height estimation

In an attempt to refine the height estimates, Eyewitness A and B were interviewed in the locations from which they had seen the aircraft. They were provided with an electronic tablet device with a camera, screen and geo-referenced aiming mark, and asked to place the crosshairs where they recalled seeing the aircraft at various points during its flight. (Figure 2 is an example of the presentation). Estimates of the aircraft height were then made using trigonometry. The aircraft height of the aircraft as first seen by these witnesses was calculated to be about 100 ft.

Recorded data

No electronic devices that recorded useful information were found at the accident site. Radar recordings were examined but did not show any secondary radar activity related to this aircraft. A contact was detected by the East Midlands Airport primary radar flying a left hand circuit from Runway 29 between 1219:20 hrs and 1222:50 hrs. However, this was of a complete circuit and no radar recordings of a flight between Runway 29 and the accident site were found.

Figure 2

Exemplar of witness height estimation imagery.
The aircraft track was reported as from left to right in this image

The lack of a recorded primary radar track associated with a flight path between the runway and the accident site indicated that the aircraft was flying at an altitude below the line-of-sight (LOS) capability of the radar, or with a ground speed slow enough to be rejected by the ground radar as clutter (approximately 50 kt). The LOS limit due to terrain in the area between the runway and the accident site is approximately 300 ft agl.

Video

A vehicle on the southbound M1 was equipped with a forward facing video camera. The camera captured part of the accident sequence and the driver of the vehicle provided this to the AAIB via Nottinghamshire Police. It showed the aircraft initially in flight to the west of the motorway. The aircraft could be seen flying generally straight for around eight seconds before it commenced a left turn. The aircraft appeared to have turned through approximately 90° before rolling sharply to the left and entering a vertical rotating descent. The aircraft passed out of sight behind the motorway embankment having completed about 360° of rotation.

Analysis of the video indicated that the aircraft was approximately 100 ft above the ground when it first appeared on the video recording and peaked in the climb at a height of approximately 200 ft. The video recording was of insufficient quality for a more accurate analysis. The estimated flight path of the aircraft indicated by the video is given in Figure 3.

Figure 3

Path of the aircraft estimated from analysis of the car video recording

Pilot information

The accident pilot had commenced flying training in 2001 and all his flying had been based at Hucknall Airfield. He held a JAA PPL(A) valid until Sept 2016. His single engine piston (SEP) aircraft rating was valid until 5 September 2014 and his most recent biennial flight review was conducted on 30 June 2012. He had completed 35 minutes of circuits with an instructor on 5 April 2014 as part of a biennial flight review but the weather had precluded completing this exercise. He held a Class 2 medical certificate valid until 6 September 2014

The pilot and passenger had flown together nine times in the previous 12 months.

Passenger

The passenger was an experienced pilot with a UK PPL(A) first issued in 1974. He held a current EASA PPL (A) issued on 19 December 2013 with an SEP rating valid until 31 March 2016.

He held a Class 2 medical certificate valid until 30 January 2015. His latest logbook indicated a total of 758 hrs flying experience. His recent flying had been mainly on a Robin 221 aircraft and he last flew the accident aircraft on 21 December 2013.

Weather

The UK Met Office provided details of locally recorded weather and an aftercast for the surrounding area. At 1200 hrs a weather station at Watnall (about 1.5 km west of the accident site) recorded visibility of 10 km, wind from 330° at 7 kt, temperature 19.5° C and dewpoint 15.3° C. The cloud was reported as scattered at 1,600 ft and broken at 4,900 ft.

Other pilots operating locally reported that the wind was northerly at 5 to 10 kt. The sky was overcast at a height of between 1,100 ft and 1,500 ft. The wind had mainly favoured Runway 04 during the morning but had changed to favour Runway 29 before the accident flight departed.

Airfield information

Hucknall has two intersecting grass runways to the south of a large disused concrete runway. Runway 29 has a declared length of 776 m and ends at the edge of the concrete runway. An air-ground radio service was provided from a glazed structure on the roof of the clubhouse.

Pathology

Post-mortem examinations were conducted by a forensic pathologist and his report was reviewed for the AAIB by a specialist aviation pathologist. He reported that both occupants had received broadly similar injuries, the crash forces were beyond the range of human tolerance. No additional or alternative safety equipment would have been likely to affect the fatal outcome of the accident.

The aviation pathologist provided the following summary:

> *'No medical or toxicological factors have been found which could have had a bearing on the cause of this accident.'*

Fuel

Airfield refuelling records show that G-YIII was last refuelled with 58 l of Avgas on 8 June 2014 by the pilot involved in this accident.

Aircraft weight and balance

The Owner's Manual for G-YIII was provided by the operator. The aircraft basic weight was noted as 1,151 lb, maximum takeoff weight (MTOW) 1,600 lb and the maximum fuel weight 135 lb.

The aircraft had operated in the circuit for at least 90 minutes since being fully refuelled, and based on information published by the manufacturer was assumed to have about 65 lbs of fuel remaining. The pilot and passenger had a combined weight of approximately 340 lbs and no items of significant mass, such as flight bags, were being carried. Therefore the weight of the aircraft on takeoff for the accident flight was calculated to be approximately 1,556 lb.

CAA change sheet 1 issued February 1993 was incorporated in the Owner's Manual and noted a performance decrement for the aircraft to increase the takeoff distance required by 15% and decrease the scheduled rate of climb by 160 ft/min.

This information indicated that at MTOW, at an ambient temperature of 20°C, G-YIII should have been capable of sustaining a 500 ft/min rate of climb.

Engineering

Initial examination

The aircraft came to rest in a crop field approximately six metres from a line of overhead cables in a near vertical attitude, (Figure 4). It was resting on its nose and there was no evidence that it had made contact with the ground prior to this point.

Figure 4

Accident site on AAIB arrival

The aircraft had experienced significant compression of the forward fuselage which forced the engine upward, breaking the lower engine mounts. Both wing leading edges were compressed and both fuel tanks had ruptured. Approximately five litres of fuel were recovered from each fuel tank. The extent of the leading edge compression was more pronounced on the left wing, and the rear fuselage had been bent to the right during the impact sequence. One propeller blade was bent backward under the engine, the remaining blade was unbent. There was no evidence of leading edge damage or chordwise scoring or witness marks on either propeller blade.

The continuity of all of the flying control circuits was confirmed, with the exception of one of the left aileron control cables, which had failed. The pre-impact position of the engine controls could not be determined. The emergency services confirmed that when they reached the accident site both occupants had been wearing seat belts, the mounting points for which had failed.

Aircraft records

Examination of the aircraft records indicated that its maintenance complied with current requirements. They showed that the engine had been overhauled in October 2011 and had operated for 719 hours since overhaul. A compression check was carried out in November 2013 with no defects recorded.

Carburettor heat

In order to provide protection against carburettor icing, the aircraft type is fitted with a carburettor heating system. The cockpit CARB HEAT selector is connected to a rotating flat plate valve in the air intake by a cable and lever arm. When the selector is moved to the ON or HOT position, the cable pulls the lever arm rearward, rotating the valve forward, preventing cold air from entering the carburettor and allowing air heated by the exhaust manifold to flow into the carburettor to melt any ice present.

Detailed examination

Examination of the fracture surface of the failed aileron control cable indicated that the cable had failed in overload and that there was no evidence of progressive failure of the cable. There was no evidence of a pre-impact restriction within the control circuits.

Analysis of the fuel recovered from both fuel tanks confirmed that it met the specification for AVGAS and no evidence of contamination was found. The engine fuel filter was full of fuel and free from contamination.

Due to mechanical damage the engine, carburettor and magnetos could not be operationally tested. The magnetos were therefore disassembled. There was no evidence of corrosion within the units and no defects were identified which would have prevented their normal operation.

The carburettor was removed from the engine and disassembled. No evidence of pre-impact contamination or restriction of the air intake filter was found. The carburettor air intake body had been deformed during the impact, clamping the carburettor heat valve in the COLD or OFF position. The carburettor acceleration pump was found to operate normally and fuel was present in the carburettor bowl. No pre-impact defects were identified which would have prevented the carburettor from operating normally.

After removing the ignition plugs, the engine could be rotated freely and the accessory drive train functioned correctly. A compression check confirmed that the number one cylinder had low compression compared to the number two and three cylinders, and the number four cylinder had no compression. Inspection confirmed that the lack of compression was due to impact related damage.

ATSB report

The Australian Transport Safety Bureau (ATSB) conducted a review of events involving partial power loss on takeoff over a ten year period[2]. Of 242 events considered, 9 resulted in fatalities compared to no fatalities following total power loss in the same period. The ATSB commented that:

> *'15 of the 242 occurrences resulted in a loss of control. More than half of these loss of control accidents resulted in fatalities.'*

And:

> *'the initial actions taken by the pilot do not necessarily affect the final outcome – what is more important is that the primary focus be on maintaining airspeed to prevent stalling.'*

Analysis

The pilot held the appropriate licence and medical certificate, and was in recent flying practice and in good health. The passenger was not required to hold any licence but also held the correct licence and medical certificate to operate the accident aircraft.

There was nothing unusual in the pre-flight activities. Accident damage meant that it was impossible to be certain of the fuel state, but the fuel on the accident site, the refuelling records and time operated indicated that, probably, sufficient fuel remained to conduct the flight safely.

When the aircraft became airborne there was nothing to attract the continued attention of witnesses on the airfield, suggesting that at this stage the flight was proceeding normally. The departure was sufficiently routine that witnesses were not certain if the aircraft had completed a circuit or not.

The first evidence of anything unusual was the sighting by Witness A of the aircraft flying low, approximately 100 ft agl, tracking south from the area of the disused concrete runway. This approximate height and track was independently confirmed by car camera footage and other witness statements.

There was no reason for the aircraft to be in this location during normal flight operations and nothing to suggest that either the pilot or passenger would deliberately choose to operate the aircraft in this way. In the absence of deliberate action it is likely the aircraft was at this height because of a performance issue.

The aircraft weight at the time of the accident was slightly below its MTOW; even at MTOW the aircraft should have been capable of climbing at approximately 500 ft/min. The airframe was found to be complete at the accident site and the flaps were up. There was no evidence

Footnote

[2] http://www.atsb.gov.au/publications/2010/avoidable-3-ar-2010-055.aspx

of a pre-impact restriction or defect within the flying control circuits and no other airframe defect which could have had a significantly detrimental effect on aircraft performance.

The lack of rotational damage to the propeller was consistent with the engine operating at low power at impact. Although damage prevented testing, no evidence was found of a pre-impact defect within the engine or its fuel and ignition systems which would result in abnormal engine operation.

The environment was conducive to the formation of carburettor icing at low and moderate power settings. The position of the carburettor heat valve in the damaged air intake indicated that the carburettor heat system was in the OFF or COLD position during the impact sequence. Carburettor icing would affect the performance of the engine, reducing the available power and causing rough running. Carburettor icing could have formed after power checks and before departure. Carburettor icing may be more likely when operating from damp grass and there is some evidence that, while the grass was not wet it may have been damp. Eyewitness A and D reported the engine noise as constant, which is not entirely consistent with carburettor icing having formed.

No single reason was identified for the aircraft not performing in the expected manner, but insufficient power was available to climb away from the ground or operate at a safe speed.

The suggested action following an engine failure on take off is to land within 30° left or right of the aircraft heading. This course of action is most obviously indicated when an engine failure is total, but more complex for the pilot to determine when the engine continues to run but is not developing full power. Witness B described the engine as running but sounding as if it was developing no power. Witness A reported that the aircraft was climbing, but slowly.

The final manoeuvre described by the witnesses and seen on the video is a stall and wing-drop entry into an incipient spin. This loss of control at low height gave no prospect for recovery and the evidence from the accident site indicated that the aircraft struck the ground in a steep nose-down attitude while rotating to the left.

Whereas a forced landing may result in aircraft damage or injury, a stall and spin at low height frequently results in a vertical impact and fatal injuries. Maintaining flying speed in the event of power loss enables the pilot to maintain control of the aircraft, even if this results in a forced landing on a suboptimal surface. Several AAIB investigations indicate that loss of flying speed leading to a stall and spin at low height will result in fatal injuries.

Conclusion

The aircraft stalled and entered an incipient spin, probably following a partial loss of engine power the cause of which could not be determined.