ACCIDENT

Aircraft Type and Registration:	Cessna 414, N414FZ (previous registration G-AZFZ)	
No & Type of Engines:	2 Continental Motor TSIO-520 piston engines	
Year of Manufacture:	1971 (Serial no: 414-0175)	
Date & Time (UTC):	26 June 2018 at 1320 hrs	
Location:	Farm building at Enstone Airfield, Oxfordshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 1 (Minor)	Passengers - 1 (Serious)
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	49 years	
Commander's Flying Experience:	1,194 hours (of which 9 were on type) Last 90 days - 60 hours Last 28 days - 26 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB enquiries	

Synopsis

Shortly after taking off from Enstone Airfield, and while in a climbing turn to the right, the right engine stopped. The aircraft descended and returned to the airfield, crossing the runway at a low height before crashing into a poultry farm on the north side of the airfield. The aircraft and part of the poultry farm were destroyed in the subsequent fire. The pilot sustained minor injuries and the passenger multiple injuries, including a fractured vertebra.

Introduction

This investigation was carried out as a correspondence investigation and was based on information provided by the aircraft commander, witnesses, technical publications and photographs taken at the scene of the accident.

History of the flight

The aircraft departed Dunkeswell Airfield on the morning of the accident for a flight to Retford (Gamston) Airfield with three passengers on board, two of whom held flying licences. The passengers all reported that the flight was uneventful and after spending an hour on the ground the aircraft departed with two passengers for Enstone Airfield. This flight was also flown without incident.

The pilot reported that before departing Enstone he visually checked the level in the aircraft fuel tanks and there was 390 ltr (103 US gal) on board, approximately half of which was in the wingtip fuel tanks. After spending approximately one hour on the ground the pilot was heard to carry out his power checks before taxiing to the threshold of Runway 08 for a flight back to Dunkeswell with one passenger onboard (Figure 1).

During the takeoff run the left engine was heard to stop and the aircraft veered to the left as it came to a halt. The pilot later recalled that he had seen birds in the climbout area and this was a factor in the abandoned takeoff. The aircraft was then seen to taxi to an area outside the Oxfordshire Sport Flying Club, where the pilot attempted to start the left engine, during which time the right engine also stopped. The right engine was restarted, and several attempts appeared to have been made to start the left engine, which spluttered into life before stopping again. Eventually the left engine started, blowing out clouds of white and black smoke. After the left engine was running smoothly the pilot was seen to taxi to the threshold for Runway 08.

The takeoff run sounded normal and the landing gear was seen to retract at a height of approximately 200 ft agl. The climbout was captured on a video recording taken by an individual standing next to the disused runway, approximately 400 m to the south of Runway 08. The aircraft was initially captured while it was making a climbing turn to the right and after 10 seconds the wings levelled, the aircraft descended and disappeared behind a tree line. After a further 5 seconds the aircraft came into view flying west over buildings to the east of the disused runway at a low height, in a slightly nose-high attitude. The right propeller appeared to be rotating slowly, there was some left rudder applied and the aircraft was yawed to the right. The left engine could be heard running at a high rpm and the landing gear was in the extended position. The aircraft appeared to be in a gentle right turn and was last observed flying in a north-west direction. The video then cut away from the aircraft for a further 25 seconds and when it returned there was a plume of smoke coming from buildings to the north of the runway (Figure 1).

The pilot reported that the engine had lost power during a right climbing turn during the departure. He recovered the aircraft to level flight and selected the 'right fuel booster' pump (auxiliary pump) and the engine recovered power. He decided to return to Enstone and when he was abeam the threshold for Runway 08 the right engine stopped. He feathered the propeller on the right engine and noted that the single-engine performance was insufficient to climb or manoeuvre and, therefore, he selected a ploughed field to the north of Enstone for a forced landing. During the approach the pilot noticed that the left engine would only produce "approximately 57%" of maximum power, with the result that he could not make the field and crashed into some farm buildings.

There was an immediate fire following the accident and the pilot and passenger both escaped from the wreckage through the rear cabin door. The pilot sustained minor burns. The passenger, who was taken to the John Radcliffe Hospital in Oxford, sustained burns to his body, a fractured vertebra, impact injuries to his chest and lacerations to his head.

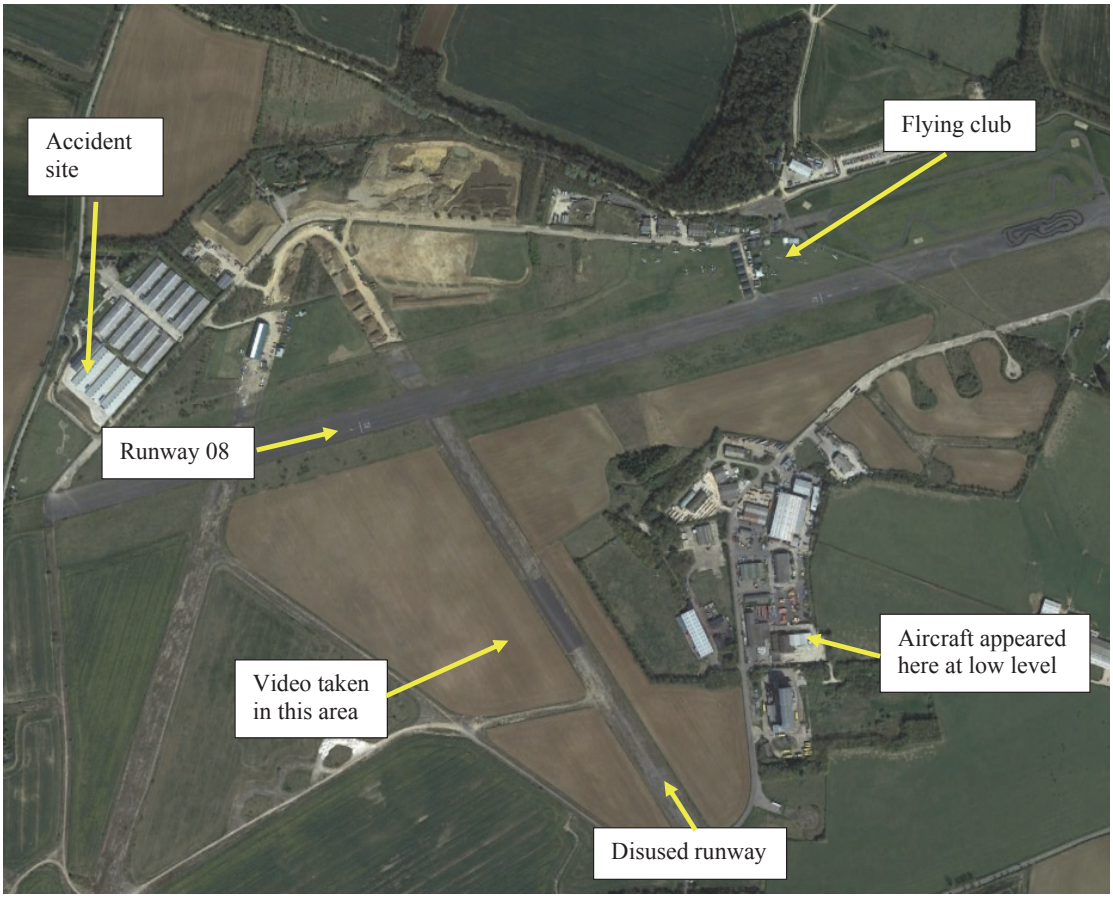

Figure 1

Enstone Airfield

Accident site

The aircraft had crashed into a poultry farm on the edge of the airfield, destroying part of a timber-framed building that was partially lined with asbestos. The resulting fire caused a substantial loss of poultry, from the effect of the fire and asbestos contamination. The aircraft was destroyed in the intense fire (Figure 2).

While liquid petroleum gas (LPG) was present at the accident site, the General Manager responsible for the farm advised that it had not been compromised in the accident and that the intense fire was caused by the fuel on the aircraft.

Figure 2

Remains of aircraft and engines at the accident site

Weather

The Met Office provided an aftercast based on the weather conditions at the time of the accident at RAF Brize Norton, RAF Benson and Oxford Kidlington Airport. With stable atmospheric conditions it was assessed that the weather at these locations would have been very similar to the conditions at Enstone Airfield. The aftercast concluded:

> *'The weather conditions at the time of interest would have been benign, with light easterly winds, visibility in excess of 10 Km, with no significant weather and no significant cloud below 5,000 feet. The most likely QNH pressure 1025 hPa, air temperature 27 degrees Celsius, wind speed and direction for 1,000 ft (agl) 090 degrees 05 knots …'*

Pilots qualifications and experience

The pilot's logbook and licence show that he undertook his check flight for his Multi Engine Piston (MEP) rating on 10 March 2016 and last renewed it on 21 March 2018. On the morning of the accident he had accumulated 120.4 hours as pilot-in-command on MEP aircraft, of which 8.5 hours and 10 flights had been flown in N414FZ. The pilot had not flown any other Cessna 414 aircraft. Although there was no requirement for him to have done so, there was no record of the pilot having had a formal conversion flight on this aircraft type.

Aircraft history

Much of the aircraft documentation, including the Pilot's Operating Handbook (POH), was destroyed in the fire. The current registration document for N414FZ was issued on 4 April 2018 when the aircraft was purchased by the pilot who was a joint owner.

A 50-hour maintenance check was completed on 2 November 2017 at 5,274.7 airframe hours during which Teledyne Continental Service Bulletin 95-7 was carried out on both engines. This Service Bulletin requires a check of the engine manifold valve for evidence of a fuel leak. The maintenance documents record that the fuel pressure tests were carried out satisfactorily on both engines. The owner had reported that the cylinder head temperature (CHT) on the right engine was not working. The fault was traced to a wiring defect and rectified. No significant defects were identified during the maintenance check.

Approximately 20 flying hours later, on 22 March 2018, the aircraft was taken to another maintenance organisation for a survey and clean. Wear was discovered in both propellers, which were replaced. No other significant faults were identified, and the engine ground runs were found to be satisfactory. The aircraft was collected on 14 June 2018 and the accident occurred 5 flying hours later.

The pilot reported that he had experienced no technical problems with the aircraft prior to the accident flight.

Aircraft fuel system

General

In the Cessna 414, the aircraft fuel system consists of the main wingtip fuel tanks (50 US gal each) and an auxiliary fuel tank (20 US gal each) in each wing. Two electrically-operated fuel pumps, the auxiliary pump and the fuel transfer pump, are mounted in each main fuel tank. The auxiliary fuel pump is mounted on the bottom of the main fuel tanks and provides fuel pressure for priming during engine starting and supplies fuel to the engine in an emergency. The transfer fuel pump is mounted on the main tank rear bulkhead and transfers fuel from the nose section of the main tank to the centre baffle area, where it is picked up and routed to the engine by either the engine-driven or auxiliary fuel pump. The fuel transfer pump prevents the possibility of fuel starvation to the engine during steep angles of descent and when fuel is low. The fuel auxiliary pump provides fuel to the engine-driven fuel injection pump via the fuel selector valve. A fuel vapour return line is installed between the engine-driven pump and the main fuel tanks.

Auxiliary fuel pump ('booster pump')

N414FZ had been fitted with a three-position auxiliary fuel pump switch and circuitry which was compliant with Cessna Service Bulletin MEB88-3. This modification allows the pilot to have direct control of the output pressure of the two auxiliary fuel pumps. The two switches are labelled AUX PUMP L and AUX PUMP, R. The positions on each switch are LOW, OFF and HIGH. The LOW position operates the auxiliary pumps at low speed and can be used, when required, to provide supplementary fuel pressure for all normal operations.

The HIGH position is reserved for emergency operations and operates the pump at a high speed which can provide sufficient fuel flow to sustain partial engine power in the event of an engine-driven fuel pump failure.

The Airplane Flight Manual Supplement for the auxiliary fuel pump switch system states:

> *'On rare occasions, such as during engine starting in cold weather, the HIGH position (instead of LOW) may be needed for a few seconds to ensure a good ground start or restart in flight.*
>
> ***CAUTION***
>
> ***If the auxiliary fuel pump switches are placed in the HIGH position with the engine-driven fuel pump(s) operating normally, total loss of engine power may occur.'***

Fuel distribution

The fuel distribution system allows either engine to be fed from the main fuel tanks in either wing or the auxiliary fuel tanks. Two fuel selector handles, one for each engine, are located between the front seats on the cabin floor that are marked with the following position:

Left engine fuel selector handle	*Right engine fuel selector handle*
- LEFT MAIN	*- RIGHT MAIN*
- right main	*- LEFT MAIN*
- LEFT AUXILIARY	*- RIGHT AUXILIARY*
- off	*- OFF*

The main and auxiliary fuel tanks are fitted with a capacitance fuel quantity indicating system. The fuel quantity gauge is a dual-indicator fuel gauge for the left and right main fuel tanks as well as the left and right auxiliary fuel tanks. When the fuel selector handle is in the MAIN TANK position, the gauge will indicate the quantity of fuel in the main tanks. When the fuel selector handle is placed in the AUXILIARY position an indicator light under the gauge will illuminate, indicating that the selector handle is in the auxiliary position and the fuel quantity gauge is indicating the content of the auxiliary tank.

Last refuel

N414FZ was last refuelled with 185 ltr (48 US gal) of Avgas 100LL at Dunkeswell Airfield on the morning of the accident. The aircraft then flew for approximately 0.8 hour before departing on the accident flight when the pilot reported that there was 390 ltr (103 US gal) of fuel on board. There have been no reports of any other aircraft experiencing problems with fuel uplifted from Dunkeswell Airfield.

Aircraft performance

Engines

The engines fitted to N414FZ were Continental TSIO-520-NB that had been modified by RAM Aircraft in 1996 by a Supplementary Type Certificate (STC) to increase the horsepower by approximately 25 hp. This modification would increase the climb and single-engine takeoff performance.

Regarding this modification, the FAA mandated for Part 135[1] aircraft the Time Between Overhaul as 1,600 hours or 12 years, this requirement did not apply to Part 91[2] aircraft such as N414FZ. At the time of the accident, the engines had operated for 5,827 and 4,447 hours since new and 1,764 and 1,774 hours since overhaul. However, RAM Aircraft had no record of the engines having been overhauled and considered it unlikely that the aircraft would still be able to achieve the increased performance from the modification that had been embodied in 1996.

Aircraft weight

The aircraft had last been weighed on 7 October 2013 when the basic weight was 4,875 lb and the centre of gravity was established as 156.97 inches aft of the datum.

During the accident flight there was approximately 140 lb of equipment in the cabin.

Performance graphs used on the accident flight

The pilot reported that he would have calculated the aircraft's performance during the accident flight using the aircraft's POH, which he believed were based on the engines being equipped with the RAM modification.

Calculation of aircraft performance by AAIB

As RAM aircraft advised the AAIB that the performance curves for the RAM modification were unlikely to be achieved, the AAIB estimated the single-engine climb performance using a POH for unmodified engines. The performance was calculated on:

Pilot and passenger	448 lb
Basic weight	4,875 lb
Other equipment	140 lb
Fuel	618 lb
	Total weight 6,066 lbs
Temperature	27°C (81°F)
Airfield height	550 ft (amsl)

Footnote

[1] Part 135 is regulations defined by the US Federal Aviation Administration (FAA) for operations of small commercial aircraft.

[2] Part 91 is regulations defined by the US Federal Aviation Administration (FAA) for operations of small non-commercial aircraft.

These parameters gave a single-engine climb performance of 173 ft/min at maximum takeoff weight (6,350 lb) and a single-engine climb performance for the accident flight (6,066 lb) of 250 ft/min. This climb performance assumed:

Max continuous power on the operating engine.

The propeller was feathered on the inoperative engine.

The flaps and landing gear were in the retracted position.

The engine cowl flaps were closed on the inoperative engine and open on the operating engine.

For the accident flight, the aircraft was flown at an airspeed of 101 kt

AAIB comment

Engine failure

The pilot and the passengers reported that both engines operated satisfactory on the two flights prior to the accident flight. No problems were identified with the engines during the maintenance activity carried out 25 and 5 flying hours prior to the accident and the engine power checks carried out at the start of the flight were also satisfactory. It is therefore unlikely that there was a fault on both engines which would have caused the left engine to stop during the aborted takeoff and the right engine to stop during the initial climb.

Fuel

The aircraft was last refuelled at Dunkeswell Airfield and had successfully undertaken two flights prior to the accident flight. There had been no reports to indicate that the fuel at Dunkeswell had been contaminated; therefore, fuel contamination was unlikely to have been the cause.

The pilot reported that there was sufficient fuel onboard the aircraft to complete the flight, which was evident by the intense fire in the poultry farm, most probably caused by the fuel from the ruptured aircraft fuel tanks.

With sufficient fuel onboard for the aircraft to complete the flight, the most likely cause of the left engine stopping during the aborted takeoff, and the right engine stopping during the accident flight, was a disruption in the fuel supply between the fuel tanks and engine fuel control units. The reason for this disruption could not be established but it is noted that the fuel system in this design is more complex than in many light twin-engine aircraft.

Aircraft performance

The AAIB calculated the single-engine climb performance during the accident flight using the performance curves[3] for engines not equipped with the RAM modification. It was a hot day and the aircraft was operating at 280 lb below its maximum takeoff weight. Assuming

Footnote

[3] Cessna Model 414 FAA Flight Manual applicable for serials numbers 414-0001 thru 414-0350, Revision 12, dated 29 August 1996.

the landing gear and flaps were retracted, the engine cowls on the right engine were closed and the aircraft was flown at 101 kt, then the single-engine climb performance would have been 250 ft/min. However, the circumstances of the loss of power at low altitude would have been challenging and, shortly before the accident, the aircraft was seen flying with the landing gear extended and the right engine still windmilling. These factors would have adversely affected the single-engine performance and might explain why the pilot was no longer able to maintain height.

Bulletin Correction

The AAIB report published in Bulletin 4/2019 reported in the Synopsis: '*The pilot and passenger both sustained minor injuries*.' This was based on early information. It was later established that the passenger had sustained multiple injuries, including a fractured vertebra. The passenger's injuries are therefore properly classified as 'Serious'.

The Bulletin header information should, therefore, read:

Injuries: Crew - 1 (Minor) Passengers - 1 (Serious)

The online version of this report was amended on the 14 November 2019 and a correction will appear in the December 2019 Bulletin.