

Aircraft type and registration: Cessna 414a Chancellor II G-OFRL (light twin-engined, fixed-wing aircraft)

Year of manufacture: 1979

Date and time (GMT): 15 May 1984 at 1427 hrs

Location: Bournemouth (Hurn) Airport

Type of flight: Aerial work (training)

Persons on board: Crew – 2 Passengers – 1

Injuries: Crew – Nil Passengers – Nil

Nature of damage: Substantial damage – airframe destroyed

Commander's Licence: Commercial Pilot's Licence

Commander's Age: 63 years

Commander's total flying experience: 14800 hours (of which 1600 were on type)

History of the flight

The purpose of the flight was to provide the trainee with type familiarisation and instrument flying practice prior to his taking the Instrument Rating Renewal Examination on that aircraft. The right hand seat was occupied by a company type rating examiner. The take-off from Hurn was at 1332 hrs and after climbing to FL50 to the northwest of Hurn the familiarisation exercises were flown comprising approaches to the stall in different configurations and a practice engine fire on the right engine. The drill was completed using the Cessna Check Lists and the auxiliary fuel pumps were switched OFF as a part of this procedure. After about 5 minutes of single engine flying, the right engine was restarted. This time the Check List was not used as the appropriate drill could not be found, and to save time the drill was called by the instructor from memory. It is probable that the auxiliary fuel pump switches were operated to the ON position prior to starting the engine.

After the engine restart the aircraft returned to Hurn for a practice holding pattern followed by two ILS procedures. During this time it was noted that there was some vibration and that the fuel flow indication for the right engine was significantly higher than the left. The mixture control for the right engine was leaned-off until the fuel flows equalised and the vibration ceased. However, on final approach the mixture control was advanced to the full-rich position and left there for the remainder of the flight. The crew commented that the vibration disappeared at the high power settings used during the go-arounds.

After the second overshoot, the aircraft entered the circuit cleared for a touch-and-go landing on runway 17. The final approach was described as steep and was flown with full (45°) flap. After a short ground run, the trainee opened the throttles and at about 80 kt rotated the aircraft; the flaps were still at the 45° setting. Shortly after becoming airborne there was a loss of power accompanied by vibration or buffeting, the aircraft yawed and rolled to the right and the airspeed started to decay. The trainee retracted the flaps to 30° and at this point the instructor took control, closed the throttles and landed the aircraft on the grass on a heading of about 200°M. It then ran across the south-western taxiway through the airfield perimeter fence, across a public road when the undercarriage collapsed, finally coming to rest in an adjacent field.

Both fuel tanks were ruptured by impact with the fencing posts but there was no fire. The crew, who were uninjured, shut off the fuel cocks, switched off the electrics and then evacuated from the aircraft through the main entry door. The emergency services responded very quickly and were at the scene by the time the crew left the aircraft.

Wreckage examination

While there were strong indications of engine rotation and power on the left propeller the right starboard propeller had clearly been static when it sustained impact damage. The sparking plugs from the right engine were found to be heavily sooted and two were wet with fuel. An on-site examination of the right engine and its fuel system revealed no mechanical defect or failure, and rig testing of the fuel system likewise uncovered no significant fault which could explain the stoppage. Fuel was found in the fuel lines and there was evidence that there had been a large amount of fuel in each tank, substantially more than the minimum useable. The right auxiliary fuel pump was found to function correctly as switched by the cockpit control

and prime switches and the fuel low pressure switch.

The propeller blades of both engines were found to be at a fine pitch condition and the flaps were at 30°. The aircraft had been 'shut-down' by the crew after the accident and most control and switch positions were not relevant to the accident but it was noted that rudder trim was set to a marked 'nose-left' position, approximately 60% of range.

The fuel system

The fuel system in this family of aircraft (Cessna Model 340 and 400 series with Teledyne Continental engines) includes an electrically driven auxiliary fuel pump, backing each mechanical engine driven pump (EDP). The auxiliary pump operates in two modes. Switched to the "low" position, part of its output is recirculated to inlet. Switched to the "on" position, it operates as for the low condition until a pressure switch at EDP outlet senses a pressure below 5 psi, indicating an EDP failure. In such a case the pressure switch operates a relay activating a solenoid valve in the auxiliary fuel pump which is then electrically latched in the "on" condition. The solenoid valve reduces the bypass flow in the auxiliary pump which then operates in a high output mode as a substitute for the failed EDP. This will provide sufficient fuel for partial power operation but, on some variants, will prevent the use of fuel from the auxiliary tanks. If the auxiliary pump is operated in the high mode with a functional EDP then engine overfueling will occur which can cause rough running, loss of power and, in certain conditions, engine stoppage.

Flight documentation

The Pilots Operating Handbook produced by the Cessna Aircraft Company formed part of the Flight Manual for this aircraft. The CAA had issued Change Sheets 3 and 4 to this manual, dated 19.8.81, and these had been incorporated into the handbook. These amendments required that the Descent Drill item contained in the Abbreviated Checklist and the Amplified Normal Procedures be changed from "Auxiliary Fuel Pumps – ON" to read: "Auxiliary Fuel Pumps (each engine in turn) – ON, OFF and immediately back to ON". This is accompanied by the following note – (Ensures aux. fuel pump not running in high-speed mode because of earlier transient fuel pressure reduction.).

Although these amendments had been included in the Pilots Operating Handbook on the aircraft, the actual checklists to be used by the pilots were the standard Cessna Checklists and had not been changed. This amended procedure was not used on this flight.

Aircraft performance data

The Cessna Aircraft Company publish no performance data for a take-off with flap selected. The available data for a zero flap take-off gives a rotate speed of 93 kt, a V₂ of 98 kt and V_{mca} of 79 kt.

Under the ambient conditions and at the estimated aircraft weight of 6168 lb, the aircraft should have been able to achieve a single engine climb rate of 440 ft/min at the optimum speed of 105 kt. However, this would be degraded at the lower reported speed of 80 kt, and further reduced by 800 ft/min due to full flap, 350 ft/min due to landing gear down, and by 400 ft/min due to a windmilling propeller.

The engine failure

There is clear evidence that the engine failed due to 'rich-cut' at some point shortly after the touch-and-go landing, and that this was caused by an abnormally high fuel flow to the right engine. It is probable that the auxiliary fuel pump was operating in a high output mode and that this was due to the pump switches not being operated in accordance with the approved sequence during the engine restart. There are similarities between this accident and previous accidents to this type of aircraft where the auxiliary fuel pumps were suspected as having been contributory factors. There is no flight deck warning that the pumps are operating in the high output mode. Such a warning system would be technically simple, and it is felt that it would have the advantage of both warning the pilot of an engine driven pump failure – for which there is an emergency procedure – and the inadvertent operation of the pressure switch caused by a transient low pressure in the fuel system, for whatever reason.

The touch-and-go

A safe climb out could not be achieved following the complete loss of power from one engine just when the aircraft became airborne at a speed of about 80 kt with full flap extended. The commander was therefore left with no alternative but to land whilst it was still possible to control the aircraft.

Had the alternative practice been followed of raising the flaps to the take-off position and retrimming the aircraft during the ground roll, it is clear that the outcome would have been different.