ACCIDENT

Aircraft Type and Registration:	X'Air Falcon 582(2), G-CGOV
No & Type of Engines:	1 Rotax 582/48-2V piston engine
Year of Manufacture:	2010 (Serial no: BMAA/HB/599)
Date & Time (UTC):	13 September 2020 at 1730 hrs
Location:	Old Park Farm Airfield, Port Talbot
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to landing gear
Commander's Licence:	Private Pilot's Licence
Commander's Age:	41 years
Commander's Flying Experience:	361 hours (of which 146 were on type) Last 90 days - 1 hour 30 minutes Last 28 days - 1 hour 30 minutes
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed heavily in a field beside the departure runway following a total loss of engine power shortly after takeoff. The cause of the engine failure was not determined.

History of the flight

The pilot was flying from Old Park Farm Airfield, a grass airstrip with a 300 m runway aligned north-south and a shorter runway aligned approximately 12/30. In light winds, departure on Runway 18 is the preferred option owing to its slight downward gradient. High-tension power lines cross the departure paths to the south and west, and there is a large area of rough open ground about 1 nm to the south-west between the airfield and Swansea Bay. The pilot was familiar with the airstrip and had considered the options if faced with an engine failure when departing from the southerly runway.

The wind was light and variable, and the temperature was 21ºC with a dew point of 13ºC.

The pilot started the aircraft and carried out the engine warm-up checks before taxiing from the hangar to the takeoff point where the power checks were carried out. She reported that all indications during the engine warm up and power checks were normal. The pilot then shut down to allow a second pilot to embark the aircraft, before starting it once more and repeating the engine power checks without issue.

After waiting for 5 minutes while other aircraft landed, the pilot took off from the southerly runway, setting full power before releasing the brakes to achieve a short takeoff. The pilot reported that the engine power, acceleration and climb performance were all normal. The aircraft departed to the south-west and was turning more westerly during the climb, passing 600 ft aal, when the pilot described experiencing a "coughing" of the engine followed a few seconds later by total power loss.

The pilot turned the aircraft away from the high-tension power lines and rough open ground ahead, back towards the airstrip, and identified a field short of the airstrip in which to land. Subsequently, she realised the aircraft would overshoot the intended landing point and turned left into the field containing the airstrip. She stated that a "loss of lift" occurred late on the approach which she attributed to localised wind effects owing to trees. The aircraft landed in a part of the field containing crops and a steeper gradient than the runway. The occupants were uninjured, but the landing gear was extensively damaged.

Previous flight

The aircraft's previous flight, conducted to renew its permit to fly, was on 11 August 2020. The aircraft had been re-filled with Mogas from a nearby petrol station for the flight, which took place without incident.

Imagery

A video of the accident flight showed a loss of engine power with a smooth rundown, followed by several 'surges' before it stopped completely. The propeller appeared to be free to turn in the airflow following the loss of power. The video showed that the pilot maintained an initial speed of 60 mph which reduced to 50 mph in the latter stages of the approach. It also showed that the late turn into the field in which the aircraft landed was made at less than 200 ft aal.

Aircraft information

The X'Air Falcon is a fixed wing microlight. The wing is mounted above the fuselage and the engine is mounted centrally above and in front of the wing leading edge. Fuel is fed from the fuel tanks, located in the fuselage behind the seats, by a fuel pump fitted close to the engine. The fuel pump is actuated pneumatically using pressure impulses from the engine crankcase.

The engine manufacturer recommended:

> *'If possible, the* [fuel] *pump should be located below the fuel tank level…. If the fuel tank is considerably lower than the engine, an electric pump should be used.'*

The aircraft did not have an electrical fuel pump.

The ASI is calibrated in mph. An aide-memoire in the cockpit stated the best glide speed as 60 mph IAS and the stall speed as 32 mph IAS. The flight test schedule for the renewal of the Permit to Fly recorded that the clean stall was demonstrated at 31 mph.

The pilot observed that, during practice forced landings, the high-mounted engine could disrupt the airflow over the elevator resulting in less control authority.

Figure 1

G-CGOV, X'Air Falcon (with permission of the owner)

Post-accident inspection

A preliminary inspection by a BMAA Inspector found that the engine turned freely by hand with apparent compression and the engine-driven fuel pump was working. Fuel was found in the tank and the carburettor float bowls, with no dirt or particulates in the fuel filter. However, the fuel appeared "*yellowed*" in colour. The reason for this was not determined.

Mogas

The LAA published a Technical Leaflet (TL)[1] on the use of Unleaded Mogas, stating:

> *'Unleaded Mogas… has a much higher vapour pressure than 100LL or UL91 Avgas. The initial boiling point of the fuel is only slightly above ambient temperature, so it takes only a slight rise in temperature or drop in pressure to make it start to vapourise.'*

Accordingly, it also states:

> *'...unleaded Mogas fuel is restricted to operation with a fuel tank temperature not exceeding 20° C and an altitude not exceeding 6,000 ft.'*

Footnote

1 LAA, TL2.26 *'Procedures for the use of unleaded MOGAS to EN228'*, Issue 2, Dec 2017, available at http://www.lightaircraftassociation.co.uk/engineering/TechnicalLeaflets/Operating%20An%20Aircraft/TL%202.26%20Procedure%20for%20using%20E5%20Unleaded%20Mogas.pdf [accessed January 2021].

The TL states that vapour problems are most likely to occur *'… in aircraft fitted with engine-driven mechanical fuel pumps….'*, and:

> *'In the typical aircraft system the fuel pump is located above the fuel tank, so the fuel pressure on the upstream side of the fuel pump is reduced below atmospheric by the action of the pump sucking up the fuel, making it very vulnerable to fuel vapour formation on the inlet side of the pump….'*

In a properly designed fuel system any vapour that forms should not become trapped, but it is possible that the vapour could form in low pressure areas, such as the suction side of a fuel pump, and this can cause a stream of vapour bubbles to enter the carburettor resulting in a loss of power and, if not addressed, a total loss of power.

Although the BMAA has not published similar limitations, it stated that it viewed the LAA TL and the limitations it applies as:

> '…*a helpful guide or rule of thumb. Owners should be mindful that these factors increase the likelihood of vapour locking as well as Ethanol content, general fuel quality, fuel system layout and method of aircraft operation.'*

Carburettor icing

Safety Sense Leaflet 14, '*Piston Engine Icing*'[2], published by the CAA describes the types of icing that may be encountered, and the engine factors and atmospheric conditions that contribute to icing with piston engines. The leaflet presents a chart which provides a graphical representation of the temperature and humidity conditions where engine icing may occur. The temperature and dewpoint on the day of the accident would have resulted in a relative humidity in the region of 60%, where the chart presents that moderate icing may be encountered when cruise power is set, or serious icing when descent power is set.

The LAA TL states that tests have shown that:

> *'when using Mogas, carburettor icing will commence under an even wider range of temperature and humidity conditions than with Avgas.'*

Analysis

Causes for the loss of power

A preliminary inspection of the engine did not reveal a cause for the loss of power. The discoloration of the fuel may indicate the poor quality of the fuel, but the short period that had passed since the aircraft had been refuelled would suggest that there had not been sufficient time for it to degrade. The BMAA Inspector who carried out the inspection suggested that the nature of loss of power seen in the video may indicate electrical failure, as opposed to fuel starvation or quality, as the cause.

Footnote

[2] CAA, January 2013, available at http://publicapps.caa.co.uk/docs/33/20130121SSL14.pdf [accessed January 2021].

Another possibility for the loss of power is vapour forming in the fuel. The design of the fuel system is such that the fuel pump draws fuel from the tank some distance below it. For this design of fuel system where the fuel tank is much lower than the engine, the engine manufacturer recommends an additional electric fuel pump installed below the fuel tank level.

The low pressure from the suction required to raise the fuel from the tank to the engine fuel pump made the formation of vapour more likely. The low fuel flow during the 5 minutes holding before takeoff may have allowed these vapour bubbles to accumulate and cause the power loss after takeoff.

Carburettor icing was possible with the conditions experienced that day and the use of Mogas would also have increased the likelihood. However, the loss of power occurred while full power was set during the climb, and not a lower power setting when the risk of carburettor icing is more likely. The nature of the power loss also suggests that carburettor icing was not the likely cause.

The turnback

Prior to the flight the pilot had considered the threats and appropriate options in the event of an engine failure. This meant she was mentally prepared for such an event and able to make the decisions necessary for a safe turnback from the wires and the open rough ground ahead. Aware of the need to mitigate the risk of stalling in the turn, while also ensuring sufficient control authority, the pilot maintained 60 mph throughout the turn.

The reduction of airspeed below the best glide speed in the latter stages of the approach would have increased the rate of descent of the aircraft. The left turn into the field containing the airstrip in the final stages of the approach would not only have further increased the rate of descent but also given the pilot limited opportunity to assess the touchdown among crops on the steeper gradient.

Conclusion

The aircraft suffered a hard landing following the total loss of engine power. The cause of the engine failure was not determined, but fuel vapour locking or carburettor icing were both possibilities given the configuration of the fuel system and the use of Mogas.

Although the aircraft was damaged in the subsequent forced landing, the pilot was able to achieve a safe turn away from obstacles because she had considered beforehand what she would do following an engine failure during departure from this runway. However, the loss of performance during the late turn into the landing field in the final stages of the approach probably contributed to the hard landing.