**ACCIDENT**

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| **Aircraft Type and Registration:** | Cessna 185A Skywagon, G-BLOS |
| **No & Type of Engines:** | 1 Continental Motors Corp IO-470-F piston engine |
| **Year of Manufacture:** | 1962 (Serial no: 185-0359) |
| **Date & Time (UTC):** | 7 October 2020 at 1620 hrs |
| **Location:** | Pauncefoot Airstrip, Romsey |
| **Type of Flight:** | Private |
| **Persons on Board:** | Crew - 1 Passengers - None |
| **Injuries:** | Crew - 1 (Serious) Passengers - N/A |
| **Nature of Damage:** | Wings separated and significant fuselage damage |
| **Commander's Licence:** | Private Pilot's Licence |
| **Commander's Age:** | 63 years |
| **Commander's Flying Experience:** | 395 hours (of which 42 were on type)<br>Last 90 days - 5 hours<br>Last 28 days - 0 hours |
| **Information Source:** | AAIB Field Investigation |

**Synopsis**

Soon after takeoff, the aircraft began descending with an increasing ground speed towards a small wooded area. The aircraft struck the trees, becoming increasingly disrupted as it descended through them. The fuselage came to rest upright amongst thick bushes around 1,000 m from the start of its takeoff run. The wings were found approximately 30 m behind the location of the main wreckage.

Witnesses on a nearby road had seen the aircraft descending towards the trees and had alerted the emergency services. The aircraft was located with some difficulty and when the emergency services reached it, the pilot was found lying partially outside the fuselage on the ground at the right hand side. He had suffered serious injuries in the accident.

The aircraft was severely damaged, but extensive examination did not reveal any faults which could have caused or contributed to the accident. It seems likely that the pilot became incapacitated after takeoff and that the aircraft began a descent due either to being slightly out of trim for the climb, or because of an involuntary movement by the pilot on the control column. The pilot could not recall any events of the accident. It was not possible to establish the exact cause of the likely incapacitation.

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**History of the flight**

The aircraft was kept in a purpose-built hangar at a private airstrip near Romsey in Hampshire. The pilot, who co-owned the aircraft, wheeled it out of its hangar and prepared it for a late afternoon flight to Sandown on the Isle of Wight. The wing fuel tanks were full and contained a total of 320 litres (84.5 USG) of Avgas. Having performed the pre-flight checks, the pilot started the engine before taxiing to the runway. He completed the pre-takeoff power checks before lining up on the runway for takeoff. He did note that during the engine power checks the propeller control was slow to react at first, but was satisfactory on a second and third check and gave him no further cause for concern. After takeoff the aircraft climbed normally at first with the pilot making a small heading change to the right as was his normal practice. The aircraft then appeared to level and start to gradually descend, with increasing ground speed, heading directly towards the trees.

The pilot has no recollection after the slight heading change but became vaguely aware of foliage passing the cockpit. At this point, the aircraft was striking the tree tops. This had the effect of slowing the aircraft as it descended through the tree canopy. The main portion of both wings detached as the aircraft collided with thicker tree trunks as it descended to the ground. The fuselage and remainder of the loosely attached right wing root were eventually brought to a stop within dense bushes on the ground. The accident site was approximately 1,000 m from where the pilot had begun the takeoff roll.

Witnesses travelling along a nearby road saw the aircraft disappear into the trees. The emergency services were called, and, with some difficulty, they eventually located and gained access to the wreckage. The seriously injured and semi-conscious pilot was found lying partly out of the aircraft on the ground.

**Accident site**

The aircraft hit the tops of the trees which were part of a small forest on private land. It had descended through the canopy during which the wings and parts of the landing gear had become detached. The wing fuel tanks had been split open and all the fuel had dispersed. The fuselage was brought to a stop right-side down in dense laurel bushes which were up to 2 m high and covered most of the forest floor (Figure 1). The rear fuselage was distorted and although still attached, the empennage and fin were displaced to the side. The cabin and cockpit had generally retained their shape and the windscreen was missing. Perspex fragments from the windscreen littered the accident site. The wings were found lying approximately 30 m behind the fuselage entangled within the trees and undergrowth.

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**Figure 1**

Accident site showing the top of the fuselage and dense undergrowth

The nose section was dented and misshapen, but all the engine bay panels had remained in place. Both propeller blades were distorted in a manner indicative of rotation under power throughout the accident sequence. There were numerous dents over the entire surface of the spinner (Figure 2).

**Figure 2**

Nose section, propeller blade distortion and spinner

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**Recorded information**

An electronic tablet with an aviation navigation app was recovered from the accident site. The app records flight logs based on the Global Navigation Satellite System capabilities of the tablet. The recorded flights included the accident flight and previous flights from the same airfield.

The accident flight log started at 1416 hrs (Figure 3). The aircraft taxied along the initial part of the runway and then backtracked to the east end of the runway. The takeoff started at 1433:08 hrs and the last recorded data point was 36 seconds later.


**Figure 3**

Oblique view of the accident flight

The data for the flight is shown in Figure 4. The aircraft initially climbed at approximately 1,000 ft/min with a ground speed of approximately 70 mph. Weather information, from Southampton Airport 12 km away, indicated a head wind of about 7 mph was present at the time. This indicates that the IAS was above that required for a maximum performance takeoff. The climb rate and speeds were as expected for the aircraft type and similar to previous takeoffs from that location recorded in the tablet.

The aircraft stopped climbing, peaked at approximately 150 ft agl and started descending. The aircraft accelerated in the descent. The energy of the altitude / speed profile in the descent indicates similar engine power was in use as that in the climb. The altitude / speed profiles of the previous takeoffs from the same runway indicated a similar amount of power being produced by the engine (Figure 5).

It is not known whether the logged flights represent the entirety of the pilot's recent flying, that of the aircraft, both or neither. Sixty five flights were logged between April 2018 and the accident flight. The three flights prior to the accident flight were recorded in July 2020 and the flight prior to that was in November 2019.

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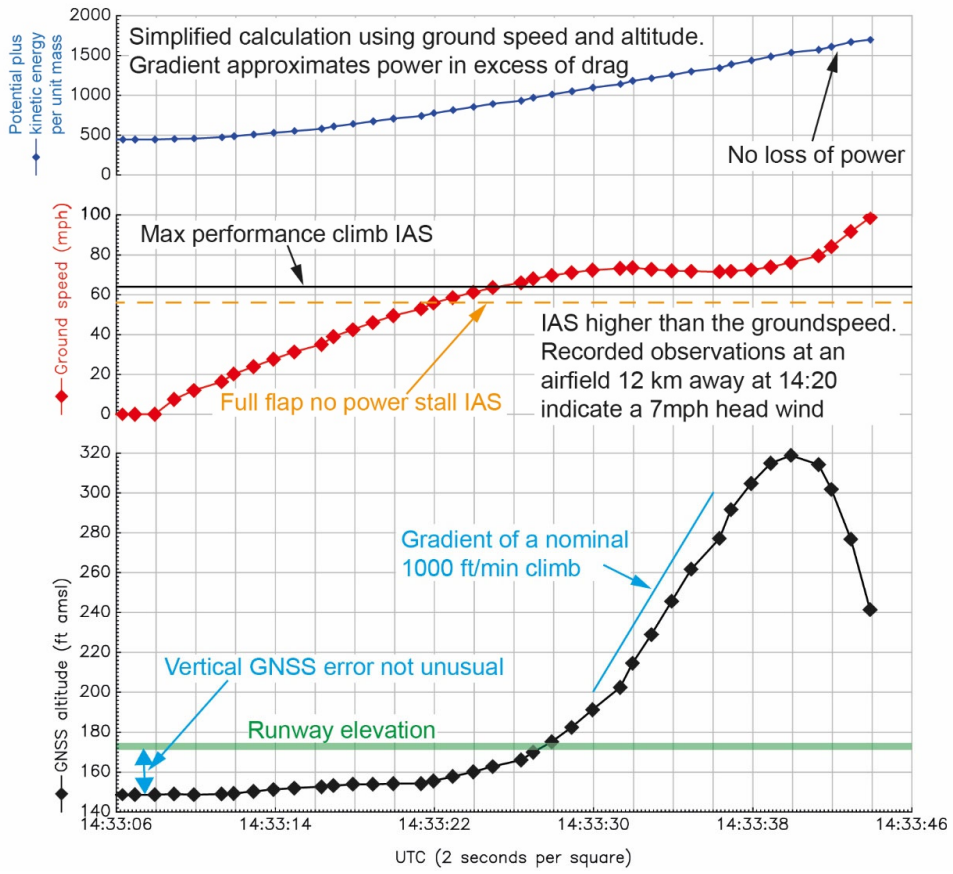


**Figure 4**

Accident flight data

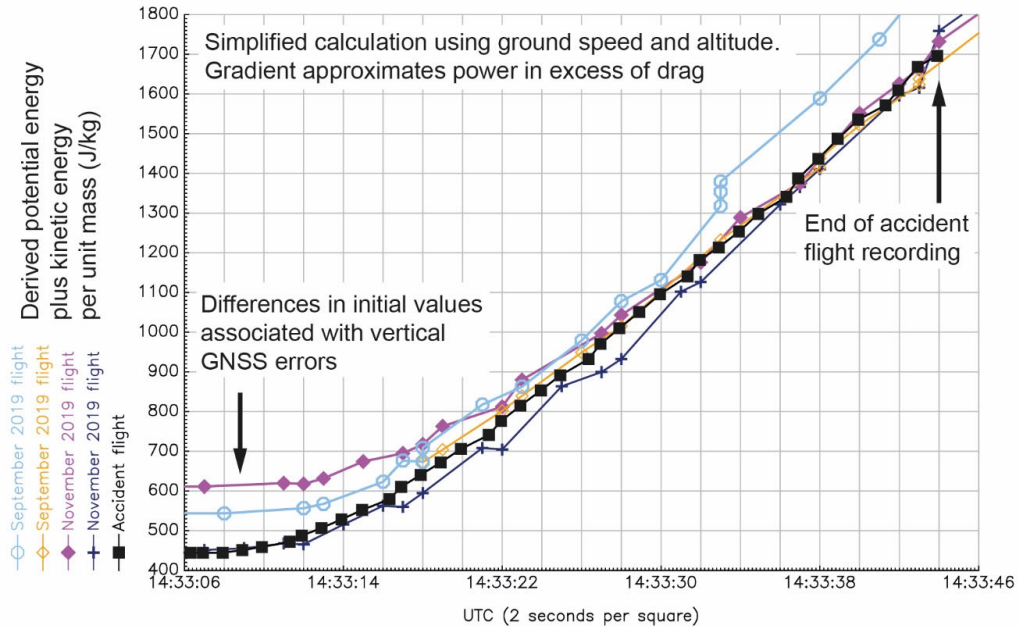


**Figure 5**

Comparison of the power used during the accident flight takeoff with that used during previous takeoffs from the same location.

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**Aircraft information**

The Cessna 185A Skywagon is a six-seat high-wing all metal monoplane. It has a fixed main landing gear and a tail wheel. It is powered by a Continental horizontally opposed, six-cylinder, fuel-injected engine, driving a two blade variable pitch propeller. It has a mechanical flying control and trim system with manually-operated, five-position flaps. Fuel is contained within two bladder-lined tanks in the inboard portion of each wing. The fuel tank capacity is 84 USG and the aircraft has a maximum takeoff weight (MTOW) of 1451 kg.

The aircraft is fitted with a tailplane trim system which consists of a continuous loop chain and cable assembly driven by a hand wheel mounted on the cockpit floor. Rotation of the trim wheel extends or retracts a pair of jackscrews which are driven by sprockets engaged on the chain section of the continuous loop. They are fixed to the fuselage structure and to brackets attached to the leading frame of the tailplane. The tailplane is pivoted at the rear and the jackscrews alter the angle of attack of the tailplane. A follow-up cable and spring assembly is attached to the tailplane and the elevator control rod to ensure the elevator conforms to the set tailplane trim position. Figure 6 shows a general arrangement of the tailplane trim system and Figure 7 shows the jackscrew assembly.

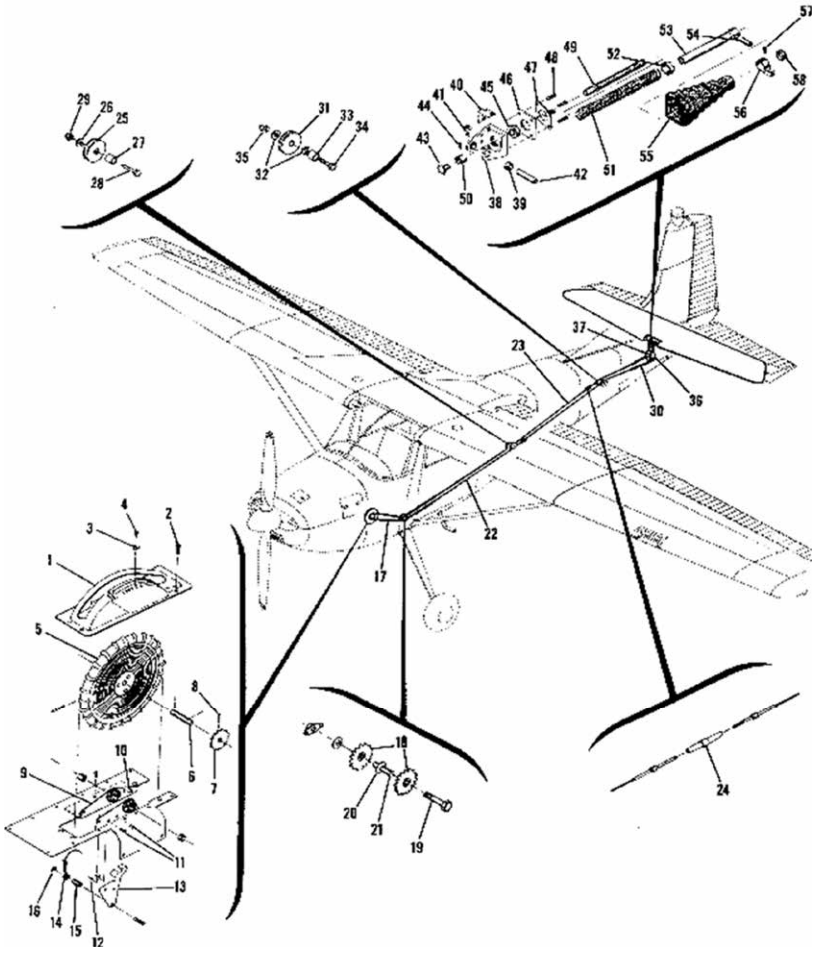

**Figure 6**

Tailplane trim system schematic

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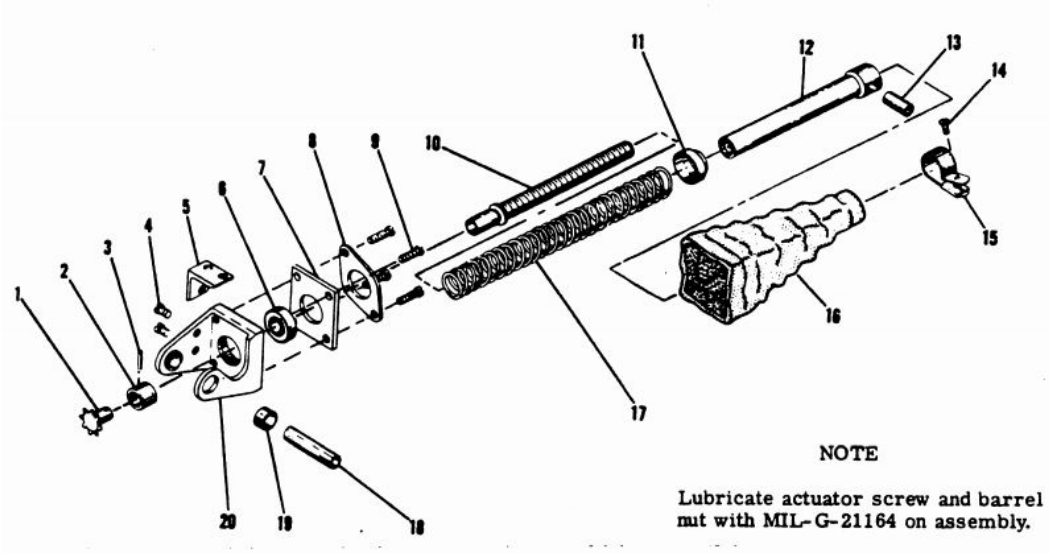


**Figure 7**

Jackscrew assembly
(Figures 6 & 7 courtesy of Textron)

The cockpit is fitted with conventional analogue instruments with a variety of toggle switches and push/pull/slide knobs and controls. The air speed indicator is calibrated in MPH. G-BLOS has several minor instrument panel modifications have been added to allow USB power supply connections for personal computer devices.

The pilot's and co-pilot's seats are fully upholstered. They are of a steel frame construction and are attached to the cockpit floor in rails which allow forwards and rearwards adjustment to suit the occupant. A locking peg engages in a hole in the rail to lock the seat in the desired position. The pilot's seat is fitted with an inertia reel anti-runback device which arrests any sudden rearward movement of the seat, should the locking peg become disengaged inadvertently.

*Aircraft history*

G-BLOS was built in 1962. The aircraft had a valid airworthiness review certificate and its most recent annual inspection was carried out in May 2020. Its engine had also undergone a full overhaul during 2018 and all the ancillary equipment had been overhauled. Perishable rubber and neoprene pipework and fittings had also been replaced with new items.

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**Aircraft examination**

The aircraft was moved to the AAIB hangar for a detailed examination.

*Fuselage and cabin*

The tail section of the fuselage just in front of the tailplane and fin leading edges had partially separated and was bent around to the left. The leading edge of the tailplane on the left side at the root was also severely damaged.

The aircraft had been made safe by the first responders and the ignition key had been removed. All the cockpit instruments and switches were intact. The barometric altimeter was set to 1015 hPa. All the other primary flying and engine instruments had returned to zero on their scales. The mixture control was fully in so was set to rich, the throttle was also fully in and therefore at a full power setting. The propeller control was also fully in at its high RPM setting. The flap lever had been bent to the right but was found to be set at the first stage of flap. The left control yoke was undamaged and was correctly connected to the aileron and elevator control cables. The right control yoke shaft had broken and was hanging loosely. The spherical yoke bearing mounted on the control panel was distorted on its right side.

The elevator trim wheel was undamaged, and its indicator was slightly aft of the mid position in the scale. The wheel was free to rotate and the trim cable and chain assembly was correctly engaged on its sprocket. It operated in the correct sense and the anti-creep system functioned correctly. The rudder trim wheel was jammed and misaligned with its shaft protruding through its centre.

The cabin heater and cabin air controls were fully in and therefore closed. The cowl flap lever, which is opened and closed to allow optimum engine cooling, was set to HALF.

The pilot and co-pilot's seats were in place, but both had a slight rightwards distortion in their steel frames. The pilot's seat position pins were correctly engaged in the seat rail with no evidence of it having been moved from the setting made by the pilot. The seat anti-run back device was correctly attached and showed no evidence of having operated.

Both safety straps were undone and correctly mounted in their rings on the cockpit floor. The left shoulder strap was hanging loose and was not attached to the cabin roof frame. The ring attachment bolt was broken, and its remains were in the anchor nut. The bolt head was missing and was not found. Apart from this the straps were in a good condition and the buckles and adjustment loops worked correctly. A test was carried out with an individual of a similar size to the pilot and found the straps to have been adjusted to a snug but comfortable fit.

*Wings, aileron flying controls and flaps*

The left wing had completely detached from the fuselage and a large part of the right wing had detached leaving part of the wing root loosely attached during the accident. Multiple impact marks were present on the remains of the leading edges of each wing. The wings

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were severely damaged. The left and right wing fuel tank bladders had been ruptured and multiple tears were present in the tank material. No fuel remained in either wing. The spars and wing struts were broken. The aileron control cables had failed in overload, as had the flap operating cables. All the electrical wiring had parted at the wing roots as had the fuel lines. The remains of the flap and ailerons were all present, but it was not possible to precisely determine their positions prior to or during the accident. However, the bend position on the flap lever and marks on its pivot fairing on the cockpit floor show that it had been at the 10° of flap setting. Control cable and linkage continuity, and flap track and aileron hinge integrity could be demonstrated. No pre-existent damage or faults were found on the flap or aileron system. The aircraft was fitted with a heading hold autopilot and its master switch was found in the OFF position.

*Rudder, tailplane and elevator controls*

The remains of the tail section were removed from the fuselage for disassembly. The rudder was correctly attached by its hinges and its control cables and linkages were damaged but had been correctly routed and operated in the correct sense. The rudder pedal range was restricted by distortion of the cockpit floor and fire wall. A large semi-circular dent was apparent on the left side of the rear fuselage and into the tailplane leading edge root. The tailplane assembly had also been displaced to the right. The tailplane and elevator, although damaged, were correctly attached at their pivot and hinge points. The elevator was free to move and, despite damage to the elevator cables, continuity and operation in the correct sense could be shown throughout the system. The continuous tailplane trim cable chain section at the tailplane had broken. The right trim jack screw drive sprocket was detached and could not be found. The left sprocket had also detached and was lying within the tail section of the fuselage beneath the jack screw.

The distance between the leading edge of the tailplane and its hinge mounting plate was measured at the jack screw mounting bracket and found to be 45 mm (1.75 inches) and indicates the tailplane trimmed position as found (Figure 8).

*Examination of the jack screws*

The jackscrews were correctly attached to the fuselage frame and to the tailplane leading frame brackets. However, the brackets were distorted and partially separated from the frame due to shearing of their attachment rivets. The rightward displacement of the tailplane had put a slight bend in both the jack screws. Disassembly of the two jack screws found them outwardly to be in very poor condition. Their boots were split and decayed and the grease covering the outer spring was aged and solidified. Despite this, both jack screw threads were free to rotate and extended and retracted correctly (Figure 9). The position on the screw shaft where the sprockets had been fitted showed that both had sheared in overload where the attachment pins passed through the shaft. An examination of the broken chain and the remaining sprocket supported this, with evidence of severe distortion to the sprocket teeth and chain links (Figure 10).

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**Figure 8**

Tailplane trimmed position as found

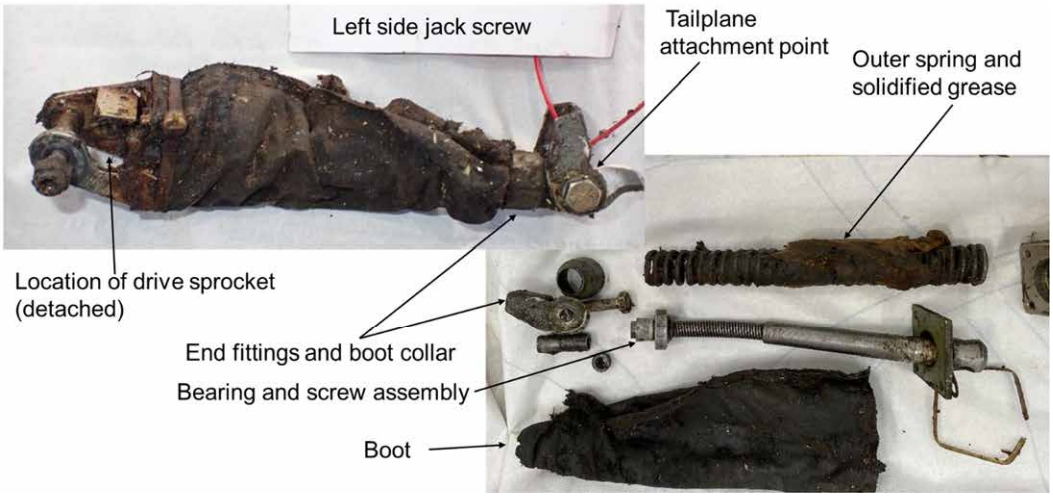


**Figure 9**

Disassembled left jack screw
(Right jack screw found in the same condition)

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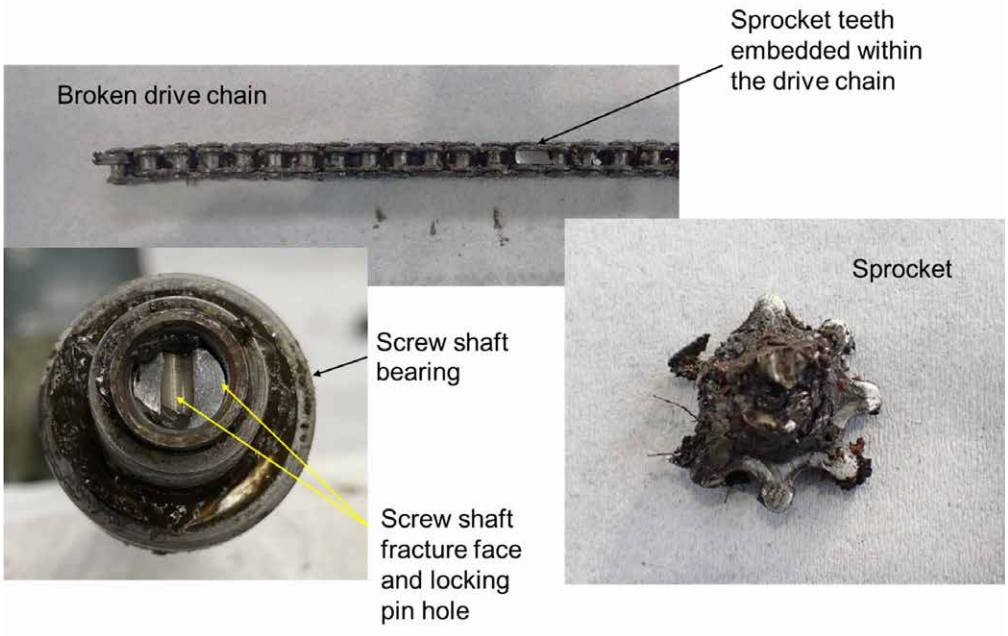


**Figure 10**

Left sprocket and chain

The upper and lower engine cowling had sustained multiple impact damage. The propeller spinner had multiple dents over its entire surface. Both propeller blades were loose in the propeller boss and the blade pitch change mechanism linkages had broken. One of the blades was twisted and bent rearwards and the other had pronounced multi-directional bending and twisting over its entire length. The tip of this blade had been fractured and was missing (Figure 11).

**Figure 11**

Condition of the propeller blades and spinner

The engine mounting frame had been slightly distorted but was correctly attached to the fuselage. The left crankcase engine mounting lug had fractured. The engine was free from fluid leakage and clean lubricating oil was at its normal level in the sump. The crankshaft could be moved freely by hand. The engine and its ancillary components were in good condition commensurate with the relatively recent full overhaul. The fuel filter was full of clean fuel with no evidence of water contamination. The filter gauze was free from debris and not blocked.

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All the spark plugs were correctly fitted and connected to good condition leads. Examination of the spark plugs found all but one of them showing the engine was in a good state of tune. One of the plugs, the No 4 cylinder upper, was slightly fouled. An internal visual examination of the cylinders found all six to be in good condition. The piston faces were normal and honing marks were present on the cylinder liners as would be expected after the overhaul. The valves and rocker assemblies were also undamaged.

The exhaust manifold was removed from the engine for examination. The stubs and pipes were impact damaged on both sides of the engine. However, they were in a good overall condition and there were no holes or cracks apparent. The exhaust gaskets were also in good condition with no signs of leakage. The exhaust heat exchanger muff was removed, and no evidence was found of exhaust gas leakage from the heat exchanger cylinder within. The colour of the internal surfaces of the exhaust manifold also indicated that the engine was operating normally.

The air intake sponge-foam filter fitted in the lower section of the engine cowling had tree debris embedded in it but was dry, in good condition and prior to the accident had been clean and clear. The air duct leading to the injection carburettor was also free from blockage. The fuel injectors were removed and examined and were clear, as were the injector pipes.

The mixture, throttle and propeller control cables, rods and linkages were correctly attached and were free to move throughout their full range.

**Survivability**

The cockpit structure had generally retained its shape. The pilot's seat was still correctly attached to its rails although its frame was distorted slightly to the right. The seat position pin remained where it had been set by the pilot and was correctly engaged in the rail. The pilot was wearing the lap strap with a diagonal shoulder strap. During discussions with the pilot, he explained that he was in the habit of always wearing the safety harness and adjusting it so that it was a tight fit. He did this along with a seat position which enabled him to reach all the aircraft controls comfortably. A person of similar stature to the pilot was seated in the cockpit and the strap held in position. This reconstruction demonstrated that the pilot could not fall or slump into the controls.

Of note was the broken shoulder strap roof frame mounting bolt. Examination of the shoulder strap webbing found the mounting ring buckle area stitching to having experienced tensile loading, but it had not parted. The door catches were undamaged; however, distortion of the door aperture frame had allowed the right door to open. The pilot was found on the forest floor to the right of the aircraft underneath the fuselage having apparently fallen out of the open right door. He later described how he had soil and leaf matter in his nose and mouth.

**Weight and balance**

The aircraft was within the approved weight and balance envelope.

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**Meteorology**

The weather was good with a light westerly wind and visibility of more than 10 km. The temperature was 16ºC and the QFE was 1016 hPa.

**Airfield information**

The airfield is private and unlicensed leased from the landowner. It consists of a single grass runway which is 660 m long and 16 m wide and is on a heading of 080/260°. It is within a large flat agricultural field bounded by a main road at its easterly end and copse the other side of a small road approximately 300 m from its westerly end. A domestic power line also traverses north to south across the field about 200 m to the west of the runway end. The runway surface is firm, well drained and the grass cut to approximately 8 to 15 cm in length. Two distinct areas of the runway were mown and manicured to allow model flying to take place.

**Pilot incapacitation**

Pilot incapacitation is the inability of a crew member to fulfil his role due to a physiological or medical event. The range of incapacitation can vary from being conscious but unable to function to be being deeply unconscious. With a single pilot flying a light aircraft, incapacitation can severely compromise the safety of the flight and the result can be a loss of control.

There are a number of possible causes of pilot incapacitation, including:

- The effects of hypoxia (insufficient oxygen) associated with an absence of normal pressurisation system function at altitudes above 10,000 ft.
- Gastro-intestinal problems such as severe gastroenteritis potentially attributable to food poisoning, or to food allergy.
- A bird strike or other event causing incapacitating physical injury.
- A malicious or hostile act.
- Smoke or fumes associated with a fire or with contamination of the air conditioning system.
- A medical condition.

The pilot of G-BLOS had just taken off and was flying alone in daylight when the event occurred. There was no evidence of a bird strike on the aircraft and the pilot reported that he felt fine on the day of the flight. The first four conditions are therefore not considered relevant in the accident investigation.

It is possible that fumes could have entered the cabin of G-BLOS either due to an exhaust fault or some other issue with the seal between the engine and the cabin. This would have meant carbon monoxide entering the cabin, possibly in large quantities. Although the pilot had just taken off, the engine had been running for approximately 17 minutes at the time

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of the accident. Previous investigations have shown that carbon monoxide can enter an aircraft cabin at levels to cause incapacitation within a short period[1]. However, the pilot did carry a domestic carbon monoxide alarm in the aircraft and does not remember it sounding during this flight.

Medical conditions can cause a transient loss of consciousness (TLoC) or 'blackout'. It is common, affecting up to half the population in the UK at some point in their lives. An estimated 3% of emergency presentations and 1% of hospital admissions are due to TLoC[2]. There are three most likely medical causes of TLoC:

- Cardiac issues, such as coronary heart disease or arrhythmias. Coronary heart disease occurs when coronary arteries become narrowed by a build-up of atheroma, a fatty material within their walls. This can cause pain and if a blockage occurs it can cause a heart attack. Arrhythmias or heart rhythm problems are experienced by more than two million people a year in the UK.
- Epilepsy – one in every four people who are newly diagnosed with epilepsy are over the age of 65. A generalised epileptic seizure can result in the disturbance of the controls and can occur suddenly without warning. Epileptic seizures generally result in the disturbance of multiple limbs in an unpredictable fashion.
- Syncope - also called fainting or passing out. Syncope is a sudden, temporary loss of consciousness, followed by a fall from a standing or sitting position. Syncope from a sitting position is rare and almost always occurs from a standing subject. A syncope episode is usually short and is caused by a decrease in blood flow to the brain. There are a number of known causes of syncope, however, often the cause cannot be identified, and it occurs only as a solitary episode.

The pilot reported no previous medical problems that could have affected his fitness to fly which was confirmed by an examination of his medical records. There were no indications in either his medical history or his post-accident examinations to indicate any obvious reason for a possible incapacitation.

## Tests and research

*Examination carried out on another Cessna 185 aircraft*

Another UK based Cessna 185A of a similar vintage was examined with the assistance of its pilot to obtain more information about the handling characteristics of the type. This pilot had a substantial number of flying hours many of which had been accrued on the C185.

**Footnote**

1 https://www.gov.uk/government/news/aaib-report-piper-pa-46-310p-malibu-n264db-21st-january-2019 [Accessed 15/05/2021]

2 https://www.gov.uk/government/publications/assessing-fitness-to-drive-a-guide-for-medical-professionals [Accessed 15/05/2021]

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Its seating position was set to that found in G-BLOS. With an individual of similar size and build to the accident pilot seated, it was found that a correctly adjusted strap allowed comfortable reach of the controls. However, it did not allow inadvertent pushing of the control yoke if the occupant were to 'slump' forward.

The pilot of the example aircraft described his experience of the handling characteristics as follows:

- He considered the aircraft was generally light on the controls, responsive and was easy to trim.
- The flap setting effect on pitch trim was unremarkable.
- When trimmed for a phase of flight the aircraft would generally stay in trim.
- The aircraft rate of climb was predictable for any given altitude but, with its normally aspirated engine, approximately 100 feet per minute is all that could be expected above 12,500 feet.

The owner was also asked to set the pitch trim to what, in his experience, would be normal for a standard rate of climb after takeoff. A measurement was then taken between the tailplane hinge plate and the tailplane leading frame and found to be 45 mm (1.75 inches) which was the same as found in G-BLOS (Figure 8).

The example aircraft tailplane trim wheel was easy to move with no perceptible freeplay or backlash in the system. It was not possible to accurately assess the external condition of the jack screw assemblies.

**Other information**

Although the jack screw assemblies were found to work correctly in G-BLOS, their external condition was a cause for concern. The jacks screw assemblies originally had a 500 hour service and overhaul interval but in later revisions of the manuals for later models of the Cessna 180 and 185 series of aircraft this was changed to 3 years or 1,000 hours, whichever is sooner. This relies on accurate record keeping of when the overhaul was last carried out. In this case the tailplane jack screws on G-BLOS where working correctly and were smooth throughout their full range of operation. However, the evidence suggests that G-BLOS jack screws had been serviced in the past, indicated by the presence of a non-standard cable tie around the boot, but had not been removed for some time.

The aircraft was not on a Self-Declared Maintenance Programme (SDMP). It therefore did not have any deviations from the manufacturer's servicing requirements authorised by its owner.

During the investigation, research identified open source discussions regarding tailplane trim runaway held by Cessna 180 and 185 owners around the world. There are uncorroborated reports that under certain aerodynamic conditions, or if the trim wheel drive mechanism malfunctions, the tailplane can move of its own accord and back drive the jack screws up

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or down. This has the effect of causing an uncommanded pitch up or down of the aircraft. This phenomenon is because the jack screw thread lead[3] is greater than that of a standard thread. In normal circumstances the jack screw threads are well lubricated and supported by a ball bearing designed to aid rotation of the thread spindle whilst under a compressive or tensile force from the tailplane.

## Analysis

*Aircraft preparation, takeoff and descent*

The pilot removed the aircraft from its hangar and prepared for the flight as he had done on many occasions before. The aircraft was full of fuel and, with the single pilot and additional items carried in the cockpit, was within its weight and balance limits. The power checks were carried out without any problems and the aircraft was configured correctly for takeoff. Although the pilot has no recollection of doing so, a slight right heading change was made as was his normal practice. The flap lever was set to the first stage (10º) of flap which was normal for the climb after takeoff. The data held within the tablet showed that the takeoff and initial part of the climb were similar to previous takeoffs. It also showed the point where the climb reduced, and the aircraft nosed over into a descent. The ground speed profile shows the aircraft accelerated during the descent. The data indicated that there was no heading change and the rate of descent continued to increase. There was no evidence that the pilot attempted to alter the aircraft's flight path.

*Accident sequence*

A witness saw the aircraft descend at a shallow angle into the top of the trees before going out of view. The flexibility of the treetops started to absorb the energy of the aircraft but as it came down through the trees it encountered much thicker trunks and boughs which caused extensive damage to the aircraft. The leading edges show multiple impact marks of varying sizes. During the accident sequence both wings were forced rearwards and detached from the aircraft. Foliage appears to have struck the windscreen which fragmented but larger bits of tree did not enter the cockpit. The tail section struck a large tree trunk at the leading-edge root of the left tailplane, causing the tail section to partially detach. It was this impact that damaged the tailplane trim chain and sprockets and bent the jackscrews to the right.

The dents apparent over the entire propeller spinner surface suggest it was rotating as it descended in the trees. The nose section and cockpit remained relatively intact during the impact sequence.

During this sequence the pilot's shoulder strap mounting bolt on the cockpit roof broke. The exact point when this happened cannot be determined but it resulted in the pilot's upper torso becoming unrestrained. The damage to the flap lever, rudder trim wheel and co-pilot's control yoke suggest the pilot was ejected from his seat to the right having moved sideways out of his lap strap. The injuries sustained by the pilot resulted from unrestrained flailing

**Footnote**

[3] The thread lead is the axial distance travelled during one 360° rotation of a screw thread or helix. A large thread lead can create a condition where, when a compressive or tensile force applied to the 'nut' on the thread it will cause the threaded shaft to rotate. (The same principle is used in a pump action screwdriver.)

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of his limbs and then hitting the flap lever and yoke with a substantial force. Although the injuries were serious, the dense undergrowth probably went some way in reducing the potential severity of the injuries.

There was no fire after the accident. This is probably because the significant disruption to the wings and shredding of the fuel tanks some distance behind where the aircraft came to rest meant there was no fuel free draining onto hot surfaces or damaged wiring. Any fuel or oil that remained, stayed within the intact engine bay components.

There was no evidence of a pre-existing fault or malfunction of the fuselage, wings and flying controls. All the damage attributable to the descent through the trees.

*Engine power*

The condition of the engine and its ancillary components are commensurate with its relatively recent overhaul. The pilot described how he had to exercise the propeller control during his power check as at first it did not appear to respond correctly, but on his second and third attempt it responded correctly and gave him no further concern. Visual inspection of the engine after the accident showed it to be in excellent condition. No explanation could be identified to account for the single fouled spark plug, which it is not likely to have had a noticeable effect on the engine power output. No other defects were identified which would have prevented the engine from operating normally to pilot control inputs.

The marked acceleration in ground speed during the descent towards the trees suggest the aircraft was performing in accordance with the settings made by the pilot on the throttle, mixture and RPM controls. This acceleration would not be expected in an engine off descent. In addition, the nature of the damage to the propeller and spinner suggest the engine was at a high power setting as it hit the trees. Based on the evidence, an engine fault or loss of power was not considered to be a contributory factor in this accident.

*Tailplane and elevator controls*

The position of the tailplane and elevator is important to this investigation. The data shows the aircraft to deviate from the steady climb. It shows it smoothly change its pitch attitude to adopt a steady descent. The tail plane trim setting when compared to another C185A configured for post takeoff climb was appropriate. It shows the jack screws do not appear to have moved from their setting or ‘runaway’ to an extreme setting. The condition of the jack screw boots and grease surrounding the external spring, whilst unsatisfactory, did not affect the operation of the jack screws.

The elevator controls were damaged by the impact sequence but their integrity and continuity prior to the accident could be demonstrated.

The evidence from the engine, tailplane and elevator do not suggest any malfunction or failure that could have caused the aircraft to deviate from the climb.

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*Airfield and weather conditions*

The airfield and weather conditions were unremarkable and are not considered to be contributory factors in this accident.

*Pilot incapacitation*

For the accident to G-BLOS to have occurred, the aircraft needed to pitch down from its climb attitude. Since no technical cause could be found, the investigation focused on the possibility that the pilot became incapacitated. The pitch change could have been due to the aircraft being out of trim for the climb so that when the pilot was no longer in control, the pitch of the aircraft dropped to the trimmed elevator position. Although the position of the trim actuators corresponded to the position expected after takeoff in the other C185A examined during the investigation, it is clear that all aircraft are slightly different and even a small out of trim condition could have allowed the aircraft to descend towards the site of the accident. Whilst the pilot recalls the aircraft being in trim, it is possible that he does not remember the status of the trim correctly or he adjusted the trim before becoming incapacitated.

The alternative is that this could have been through a physical movement of the pitch controls of the aircraft by the pilot. The pilot was strapped into the aircraft using a lap and shoulder harness which was not fitted with an inertia reel. Reconstruction using someone of a similar stature to the pilot showed that it was not possible for the pilot to have slumped forward into the controls causing a push on the control wheel, and resultant downward pitch of the aircraft. Any movement of the control wheel is likely therefore to have been the result of disturbance of the controls by the pilot. Given that an epileptic seizure generally results in the disturbance of multiple limbs, the gentle nature of the pitch down of the aircraft, with no apparent turn or yaw would seem to discount this as a possibility.

The pilot has no recollection of the accident sequence after his memory of the aircraft climbing away, trimmed and in control. His next memory is of what he described as “trees flashing past” before regaining consciousness when the emergency services reached him. He suffered significant injuries, including a head injury and the loss of memory may well be related to that rather than any indication of incapacitation.

However, having found no other cause for the pitch down of G-BLOS from its stable climb after takeoff, it seems the most likely cause is a pilot incapacitation of some sort. The aircraft descended either as a result of the aircraft being out of trim, or an involuntary movement of the upper limbs on the control wheel. The pilot was unaware of the imminent accident .

**Conclusion**

G-BLOS struck trees in a small wooded area less than 1,000 m from the start of its takeoff run. Although the aircraft was extensively damaged, examinations showed no faults or failures that could have caused or contributed to the accident.

The investigation concluded that it is likely the pilot became incapacitated shortly after takeoff. This incapacitation meant that the pilot was unaware and/or unable to react to the descent of the aircraft. The aircraft descent began either due to the aircraft not being

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perfectly in trim for the climb, or as a result of an involuntary movement of the controls by the pilot. Examination of the pilot's medical records as well as the medical tests undergone after the accident did not show any condition that could have caused an incapacitation. It has therefore not been possible to establish an exact cause for the incapacitation.

*Published: 1 July 2021.*

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