Cessna 421, G-BKNA

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Aircraft Type and Registration:	Cessna 421, G-BKNA
No & Type of Engines:	2 Continental GTSIO-520-D piston engines
Year of Manufacture:	1968
Date & Time (UTC):	3 August 1997 at 1521 hrs
Location:	Near Shobdon Airfield, Herefordshire
Type of Flight:	Private
Persons on Board:	Crew - 2 - Passengers - 2
Injuries:	Crew - Fatal - Passengers - 1 Fatal, - 1 Serious
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	2,386 hours (last recorded log book entry 24 November 1996) Last 90 days - Unknown Last 28 days - Unknown but included 19 hours on type
Information Source:	AAIB Field Investigation

History of the flight

The aircraft was on a private flight from Elstree to Shobdon inHerefordshire. The meteorological forecast indicated that a warmfront was approaching Southern England from the south-west andconditions were generally deteriorating. The visibility on departurefrom Elstree at 1437 hrs was greater than 10 km with a brokencloud base at 2,500 feet. When the aircraft arrived at Shobdonthe visibility was estimated to be 3 to 4 km in light drizzlewith a cloud base at approximately 1,200 feet, and the surfacewind was 090_/5 kt. The first radio contact between the aircraftand Shobdon was made at about 1502 hrs when the pilot called tosay that he was inbound from Elstree. In response to this callhe was passed the airfield details. The pilot later called whenapproaching Leominster and subsequently called downwind for Runway09 which has a right-hand circuit. The

operator of the groundto air radio facility at Shobdon saw the aircraft on the downwindleg abeam the tower at what appeared to be a normal circuit height. He did not observe the aircraft downwind but shortly afterwardshe heard a brief and indecipherable radio transmission which soundedlike a scream. This same transmission was heard by an aircraftenthusiast who was monitoring the radio transmissions on his 'airband'radio. The radio operator repeatedly attempted to make contactwith the aircraft but to no avail and so he instructed an aircraftrefueller to inform the emergency services that an aircraft hadcrashed.

Analysis of recorded radar data from the radar head at Clee Hill,Shropshire, indicates that the aircraft joined the downwind legfrom the east at a height of 1,100 feet. This radar data showsthat the aircraft then followed a normal ground track until towardsthe end of the downwind leg when there was an alteration of trackto the left of about 20_ before the aircraft entered a right turnonto the base leg. At the same time as the aircraft altered trackto the left it began a slow descent, at about 350 ft/min, from1,100 feet to 600 feet, at which stage it disappeared below radarcoverage. The average ground speed on the downwind leg was 112kt and this reduced to 100 kt as the aircraft descended.

Two witnesses saw the aircraft in a position that equates to thebase leg. The witness to the east of the aircraft track firstheard the sound of an aircraft engine that was unusually loudand then saw the aircraft at an estimated height of 150 to 200feet, it was descending slowly with the wings level. A loud "cough"from one of the engines was heard "as if it had backfired"followed by a puff of white smoke and then the sound of an engineincreasing in RPM. The wings were then seen to rock from sideto side as the aircraft went out of sight. The second witness,to the west of the aircraft track, described the aircraft flyingvery low, between 50 and 100 feet, and slowly descending. Hesaw that the wings were "wavering", the left wing thensuddenly dropped until it achieved a bank angle of about 90_ atwhich stage the nose dropped and the aircraft disappeared behindsome low trees and was heard to hit the ground. Some local farmersimmediately went to the crash site. Initially there was no fireor smoke, but a small fire soon developed in the area of the rightwing and this was quickly extinguished by the farmers.

Background to the flight

The aircraft was owned by a company based at Barton Airfield inLancashire and the pilot involved in this accident was flyingthe aircraft on their behalf with the intention of selling eitherthe aircraft or shares in it. On 24 November 1996 he had recordeda total of 2,386 hours flying of which 897 hours were on twinengine aircraft the majority of which had been on the GrummanCougar. Thereafter there were no further entries in his FlyingLog book. He had collected the aircraft on 18 July 1997 priorto which he had flown the aircraft three times in the previoustwo months for a total flying time of 2 hours, since thenhe had flown the aircraft from Elstree for a further 17 hours. He occupied the right-hand seat for the accident flight, althoughhe was the pilot in command of the aircraft.

The pilot in the left-hand seat was flying the aircraft with aview to buying shares in its use. He held an Australian PrivatePilot's Licence (PPL) and had limited flying experience . Atthe end of December 1996 he had declared a total of 280 flyinghours and his only recorded time in a twin engine aircraft hadbeen in 1995 when he logged 5 hours and 42 minutes under instructionand 6 minutes as pilot in command. There is no record of anyflying after December 1996.

Aircraft fuel system

The fuel system on this aircraft consisted of a main tank andan auxiliary tank associated with each engine, the fuel selectoralso allowed fuel from a main tank to be fed to the opposite engine. The main tanks were located in each wing tip and the auxiliarytanks were in the main wing structure outboard of each engine. The usable fuel was 189 litres (50 US gallons) in each main tankand 182 litres (48 US gallons) in each auxiliary tank; thus thetotal usable capacity was 742 litres (196 US gallons).

On the day prior to the accident the aircraft had been refuelledwith 60 litres of fuel into each main tank. There was no recordof the fuel tanks having been completely full in the recent past. With the errors involved in attempting to produce accurate estimatesof the fuel consumption since then, the resultant figures arelikely to have been highly inaccurate, therefore, the exact fuelstatus prior to and after this refuelling is unknown. The pilotflew to Ostend, Belgium for an overnight stay; a flight time of51 minutes. Whilst at Ostend he did not refuel, althoughhe did buy 2 litres of engine oil. On the return flight to Elstreeon 3 August 1997 he was airborne for 1 hour 46 minutesafter which he refuelled with 50 litres into each auxiliary tank. The aircraft then crashed 45 minutes after take off from Elstree. Using a fuel flow of 110 litres per hour for these three flights,and allowing for each take-off and climb to 5,000 feet with thesubsequent circuit to land, a fuel consumption of about 445 litresis calculated.

Medical aspects

The post-mortem examination on both pilots did not reveal anyindications that drugs or alcohol had played any part in the event,however, both pilots had considerable pre-existing disease.

The pilot in command had high blood pressure, which was beingtreated, but there was some doubt about his compliance with histreatment. There was also evidence of coronary artery diseaseand he had previously suffered a heart attack.

The Australian pilot did not have a valid medical certificateand therefore was not permitted to fly as a pilot. His medicalcertificate had not been valid beyond 10 December 1996 since hehad not complied with the requirements of the Office of AviationMedicine, Civil Aviation Safety Authority of Australia. He wasa very large man, 195 cm tall and weighing 148 kg.

It was not possible to define the precise role, if any, of themedical condition of either pilot in this accident. However,with a large person in the left-hand seat it would have been difficultfor either pilot to monitor and operate the fuel selector switches,which were located on the cockpit floor between the seats.

Engineering information

The aircraft was manufactured in 1968 and had been imported fromFrance in November 1984 when it had accumulated 3,249 flying hours. It was registered in the Private Category. The last entry inthe log book recorded that on 18 July 1997 the aircraft had completeda total on 3,348 flying hours, an average utilisation of some7.6 hours per year since its importation.

The aircraft had crashed in a level grass field, its heading was285_ and the flaps and landing gear were up. The aircraft wasrolling to the left with the wings near the vertical and was descendingat an angle about 30_. The left tip tank made the first contactwith the ground and the aircraft had then cartwheeled across thefield before coming to rest across a minor road 135 feet beyondthe first impact point.

The disruption of the left wing tanks spread some fuel over a60_ arc from the impact point to a distance of approximately 80feet, the fuel spill was identified by a discolouration of thegrass, but the amount of fuel could not be assessed from the groundmarks.

Both propellers had separated as they struck the ground. Theleft-hand propeller blades were relatively undamaged and did notshow any chord wise scoring indicative of rotation, likewise therewas no blade tip damage. Note: The propeller is geared to rotateat 75% of the engine speed and will not windmill at low aircraftspeed. The right propeller showed signs of rotation and had lightdamage to two blades; there was a small amount of forward curlon the tip of one of the blades consistent with engine power atimpact.

Both engines, the left tip tank, and the rear fuselage had beendetached from the fuselage by the impact sequence. A ground firehad developed under the right engine nacelle and had melted somealuminium in that local area. The fire had spread under the aircraft,blackening the under surfaces of both wings and the fuselage,and had burnt out the right tip tank. Reports indicated thatthe fire had been extinguished by a hand held extinguisher. Theamount of fuel consumed in the fire was assessed as being relativelylow. About 5 litres of fuel remained in the right wing.

The aircraft and engines were examined at Farnborough by the AAIBwith the help of representatives from the aircraft and enginemanufacturers. Examination of the engines showed that, at impact,they had been mechanically and electrically capable of running;the left engine was stationary and the right engine was underpower at the time of the accident.

A check of the flying controls did not reveal any damage otherthan that caused by the accident. The control trim positionsfound were:

Elevator: Unreliable reading, outside normal range.

Rudder: 4_ tab left (maximum position 26_).

Aileron: 10_ up position. (maximum position 21_).

Both fuel selector *valves* were found in the off position,however the selectors *controls* inside the cockpit showed:left engine selected to right main tank; right engine selectedto an intermediate position between right main and right off. The difference in position between selectors and valves was attributedmovement of the linkages between the fuselage mounted selectorcontrols and the wing mounted control valves caused by flexureof the wing/fuselage area, and was identified by the Cessna representativeas a common feature found in Cessna 421 aircraft which have cartwheeled. The selector position prior to the accident could not be reliablydetermined.

The left-hand auxiliary fuel pump switch had been destroyed inthe impact, leaving only the damaged toggle. It was not possibleto determine which position the switch had been in before impact.

Although some fuel had been in the left wing at the time of theaccident, examination of the diaphragm bulkhead in the front ofthe left tip tank did not reveal any distortion due to hydraulicing,which would have occurred on impact if a significant quantityof fuel had been present in that tank. A similar lack of distortionwas evident in the right-hand tip tank.

Recollections of the survivor

At the time of the accident the sole survivor had been seatedbehind the pilot in the right-hand seat and was facing aft withhis lap strap secured. He suffered significant injuries to thehead and was not interviewed until 5 weeks after the accidentat which stage he was still affected by trauma. He had approximately1,000 hours flying experience of which about 500 hours were ontwin engine aircraft. Most of this flying had been completedat Elstree and he had known the pilot in command of the accidentaircraft for about 8 years.

The survivor has very little firm recall of events on the dayof the accident and was very keen to differentiate between thosememories that were definite and those that were less so. However,he did have some vague recollections of the flight which are summarisedhere.

He believes that the weather at Elstree was cloudy prior to departurebut that it was a reasonable day for flying. His next recollectionwas that whilst downwind at Shobdon the left engine surged andthen stopped. The pilot in command (right-hand seat) then triedto crossfeed fuel to the left engine; he does not recall whichtanks were in use. At this stage the pilot in the left seat wasflying the aircraft. The survivor believes that he looked outof the window and saw that they were flying very low over a rurallandscape with some trees and open farmland. The weather wasovercast with grey clouds and it was raining. The speed was low,the stall warning horn was operating and the aircraft suddenlyentered a spiral to the left. He had no recollection at all ofthe impact but whilst in hospital he had told his mother thathe remembered somebody screaming, however, at the time of theinterview he could no longer remember this event. He also hadthe impression that there was not very much fuel on board andthat the intention had been to refuel at Shobdon.

Some elements of this recollection can be verified. His descriptionof the weather at Elstree and Shobdon are correct as is the stageof flight and the countryside in which the aircraft crashed. His memory of flying low is substantiated by the two witnessesone of whom saw the aircraft roll to the left. Furthermore theengineering evidence demonstrates that the left propeller wasstationary at impact and that there was very little fuel in theaircraft.

Summary

Examination of the engines showed that they had both been mechanicallyand electrically capable of running, however, at impact the leftengine was stationary. It was also likely that there was verylittle fuel onboard the aircraft at the time of the accident. It is therefore probable that mismanagement of the fuel systemcaused the left engine to stop. The eye witness accounts areconsistent with the behaviour of a twin engine aircraft that hassuffered a failure of one engine and is flown below its minimumcontrol speed for flight on one engine. With a low power settingon the right (live) engine the speed was allowed to reduce furtheruntil the left wing stalled. There was then insufficient heightavailable to regain control of the aircraft.