ACCIDENT

Aircraft Type and Registration:	Thruster T600N 450, G-CCUZ	
No & Type of Engines:	1 Jabiru 2200A piston engine	
Year of Manufacture:	2004 (Serial no: 0044-T600N-102)	
Date & Time (UTC):	18 August 2018 at 1150 hrs	
Location:	Foston, Lincolnshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 1 (Minor)	Passengers - 1 (Minor)
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Commercial Pilot's Licence	
Commander's Age:	48 years	
Commander's Flying Experience:	1,740 hours (of which 106 were on type) Last 90 days - 17 hours Last 28 days - 1 hour	
Information Source:	Aircraft Accident Report Form submitted by the pilot and inquiries made by the AAIB	

Synopsis

The aircraft was taking off from Foston Airfield when the engine lost power and caused the aircraft to descend. The pilot was faced with limited choices for a forced landing, so used a nearby Leylandii hedge as an energy absorber. After the aircraft came to a stop, the pilot and his passenger were able to vacate the aircraft having sustained minor injuries. The aircraft was severely damaged in the accident. The was no evidence of a mechanical failure within the engine. However, a build-up of soot within the engine suggests it had been running with an overly rich fuel air ratio, which, in most circumstances, would result in a reduction of power.

History of the flight

The pilot had been contracted to carry out some instructional work for a syndicate based at Foston Airfield. After discussion with the aircraft owner, it was agreed that the pilot would conduct a short type-refamiliarisation flight in the left seat, with another pilot in the right seat. The start was uneventful, however, the pilot observed that the rpm gauge appeared to be under reading and noted that this would require rectification. He also observed the magneto test did not appear to result in an rpm drop, but when he reduced the throttle and carried out a dead-cut[1] check, the magnetos were isolating normally.

Footnote

[1] A dead-cut check ensures that each magneto can be isolated by earthing the circuit. This check is usually carried out as part of the engine shutdown checks to ensure the ignition does not remain live when the engine is stopped.

Content to continue, he then carried out a high-power taxi along the runway before back tracking to position ready for takeoff.

The pilot accelerated the aircraft along the runway and became airborne at about 35 kt, approximately 150-200 m along the 418 m runway. He then set a climb attitude and speed of 55 kt with an estimated rate of climb of 400-600 ft/min. As the aircraft passed the end of the runway, thought by the pilot to be at about 100 ft agl, there was a loss of thrust and the climb stagnated. The pilot decreased the climb speed to 45 kt, established a reduced rate of climb and altered his course slightly to the right, where there was gap in a row of nearby houses. However, there was then a further loss of thrust and the aircraft commenced a rapid descent. The pilot prepared for a forced landing but was aware his options were limited by the houses, their gardens and a large Leylandii hedge. With little choice, he decided to try to stall the aircraft to "pancake" onto the hedge. This he did, hitting the hedge just below the top. There was a loud bang and the aircraft came to a stop. The aircraft was extensively damaged but the pilot and passenger were able to vacate the aircraft unaided having suffered minor injuries.

Engineering investigation

The aircraft was fitted with a Jabiru 2200A four-cylinder horizontally-opposed piston engine. The engine controls consist of a throttle and choke. The carburettor mixture is set during the engine maintenance tuning procedures on the ground and is not adjustable from within the cockpit. Ignition is by two solid-state magnetos with two side-by-side spark plugs per cylinder. At the request of the AAIB the engine was examined to establish the cause of the loss of power. No faults were found with the ignition, carburation or choke systems. A cylinder compression check was carried out and it was found that one of the exhaust valves had a slight leak, although this did not have any significant effect on the cylinder concerned. Overall, the compression in all the cylinders was within manufacturer's limits. The was no evidence of a mechanical failure within the engine. However, there was a build-up of carbon soot within the cylinders, exhausts and spark plug electrodes.

Observations made by the pilot

Prior to the flight the pilot discussed recent maintenance carried out on the aircraft with one of its owners and reviewed its documentation. Overall, he considered all in order and the aircraft to be in a good maintenance state with, in his opinion, some minor non-urgent details which could be addressed in due course.

There was no pilot's operating handbook, so the pilot used his own notes by which to configure and start the aircraft. The pilot recalls the start as being normal and the engine "started easily". He noted the rpm gauge apparent under-read and the difficulty in carrying out the magneto drop check. To satisfy himself that the magnetos were working correctly he carried out the 'dead-cut'. In addition to verify that all was well, and to assist in familiarising himself with the aircraft, he carried out a full power taxi along the runway followed by a back-track before lining up and taking off.

After getting airborne, as the power loss started to manifest itself, the pilot described how "it dawned on me that I had very limited options, I chose the least worst, the hedge". He also described how he adjusted the airspeed to 45 kt "the best glide speed". His flying experience meant that at no stage did he consider turning the aircraft back towards the airfield. He steered the aircraft about 30° to the hedge line, intersecting it from the left.

In the pilot's opinion choosing the hedge as an energy absorber, and the fact he and his passenger were wearing four-point safety harnesses, prevented more serious injuries or a worse outcome.

Other evidence

A video of the aircraft taking off showed the initial climb during which the engine can be clearly heard. Although at first the climb appears normal, and was as described by the pilot, as the aircraft passes over the end of the runway the aircraft stops climbing and eventually starts to descend. The engine tone appears to change slightly just before the aircraft stops climbing and there appears to be a short burst of misfiring during the descent. At this point the video stops. Based on the video, in particular the aircraft dimensions when compared with features on the ground, the aircraft appears to be lower than the pilot's estimation as the aircraft passed over the end of the runway, possibly as low as 60 ft agl.

Discussion with a third party, familiar with the engine and its installation in Thruster aircraft, described the rpm indication system as being relatively simple. Crankshaft rotational speed is sensed by a Hall-effect sensor which drives a small gauge. It was also suggested that experience has found that these gauges can be unreliable. Their experience also suggests that the rpm change, when carrying out a magneto drop test, is low, between 10 and 30 rpm.

Analysis

The rapid onset of events meant the pilot had no time to understand what was causing the power loss, so just concentrated on landing the aircraft. From the video evidence the height of the aircraft as the engine lost power can be estimated and this supports the fact he had very little time in which to react. As he said, faced with limited options "the hedge was the least worse option". The type of hedge along with the four-point harnesses probably prevented a worse outcome in this accident.

The pilot had not attempted to turnback towards the airfield. AAIB experience, during numerous previous investigations, has found that there is a high risk of loss of control during a turnback in engine power loss situations. In many cases this has resulted in accidents with fatal injuries.

There is no evidence of a component failure or malfunction which could have led to the power loss. However, the heavy 'sooting' of the cylinders, plugs and exhausts suggests an overly-rich fuel air mixture, such as could have been caused by carburettor settings or by running the engine with the choke set. The pilot was sure that he had opened the

choke after his engine starting process but, in the stressful circumstances of the accident, he could not exactly recall the aircraft configuration.

The rpm gauge under reading and the magneto drop test are not likely to have caused the loss of power. In the Jabiru engine the rpm drop is very small, maybe as little as 10 to 30 rpm. This is because the two spark plugs are close together in the cylinder head, so the ignition points to set off the flame front are close together. In other engines, where the plugs are opposite each other, two separate flame fronts are initiated and this has a greater effect on the rpm when one plug ceases to spark. Therefore, the loss of one spark in the Jabiru engine has less effect on the ignition characteristics, thus the effect on rpm is less marked. Not having a reliable rpm gauge meant that magneto drop test was not clearly discernible. The reduced ability to monitor the rpm may have also influenced an assessment of whether the engine was achieving full power.

Conclusion

There was no evidence of a component failure or malfunction that could have led to the engine power loss. The build-up of soot within the engine suggests it had been running with an overly rich fuel air ratio, which, in most circumstances, would cause a reduction of power. This resulted in the aircraft not being able to sustain a satisfactory climb and then descend. The pilot was left with no practical choice other than to carry out a forced landing, the severity of which was somewhat reduced by the hedge and the four-point harnesses he and his passenger were wearing. The decision not to turnback probably also reduced the risk of a more serious outcome.