No: 8/88 **Ref: EW/C1046** **Category: 1b**

Aircraft Type and Registration:	Cessna 421B, G-HAST
No & Type of Engines:	Two Teledyne Continental GT510-520H piston engines
Year of Manufacture:	1975
Date and Time (UTC):	20 October 1987 at 1200 hrs
Location:	Hatfield Forest, near Stansted Airport, Essex
Type of Flight:	Private (business)
Persons on Board:	Crew - 1 Passengers -5
Injuries:	Crew - 1 (Fatal) Passengers - 5 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence with current Instrument Rating
Commander's Age:	40 years
Commander's Total Flying Experience:	Believed to be about 500 hours (of which about 200 were on type)
Information Source:	AAIB Field Investigation

The aircraft was on an IFR flight from Stansted Airport to Tatenhill Aerodrome with a pilot and five passengers on board. Shortly after take-off from runway 23 at Stansted the pilot reported that he had a problem and wished to return. Stansted ATC cleared him for a left hand circuit and return. As the aircraft turned left hand towards a down wind leg the left bank was observed to suddenly increase and it turned onto its back before descending vertically and crashing into a wooded area to the south west of the Airport. Immediately after the impact there was a fierce fire; all the occupants were killed instantaneously.

History of the flight

At 0946 hrs on 20 October 1987 the pilot visited the Meteorological Office and obtained the weather forecast. This indicated that a moist, potentially unstable airstream was covering the whole route, with 6 oktas of cloud at between 600 and 700 feet, with visibility generally 3500-4000 metres. The landing forecast for Birmingham Airport was surface wind 130/05 kts, visibility 3200 metres, 8 oktas of cloud at 1800 feet. Tatenhill is a private aerodrome situated about 22 nm north of Birmingham; it has no approach or landing aids. The pilot filed an IFR flight plan to depart Stansted at 1000 hrs and nominating Tatenhill as the destination with Birmingham as the preferred alternate. Fuel endurance

was entered as 3½ hours. The aircraft had last been re-fuelled on 14 October 1987 when a total quantity of 1140 lbs was reported to be loaded. That was sufficient fuel for the flights from Stansted to Tatenhill and/or Birmingham and return together with adequate reserves. The basic weight of the aircraft, when last weighed in April 1986, was 5339 lbs. With the weight of fuel reported to be carried, and pilot and passenger weight plus hand baggage estimated to be 940 lbs, the take-off weight on 20 October 1987 was about 7420 lbs. The maximum permitted take-off weight for the Cessna 421B is 7450 lbs. Both the weight and Centre of Gravity were within permitted limits.

At about 1035 hrs the pilot and passengers boarded the aircraft. The engine start appears to have been normal, and the pilot asked Stansted ATC for a revised departure time; this was agreed to be 1050 hrs. Taxy clearance was approved, and the pilot correctly read back his flight clearance and acknowledged a radar identification code of 4445. The aircraft was cleared onto runway 23 and, at 1058 hrs, the pilot released the brakes and commenced the take-off run. From eye-witness accounts initial acceleration appears to have been normal, however very shortly after the aircraft became airborne the pilot transmitted the message, "We have a problem and we would like to come down". Stansted ATC cleared the aircraft to turn left and asked if the pilot could maintain altitude. The reply was garbled and unreadable, and about 30 seconds later the aircraft crashed in a wooded area on the edge of Hatfield Forest. The accident was observed from Stansted ATC and the emergency services were alerted immediately. In spite of having to cross difficult terrain - including a considerable distance across sodden, ploughed land - the first appliances arrived at the accident site within 18 minutes of the impact.

From an analysis of a radar recording of the flight and eye-witness accounts it has been possible to establish with reasonable accuracy the aircraft's flight path. After lift off the aircraft climbed on runway heading to a height of about 200 feet agl, and accelerated to an airspeed of about 110 kts. It was during this stage that the pilot reported that he had a problem and wished to return. The aircraft then entered a gentle turn to the left, reaching a maximum height of 250 feet agl before starting a slow descent. At the same time the airspeed was progressively reducing, the last measurable speed being 90 kts. As the aircraft reached a heading which would have taken it down wind for a landing back on runway 23, the left bank suddenly increased rapidly and it turned over onto its back before descending steeply to the ground. The Stansted Airport weather actual conditions at that time were; surface wind 130/05 kts, visibility 3800 metres in rain, 5 oktas cloud at 300 feet and 5 oktas at 2500 feet.

Wreckage examination

Initial examination of the wreckage showed that the aircraft had struck the ground at a fairly low speed in an attitude that was almost vertical. It had come to rest on a heading of 036° (M) and the wreckage was contained within a small area. The configuration at impact had been landing gear down and locked, with the wing flaps up. Both propellers had separated from the engines during the impact. The degree of damage they had sustained showed that, at the moment of impact, the right hand engine had been producing high power. The left hand propeller showed evidence of rotation at impact, but the symmetrical rearward bending of the blades indicated that the left engine had not been producing power. The left hand propeller blades had not been feathered. A severe fire had occurred which had destroyed most of the fuselage and wing centre section. It was nevertheless possible to establish that

the flying controls had been connected prior to impact. The wreckage was transferred to the AAIB at Farnborough for more detailed examination.

Both propellers were disassembled and examined with the assistance of the manufacturer. This examination confirmed that the right hand propeller and engine had been delivering power normally before impact, but that the left propeller and engine had not been producing power. The left hand engine had suffered slight fire damage in the post crash fire, but was found to be in good condition internally, with no evidence of any mechanical failure. All moving parts were adequately lubricated and the oil was of the correct specification. The left magnetos had suffered fire damage and could not be tested; however no pre-impact defects were noted. A complete examination of the fuel system was not possible, as much of the aluminium alloy pipework had been burned away. However, it was confirmed that the fuel selector valves were correctly aligned for take-off with both engines feeding directly from their associated main fuel tanks. The serviceability of the electric fuel pump in the left main tank could not be established due to fire damage. The left engine driven fuel pump had also suffered fire damage, and the rubber seals were leaking. Upon disassembly it was found that the aneroid unit within the pump was corroded and could not have functioned. No pre-crash defects were found in any other components within the fuel system.

The possible adverse effects of the corrosion within the fuel pump aneroid unit to engine performance were investigated using another similar engine in a test facility. It was found that this condition caused the engine to misfire and run roughly at high power settings, but that the engine ran normally at low power. The tests, whilst not totally representative of the conditions on the accident flight, showed no tendency for the engine to fail completely, although sudden full throttle applications grossly aggravated the rough running. Thus no reason for the apparent marked power loss associated with the left engine fitted to G-HAST has been established.

Engine failure in light twin-engined aircraft

The most critical time for an engine failure in a light twin piston-engined aircraft is during the short period late in the take-off run whilst the aircraft is accelerating to a safe controllable single engine speed. Full details of the actions to be taken and the minimum safe speeds are invariably included in manufacturers' flight manuals. For the Cessna 421B the minimum single engine control speed on the ground is 82 kts, and the minimum recommended single engine speed in flight is 103 kts. At a take-off weight of 7450 lbs under standard conditions with both engines operating at full power, the Cessna 421B will achieve a rate of climb after take-off of 1940 feet/min. However, under the same conditions with one engine inoperative the maximum possible rate of climb reduces to 350 feet/min; and this can only be achieved provided that the landing gear is raised, the flaps are up, the propeller of the failed engine is feathered, and 5° of bank towards the live engine are applied. If the landing gear remains down, and the propeller of a failed engine is not feathered, a positive rate of climb is not possible.

It is apparent that, on the accident flight, the landing gear remained down from take-off to impact. It is also apparent that, at the moment of impact, the left engine had not been producing power and the left

propeller was not feathered. When, shortly after lift off, the pilot reported that he had a problem and wished to return, he was for some reason either unable or too busy to describe the precise nature of the trouble. However, as the aircraft subsequently accelerated to 110 kts and climbed to 250 feet agl ground level, his initial problem cannot have been total failure of the left engine, although it is possible that, at that time, the engine was showing signs of rough running or a malfunction that might have preceeded the final failure. After achieving a maximum of 110 kts on the initial climb, the aircraft's airspeed has been measured to have progressively reduced to 90 kts, at which stage it disappeared below radar cover. At an airspeed of 90 kts or below, with full power on the right hand engine and a failure of the left hand engine with an unfeathered propeller, it would not have been possible for the pilot to have maintained directional control of the aircraft.