ACCIDENT

Aircraft Type and Registration:	Rogers Sky Prince, G-CJZU
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	2009 (Serial no: 00118-1507)
Date & Time (UTC):	30 June 2021 at 1536 hrs
Location:	Near Goodwood Aerodrome, West Sussex
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:	65 years
Commander's Flying Experience:	706 hours (of which 16 were on type) Last 90 days - 89 hours Last 28 days - 19 hours
Information Source:	AAIB Field Investigation

Synopsis

After takeoff the engine in G-CJZU suffered a partial power loss[1]. This power loss became more significant as the aircraft reached 300 ft aal. The aircraft had little natural stall warning and was not fitted with an artificial stall warning device. A safe flying speed was not maintained, and the aircraft departed from controlled flight at a height from which it was not possible to recover. The aircraft descended steeply and struck the ground nose first. The accident was not survivable.

Examination of the engine could not find any faults that could have caused or contributed to the loss of power. The aircraft had sufficient fuel for the flight. Insufficient supply of fuel to the engine from the tanks could have caused the power reduction but the damage to the aircraft meant that it was not possible to establish the condition of the fuel system or level of fuel supply. It is also possible that a fault in the ignition system could have contributed to the power reduction, but the damage from the post impact fire meant that the integrity of the electrical system could not be fully assessed. Weather conditions were also conducive to carburettor ice forming on the taxi out to the runway. It is possible that carburettor ice formation caused the engine to lose power after takeoff.

Footnote

[1] A situation where an engine provides less power than commanded by the pilot, but more power than idle thrust.

Whilst the investigation of G-CJZU was in progress, a further event involving partial power occurred in which the three occupants of the aircraft were seriously injured[2]. The aircraft suffered a partial loss of engine power shortly after takeoff and the pilot attempted a turnback to land on the reciprocal runway. The aircraft stalled during the turn and struck the ground west of the runway. Three Safety Recommendations were made in that report with respect to pilot training for partial power loss events. These Safety Recommendations, whilst not a part of this report, were formed on the basis of information from both accidents and are supported by the events described here.

History of the flight

G-CJZU had been advertised for sale and the passenger had contacted the pilot to express his interest in the aircraft. The pilot arranged for the passenger to come and see the aircraft as well as experience a flight in it. The passenger arrived at Goodwood and proceeded to spend some time with the pilot and G-CJZU.

At 1529 hrs the aircraft was seen taxiing for takeoff on Runway 32 and having completed the power checks, the aircraft began its takeoff at 1533 hrs. Having become airborne from the runway, the aircraft made a 20° right turn to avoid overflying the village of East Lavant as required by the Goodwood noise abatement procedures. The aircraft was observed by witnesses both on the airfield and around the flightpath. The witnesses described their impression that the aircraft seemed to be low and slow, and that it was struggling to climb.

CCTV showed the aircraft level or begin to descend shortly after the noise abatement turn. A decrease in pitch attitude can be seen on the CCTV lasting around seven seconds before the pitch attitude increased again. Approximately 30 seconds later, the aircraft began a gentle turn to the left but rapidly became unstable with an increasing bank angle and the nose began to drop. The aircraft was last visible dropping behind a tree line with a very nose low attitude and a high bank angle. The aircraft struck the ground at 1536 hrs having turned through almost 180° to be facing the aerodrome. Both the pilot and passenger were fatally injured.

Accident site

The aircraft wreckage was located in the corner of a field adjacent to a line of trees. The wreckage distribution was confined to a small area. The aircraft was severely damaged and had been subject to an intense post-impact fire. The ground around the wreckage was fire damaged and was wet from the application of foam by the Airfield Fire Service who attended the scene. The aircraft had struck the ground nose first and the engine was partially lodged in the layer of clay type soil; a hydraulic lift was required to extract the engine from the ground. Parts of the splintered propeller were found on the accident site. There were witness marks where the left wing had struck the ground; there were no observable witness marks from the propeller. It was not possible to determine the position of the cockpit controls prior to impact due to the impact forces and fire damage.

Footnote

[2] AAIB Report Grumman AA-5, G-BBSA AAIB Bulletin 7/2022 - https://www.gov.uk/aaib-reports/aaib-investigation-to-Grumman-AA-5-G-BBSA [Accessed June 2022].

Recorded information

Several electronic devices were recovered from the accident site; however, all were damaged in the post-impact fire and no data could be recovered from them. CCTV footage from the aerodrome captured the aircraft beginning its takeoff roll. Other footage (Figure 1) captured the aircraft airborne, starting just before the intersection of Runways 14/32 and 06/24, through to its descent to the ground. Analysis of the footage suggests that shortly after passing over the runway intersection at about 150 ft aal, the aircraft levelled off for about six seconds before climbing to about 300 ft aal over the next 26 seconds (so averaging about 350 ft/min). The aircraft is then seen to descend and roll left into a steep dive towards the ground. After disappearing from view behind a row of trees, smoke from the post-impact fire can be seen.

Witness information

There were several witnesses who saw and/or heard G-CJZU during the accident flight. All reported very similar recollections. Those who saw the aircraft commented that it seemed slow and low after takeoff and did not seem to climb away as they expected. One witness describes seeing the wings rock as it struggled away. Once the aircraft had completed the noise abatement turn, attention was drawn to the aircraft by what witnesses described as a cough from the engine, followed a few seconds later by silence. This silence was followed shortly afterwards by the aircraft seeming to bank sharply left, with the nose dropping before the witnesses lost sight of it behind a line of trees. Those who heard the aircraft striking the ground heard what they described as a “thump” before they saw an intense fire break out immediately.

Aircraft information

The Rogers Sky Prince is based on the Jodel D150 Mascaret (D150). The D150 is a two-seat low-wing tailwheel undercarriage touring aeroplane of all wood fabric-covered construction, previously factory produced as a type-certified aeroplane but now supplied in the form of a set of drawings. The standard drawings for building the D150 are of French origin but an English language version was developed in Australia. Aircraft built using these English language plans are known as the Rogers Sky Prince.

G-CJZU (Figure 2) was built in Spain and completed in 2009. In 2017 it was purchased and imported into the UK. It was sold to the present owners in 2019. The engine fitted was a Continental O-200A.

G-CJZU was significantly heavier than a standard D150, probably due to differing wood specifications within the build. This added around 20% to the empty weight of G-CJZU compared to a factory built D150. The aircraft was fitted with a fuel tank in each wing and a large main tank in the fuselage. With the heavier basic aircraft weight and two people on board, the aircraft maximum takeoff weight was liable to be exceeded if the pilot wished to use the fuselage tank as well as the wing tanks. The operator had put in place procedures to ensure the weight was calculated carefully if pilots wished to make use of the extended range with the fuselage tank in use. It was normal practice for this tank to be left empty.

Figure 1

Approximate ground track (note rising ground at the top of the chart) and composite image from CCTV showing G-CJZU flightpath (two-second spacing between aircraft)

Figure 2
Rogers Sky Prince G-CJZU (used with permission)

The aircraft had brake pedals only on the left side of the cockpit, with the fuel selector mounted on the floor between the legs of the left seat pilot. The fuel selector was reported to be difficult to reach, requiring that the pilot slip their shoulder straps off in order to reach down to move it. The fuel selector had four positions (LEFT, MAIN, RIGHT and OFF).

The aircraft engine mixture control was a pull/push lever with a red round knob fitted on the end. This mixture control was the same shape and had very similar dimensions as the engine carburettor heat control lever which was fitted next to it. The only difference between the two levers was the colour of the knob fitted to the end. The controls are shown in Figure 3.

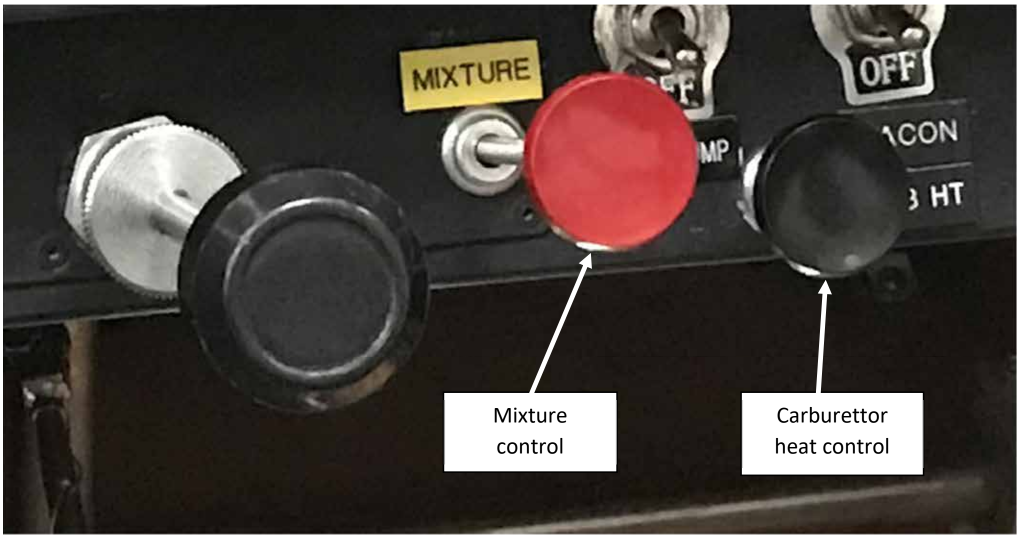

Figure 3
Cockpit controls (used with permission)

Although it was not a requirement on G-CJZU, it is good practice that such controls have different shapes and/or movement to ensure that a pilot does not inadvertently operate the wrong control.

Aircraft examination

The main aircraft structure had been severely damaged by the fire, the most significant identifiable structure were the main wing spars, but even these had been almost completely burned. Examination of the steel control lines showed no evidence of loss of integrity of the flight control system. Whilst the control surfaces which connected to the control lines had been destroyed by the fire, the steel elements of the connections were intact. Due to the angle at which the aircraft struck the ground, the cockpit was severely damaged. Electrical wiring looms had suffered extensive heat damage. The fuel system had been fragmented by the impact; the wing fuel tanks had been separated from the fuel pipes which had been distorted, bent and fractured by the impact forces. The electric fuel pump was in place, but both the inlet and outlet pipes had become separated from the pump, this was likely due to the effects of heat on the pump housing. It was not possible to obtain a fuel sample from the aircraft fuel system. The aircraft was predominantly refuelled at Goodwood, and no other aircraft reported issues with fuel supplied from the same source as G-CJZU. The main fuel selector valve was relatively undamaged (Figure 4).

Figure 4
Fuel Selector Valve

The engine, whilst having suffered some impact damage was relatively intact. The carburettor had been almost completely sheared off its attachment and the fuel inlet hose connector had been destroyed by the impact. The propeller had been fragmented on impact, but the propeller hub and part of the blade were still connected to the engine (Figure 5).

Figure 5
Engine recovered at accident site

Engine examination

The engine was stripped and inspected at an engine overhaul facility. This included the fuel pump, magnetos and spark plugs, carburettor, as well as the mechanical components. There was no evidence of any pre-existing defects that could not be explained by the ground impact or the post-impact fire.

Fuel selector valve examination

The fuel selector valve was inspected, tested and disassembled at the manufacturer's facility. The valve was found to be assembled correctly and functioning satisfactorily, and the valve position correlated with the valve switch position, which was selected to the right hand tank.

Weight and balance

It was not a requirement of the regulator nor the flying group to record the fuel remaining at the end of the flight in the aircraft log. The investigation was able to establish a day when it is likely that the wing tanks were full, and using the flight times and fuel uplift figures, it was possible to calculate that there was sufficient fuel in the aircraft for the planned flight.

Although the AAIB could not establish an exact fuel load in the aircraft at takeoff, calculations with full wing tanks and using the actual pilot weights, the aircraft was below the maximum authorised weight and within the limits for centre of gravity. Due to the closeness of the wing tanks to the datum centre of gravity in the aircraft, a decrease in fuel load would have made very little difference to the calculated flight centre of gravity.

Aircraft Maintenance

The aircraft underwent a Permit to Fly renewal on 16 September 2020 and undertook a satisfactory permit renewal flight on 18 September 2020. On 28 June 2021, following reports of a smell of fuel in the cockpit, the owner requested that a maintenance organisation conduct a visual inspection of the aircraft to determine if there were signs of a leak. The technicians conducted a visual inspection of the fuel tanks, pipes and selector and could not see any leaks. The engine cowlings were removed, and a stain observed on the engine driven pump inlet union. This union was replaced; leaks and functional checks were conducted, all of which were satisfactory. The owner subsequently flew the aircraft and could not detect any smell of fuel and did not observe any other anomaly with the fuel system or aircraft operation.

Aircraft performance and handling

Takeoff and climb

The CCTV images in which the aircraft appeared just after lift off was analysed and it showed that the aircraft had travelled approximately 480 m to get airborne. This was consistent with the performance tables from the flight manual which suggest that an aircraft at maximum takeoff weight would require 565 m to reach a height of 15 m (50 ft). The aircraft was not operating at maximum takeoff weight.

In 2021 the propeller on the aircraft was changed due to a fault with the one previously fitted. A flight test was performed to measure the aircraft performance on 1 June 2021. The results showed that the aircraft achieved an average rate of climb of 450 fpm from 1,000 ft amsl upwards for the five-minute test. No vibration was reported, and the engine limits were all observed to be normal throughout the flight range. The manufacturer of the propeller reviewed the performance figures from the flight test and considered that these figures looked within a normal range.

Other pilots who had flown G-CJZU over the previous few weeks reported that the climb rate was around 300 fpm and that the pitch attitude needed to be reasonably flat to keep the best rate of climb speed of 75 mph. CCTV of the aircraft climb out was shown to some witnesses who were familiar with the aircraft. They noted that the climb rate looked normal for the first 12 to 15 seconds of flight before it seemed that the climb stopped, and the aircraft flew level or began to descend.

Stalling

The Sky Prince is built using plans closely based on the original Jodel D150, although the individual nature of the build will give each aircraft slightly differing handling characteristics. The magazine *Air Pictorial* in 1964[3] reported the stall, both clean and with flap, in the D150 to be *'fairly sudden'* in nature with *'no perceptible aerodynamic warning'*. The article reported that there was tendency for the left wing to drop with full flap or if there was some power applied at the time of the stall. Pilots who had flown G-CJZU recently reported varying

Footnote

[3] Paul, G.J.C. (1964) 'Air Test No. 51 Jodel D.150 Mascaret', *Air Pictorial*, July 1964.

experiences with the stall on the aircraft. Some reported no wing drop and others noted significant wing drop that occurred regardless of the configuration. The pilots agreed with the Air Pictorial assessment of the stall being sudden and there was little natural warning.

The stall speed of the G-CJZU was recorded when a flight test was conducted for the import of the aircraft into the UK from Spain. The clean stall speed was listed as 54 mph, with the stalls with flaps in both takeoff and landing configurations listed as 50 mph. The aircraft was not fitted with a stall warner, nor was there a requirement for one to be fitted.[4]

Meteorology

An aftercast was obtained from the UK Met Office. This indicated that the weather over the UK was a slack pressure pattern with a high pressure south of Iceland. The weather in the Goodwood area was benign with good visibility, light to moderate winds from the northwest and a cloud base above 2,000 ft amsl. The temperature was 18°C with the surface dewpoint of 12°C.

With the temperature and dewpoint as forecast, the carburettor icing risk was moderate at cruise power, and severe at descent power. The aircraft had taxied at Goodwood for at least four minutes in conditions where it is possible that carburettor ice could have formed. The engine type fitted to G-CJZU is known to be susceptible to forming carburettor icing during taxi if the conditions are likely to promote its formation. Taxiing on grass also increases the chance of ice forming due to the higher relative humidity close to the grass. CAA *Safety Sense Leaflet 14 - Piston Engine Icing*[5] states that:

> *'...ice may build up at the low taxiing power settings, and if not removed may cause engine failure after take-off.'*

It suggests that if ice formation is likely on taxiing, the carburettor heat should be operated for 15 seconds immediately prior to takeoff.

It is unlikely that carburettor icing would have formed with the engine at takeoff power[6]. If ice does form in the carburettor, it leaves no sign once it has melted.

Airfield information

Goodwood Aerodrome is a grass airfield located 1.5 nm north-north-east of Chichester, West Sussex. Runway 32 has a TORA of 1,127 m. There are noise abatement procedures in operation including for takeoff on Runway 32. This procedure requires the pilot to turn right by 20° as soon as possible after departure to avoid East Lavant village which is positioned

Footnote

[4] The relatively more diverse nature of Permit to Fly aircraft (amateur-built, vintage and ex-military) means that designs qualifying for a Permit to Fly rarely meet the detail requirements in full of modern civil aircraft certification codes such as EASA Certification Specification - Very Light Aircraft (CS-VLA).

[5] CAA *Safety Sense Leaflet 14 – Piston Engine Icing* January 2012. Available at http://publicapps.caa.co.uk/docs/33/20130121SSL14.pdf [Accessed January 2022].

[6] CAA *The Skyway Code (Version 3)* March 2021. Available at https://publicapps.caa.co.uk/docs/33/CAP1535P%20Skyway%20Code%20Version%203.pdf [accessed September 2021].

around 750 m from the upwind end of the runway. This heading is to be maintained until well clear of the village and practice engine failures after takeoff are not permitted until well beyond the village.

The area beyond the end of Runway 34 is flat with a number of large fields before the village of East Lavant. Beyond the village the land begins to rise gently for about a further kilometre before the rise becomes steeper up to the top of the South Downs.

Personnel

The pilot of the aircraft was also the co-owner. He held a PPL with over 700 hours total experience, a significant proportion of which was in tail wheel light aircraft similar to G-CJZU. He was also a Class Rating Instructor which allowed him to instruct for the issue, revalidation or renewal of a class or type rating for single-pilot aeroplanes. The pilot was sitting in the left seat.

The passenger on the flight also held a valid PPL. He had around 200 hours total experience and had recently completed a tailwheel conversion. The passenger was not a member of the operating club and therefore signed a passenger form before the flight. The passenger was sitting in the right seat.

The combination of the occupants and their qualifications meant that legally either occupant could have been operating the controls, although friends and colleagues of the pilot commented that he was very thorough and would have been flying the aircraft even though he was qualified to allow the passenger to operate the controls under his supervision. Equally those who knew the passenger thought it unlikely he would have been operating the controls of an aircraft with which he was not familiar. The injuries identified in the pilot's hands and feet could indicate that he might have been in contact with the controls as the aircraft struck the ground, but it was not possible to be definitive.

Post-mortem examinations of both the pilot and passenger showed no pre-existing conditions that could have caused or contributed to the accident. It is likely that both occupants died at impact before the fire began.

Dealing with partial power loss

Partial power losses present the pilot with a challenging situation where decision making is key to the successful handling of the emergency. The training syllabus for the UK PPL does not include handling partial power as a specific item. The training concentrates on engine failure after takeoff and pilots practise responding immediately to a complete loss of power. In the case of an engine failure after takeoff, the pilot is faced with a known situation, and this requires little in the way of a complex decision-making process. The partial loss of power is more difficult as the pilot must assess the power level and therefore what options may be available. Such an event may require the pilot to make timely decisions such as to go for a forced landing which can be counterintuitive especially when an engine is still running.

The Skyway Code published by the CAA discusses the difficulties in dealing the partial power losses:

> *'Partial engine failures can confuse the decision making process. Assess whether the failure is likely to become worse – for example if rapidly losing oil pressure, the engine may not run for much longer. Take a positive decision to either put down in a field or continue to an aerodrome, depending on your judgement of the problem.*[7]'

In 2013 the Australian Transportation Safety Bureau (ATSB) published a report[8] in their '*Avoidable Accidents*' series which analysed the accident statistics for partial power losses. This report showed that in the period from 2000 to 2010 of occurrences reported to the ATSB, a partial loss of engine power on takeoff was more than three times more frequent than a total loss of power. Of the 242 partial engine failures, nine resulted in fatalities whilst there were no fatalities in the 75 total power loss events. A common factor in the fatalities was a loss of control. It is vital to remain at or above a safe minimum speed and to watch the angle of bank.

> *'The most severe outcomes have occurred when the partial loss of power resulted in the aircraft descending slightly (or being maintained at altitude with increasing angle of attack resulting in airspeed bleeding off), rather than an almost complete loss of power, where it was clear that height could not be maintained. If you feel yourself wanting to stretch the glide, tighten a turn, or maintain height, check the airspeed indicator. If the airspeed has bled off from the glide speed, lower the nose, reduce bank angle if in a turn and re-consider landing options.'*

The ATSB key messages are:

- Pre-flight checks prevent partial power loss

  ATSB occurrence statistics indicate that many partial power losses could have been prevented by thorough pre-flight checks.

- Pre-flight planning and pre-takeoff briefings

  Consider your actions in the event of a partial power loss as much as you would for a total power loss during the pre-flight planning and briefing. This gives you a much better chance of staying in control and ahead of the aircraft.

Footnote

[7] CAA *The Skyway Code* (*Version 3*) March 2021. Available at https://publicapps.caa.co.uk/docs/33/CAP1535P%20Skyway%20Code%20Version%203.pdf [accessed September 2021].

[8] ATSB *Avoidable Accidents No. 3 Managing partial power loss after takeoff in single-engine aircraft* 2013. Available at https://www.atsb.gov.au/publications/2010/avoidable-3-ar-2010-055/#:~:text=ATSB%20occurrence%20statistics%20indicate%20that%20many%20partial%20power,spark%20plug%20fouling%2C%20carburettor%20icing%20and%20pre-ignition%20conditions [accessed October 2021].

- Stay in control

  Have a minimum speed and maximum bank angle which you stick to even if it means reassessing the situation during manoeuvres.

The report concludes with:

> *'Most fatal and serious injury accidents resulting from partial power loss after takeoff are avoidable.'*

Teaching partial power loss

Pilots are taught to handle a complete power loss after takeoff but are rarely taught how to deal with a partial power loss. It is not required under the UK PPL syllabus as a specific item. There is also no requirement to check or assess pilots for the handling of partial power during recurrent checks or training. Many pilots complete their PPL with little or no exposure to the challenges of a partial power scenario. Few have discussed what actions might be needed with a more experienced pilot or instructor. Pre-flight discussions tend to focus on a total loss of engine power and the likely landing areas available.

The Civil Aviation Safety Authority of Australia (CASA) includes the teaching of partial power scenarios as part of the PPL syllabus requiring pilots to reach competency standards[9] for licensing. These standards include knowledge of dealing with partial power, as well as the effects of partial engine power on performance, flight profile, range and landing options.

Partial power has been covered during instructors' seminars and on safety seminars by organisations such as GASCo over the last few years.

Previous events

The AAIB has investigated numerous occurrences of partial power loss in single engine aircraft over the last 10 years of which at least nine others[10] have resulted in fatal injuries to occupants. Three accidents in the same period where partial power was a factor resulted in no injuries to the occupants. In all three of these the pilot ditched or completed a forced landing with the aircraft under full control[11].

The accident to G-YIII[12] has many similarities to G-CJZU. The report states:

> *'The suggested action following an engine failure on takeoff 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.'*

Footnote

[9] Part 61 Manual of Standards Instrument 2014 (legislation.gov.au), Volume 2, Paragraph 2.3 A6.3(b) [accessed 13 May 2022].
[10] G-BUDW, PR-PTS, G-ADXT, G-NDOL, G-CDER, G-EWZZ, G-YIII, G-GBXS, G-ASXY (these can be accessed at www.aaib.gov.uk).
[11] D-EESE, G-TLET, G-ARNZ (these can be accessed at www.aaib.gov.uk).
[12] AAIB investigation to Cessna F150l, G-YIII available at https://assets.publishing.service.gov.uk/media/55252d2340f0b61392000007/Cessna_F150l_G-YIII_04-15.pdf [accessed January 2022].

Partial power loss can also involve the pilot concentrating on diagnosing the problem, sometimes at the expense of flying the aircraft. As the pilot attempts to ascertain the cause of the partial power loss it is possible that the significant positive action required to avoid the airspeed reducing may be missed or delayed. The aircraft may also be out of balance since the amount of rudder deflection applied for full power at takeoff may no longer be appropriate.

The report into the accident of G-BGBN[13] in which both occupants suffered serious injuries states:

> *'This accident reinforces the advice that following engine failure it is essential to maintain flying speed and control of the aircraft. It is the experience of the AAIB that a controlled crash landing straight ahead is preferable to stalling at low level.'*

On the 25 September 2021, a Grumman AA-5, G-BBSA suffered a partial loss of power just after takeoff. The pilot attempted a turnback to land on the reciprocal runway but at approximately 60 ft aal, the left bank angle suddenly increased, and the aircraft descended rapidly, striking the ground 67 seconds after becoming airborne. All three occupants of the aircraft suffered serious injuries. The report into the accident made the following Safety Recommendations:

Safety Recommendation 2022-005

It is recommended that the UK Civil Aviation Authority require ab initio pilots to undergo training in the management of partial power loss situations in single-engine fixed-wing aeroplanes.

Safety Recommendation 2022-006

It is recommended that the UK Civil Aviation Authority provide detailed guidance on techniques for managing partial power loss situations and to promote their use by instructors and examiners when conducting training for a rating revalidation in single-engine fixed-wing aeroplanes.

Safety Recommendation 2022-007

It is recommended that the UK Civil Aviation Authority updates its General Aviation safety promotions to include information for pilots regarding techniques for managing partial power loss situations in single-engine fixed-wing aeroplanes.

Footnote

13 Piper PA-38-112 Tomahawk, G-BGBN, 5 June 2013 available at https://assets.publishing.service.gov.uk/media/5422f6cb40f0b613420005a7/Piper_PA-38-112_Tomahawk__G-BGBN_03-14.pdf [accessed January 2022].

The Safety Recommendations attempt to address the issue of pilot training and development from ab initio trainees, to experienced pilots both through practical training as well as through publicity and education.

Analysis

Evidence from the CCTV and witnesses indicated that G-CJZU suffered a partial loss of power on reaching 150 ft aal after takeoff. Witnesses described an aircraft struggling to climb and being slow and low. Witnesses familiar with the aircraft performance who were shown the CCTV agreed that the aircraft initially seemed to climb normally before levelling off.

Having levelled off for about six seconds, the aircraft then continued to climb. Estimates from the CCTV suggest that the aircraft reached approximately 300 ft aal. Witnesses reported that they heard the engine of the aircraft stutter or cough before the noise ceased entirely about five seconds later. It is probable that the partial power loss became more significant or complete at this point. The left wing was then seen to drop, and the aircraft began to rotate to the left, descending rapidly. It struck the ground, nose first and a fire broke out. The accident was not survivable.

The reason for the partial and then significant loss of power could not be established. There are three main reasons why a piston engine may experience partial power: a mechanical failure in the engine; failure in the ignition system; or fuel starvation.

Examination of the engine revealed no pre-existing faults or damage that could have inhibited operation of the engine. Inspection of the magnetos indicated they were likely to have been functioning, and no faults were observed with the spark plugs, but due to the fire damage, it was not possible to determine the integrity of the ignition system. The investigation was able to establish that there was sufficient fuel in the main tanks for the planned flight but was unable to establish that there was an adequate supply of fuel to the engine. Due to the extensive damage to the aircraft in the post-crash fire it was not possible to examine all of the fuel system, nor establish the position of most of the cockpit controls.

The meteorological conditions on the day of the accident were conducive to the formation of carburettor icing during taxi, especially on grass. The engine of G-CJZU was known to be susceptible to the formation of carburettor ice. Ice formed during taxiing or a delay in takeoff can cause an engine to fail if it is not cleared by selecting the carburettor heat for 15 seconds before takeoff. Any ice that had formed in the carburettor would have melted rapidly in the post impact fire and with the air temperature at 18°C. The formation of such ice leaves no detectable signs in the engine once the ice has melted.

Partial loss of power after takeoff can be a challenging emergency and one that is rarely taught or practised. The topic of partial power is not required to be covered in the UK PPL syllabus or in recurrent checks, so it was unlikely the pilot had practised it routinely. Statistics from the ATSB suggest that it is three times more common than a total power loss and much more likely to lead to fatal injuries. Unlike total power loss, where the actions to be taken are clear, partial power loss requires the pilot to assess the situation without delay and take decisive action to ascertain if the aircraft can still fly at a safe speed and height. Pilots can be distracted by trying to identify and rectify the problem rather than concentrating on flying the aircraft. Pre-flight planning and briefing, as well as having and remaining within a speed and bank angle limit, might save your life. The ATSB report and previous accidents investigated by the AAIB show that the loss of control after a partial power loss is almost inevitably going to lead to fatal or very serious injuries.

The AAIB have investigated a further 15 partial power accidents since 2010, of which nine have resulted in fatal injuries. In the report into the accident to G-BBSA, where the pilot was faced with a partial power situation just after takeoff, three Safety Recommendations were made in regard to training for pilots to deal with partial power scenarios. Those recommendations are backed up by the events in this report.

The D150 has little natural stall warning and the original factory-built model was fitted with an artificial stall warner. G-CJZU was reported to be similar to the D150 with a lack of natural stall warning and the tendency to drop the left wing in all configurations, but was not fitted with a stall warner. The pilot's attention was probably taken up with trying to solve the cause of the partial or significant power loss, and this meant that his attention may not have been on the airspeed. With little power available and no significant nose down attitude, the airspeed would have reduced rapidly, perhaps unnoticed by the pilot. As the airspeed reduced to the stall speed, the pilot would have had little warning before the aircraft stalled and the wing dropped. The aircraft was below the height at which it could be recovered.

Conclusion

After takeoff G-CJZU suffered a partial power loss which then became more significant as the aircraft climbed through 300 ft aal. The aircraft then departed from controlled flight and stuck the ground nose first. Both occupants received fatal injuries. It was not possible to determine the cause of the partial and then more significant power loss.

The ATSB published a report in 2013 detailing research into partial power loss and contains some key messages for pilots to aid them in dealing with partial power should it occur.

Safety actions/Recommendations

In the AAIB report into the accident to G-BBSA on 25 September 2021, where the pilot was faced with a partial power situation just after takeoff, three Safety Recommendations were made in regard to training for pilots to deal with partial power scenarios. The G-BBSA report can also be found in this Bulletin. Those recommendations are equally applicable to the issues raised by this report, and as a result no further Safety Recommendations are made.

Published: 16 June 2022.