ACCIDENT

Aircraft Type and Registration:	Rans S6-ES Coyote II, G-BYMV
No & Type of Engines:	1 Rotax 582-48 piston engine
Year of Manufacture:	2000 (Serial no: PFA 204-13444)
Date & Time (UTC):	14 July 2013 at 1744 hrs
Location:	Near Stoke Golding Airfield, Leicestershire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	76 years
Commander's Flying Experience:	365 hours (of which 305 were on type) Last 90 days - 7 hours Last 28 days - 4 hours
Information Source:	AAIB Field Investigation

Synopsis

The accident occurred at the end of a routine private flight in benign conditions near Stoke Golding Airfield. Witness evidence suggests that the aircraft entered a stall followed by an incipient spin after entering the circuit. The pilot may have mistaken a mown grass strip to the north of the airfield for the runway and on realising this attempted to correct his approach path or go-around, during which the aircraft entered a stall. The pilot and passenger suffered fatal injuries.

History of the flight

On the day of the accident, weather conditions were good, with clear skies, good visibility, and a light northerly wind, estimated by other pilots as being approximately 6 or 7 kt. Following normal pre-flight preparations, the pilot, accompanied by his wife, took off in G-BYMV from a private grass strip for Stoke Golding. They were flying a few minutes behind two other aircraft, which were making the same journey.

Observers at Stoke Golding saw G-BYMV join the circuit, positioning right-hand downwind for Runway 26. Towards the end of the downwind leg, the aircraft made a descending right turn onto a final approach heading, but not lined up with the runway's extended centreline. One observer commented at the time that he believed the pilot might be lining up with Fenn Lanes, a road which runs parallel to the runway immediately north of the airfield. Witnesses at the airfield, who were listening to an air-band radio, heard the pilot of G-BYMV make a radio call which they recalled as "lining up two six". This transmission struck the witnesses as unusual because the phrase 'lining up' is usually used on the ground to indicate that an aircraft is entering a runway to take off.

The aircraft continued descending, and made some slight turns, before entering an incipient spin to the right. It struck the ground in a steep nose-down attitude and at relatively low speed. A number of people saw the last moments of flight; they believed that they had heard the aircraft's engine running until they heard a loud noise consistent with impact. They made their way rapidly to the accident site, telephoning the emergency services as they did so. An air ambulance arrived promptly, but the pilot and passenger had suffered fatal injuries.

Stoke Golding Airfield and its surroundings

Figure 1 shows Stoke Golding Airfield, Fenn Lanes, and the fields to the north. The grass Runway 08/26 at Stoke Golding is approximately 500 m in length and about 21 m wide. It also shows an area of mown grass in a field about 270 m to the north of the airfield.

The mown strip was approximately 260 m in length and 18 m wide, aligned on a westerly direction of approximately 240º and bordered by an area of crop and long grass.

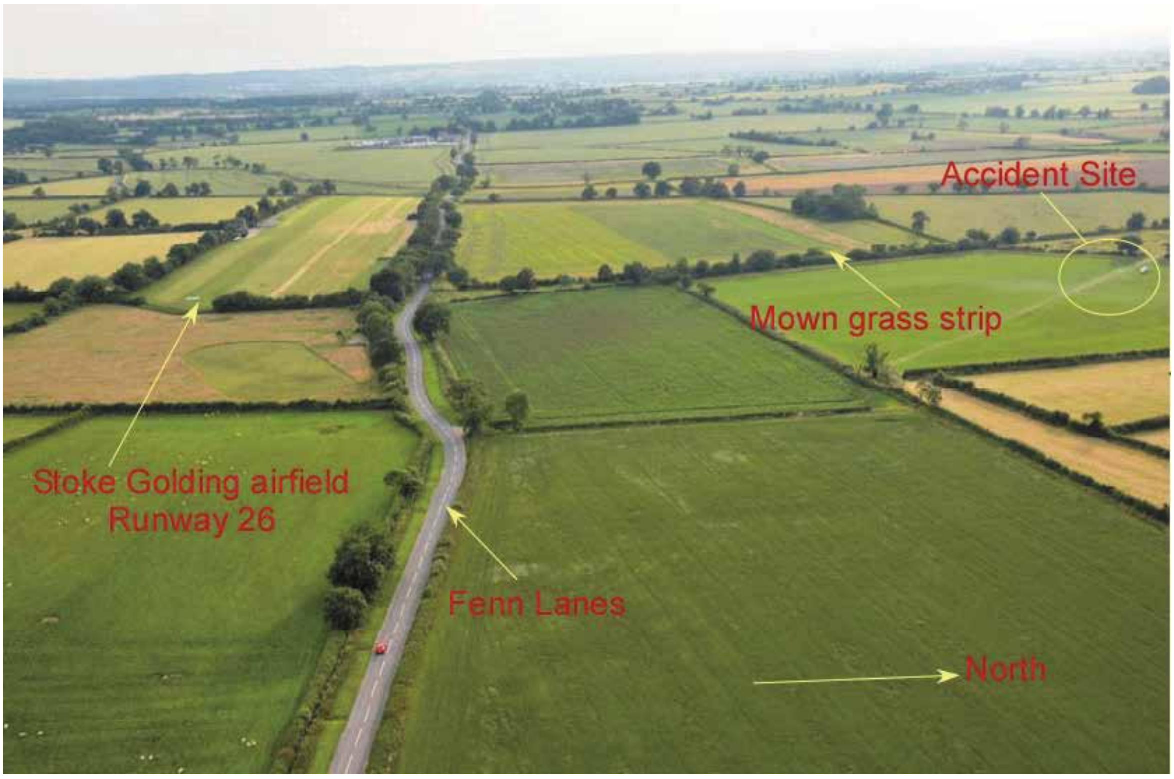

Figure 1

Stoke Golding Airfield and surrounding area

Meteorology and angle of the sun

An aftercast provided by the Met Office reported that:

> *'The UK was under the influence of high pressure at this time which was giving settled weather conditions. The situation in the area of the incident was relatively benign, with good visibility, little or no cloud below 5,000FT and surface winds no higher than 10KT.*
>
> *Although some convective cloud is apparent in the visible imagery under the high cirrus cloud, from observations the base of this cloud was above 5,000FT and the radar shows no precipitation associated with it. This means that any convective cloud was not deep enough to produce showers.'*

The closest airport to the accident site was Coventry, 13 nm to the south-south-west. The METAR timed at 1750 hrs (six minutes after the accident) stated that the wind was northerly at 7 kt, conditions were CAVOK, the temperature was 27ºC, the dewpoint 10ºC, and the QNH was 1022 hPa.

At the time of the accident, the sun was 21° above the horizon at Stoke Golding, on a bearing of approximately 280º from the airfield.

Recorded information

Recorded information was available from a portable device[1] recovered from the aircraft. Although severely damaged, a track log of the accident flight was successfully recovered, with aircraft GPS-derived position, track, altitude and groundspeed recorded, on average, once every 2.5 seconds. The record commenced at 1726 hrs as the aircraft took off and ended at 1735:18 hrs. Records of four previous flights were also recovered. These were a local flight from the aircraft's base on 10 June 2013 and three previous flights on 6 July 2013. Information from the device is shown in Figures 2 and 3. Figure 2 shows the approach to Stoke Golding Airfield in slant view, and Figure 3 shows the recovered data.

After departure, the aircraft followed an approximately straight track to Stoke Golding Airfield, climbing to an altitude of approximately 900 ft at an average rate of about 420 ft/min, after which the climb rate reduced to about 65 ft/min.

Approximately 0.7 nm to the north-west of Stoke Golding Airfield, and at an altitude of approximately 1,380 ft, the aircraft made a right turn (Point A). As the turn continued, the aircraft climbed to its maximum altitude of approximately 1,400 ft, before starting a gradual descent. Having positioned 0.9 nm from the airfield, the aircraft made a left turn as though positioning onto a downwind track for Runway 26 and the descent rate was stabilised at about 510 ft/min (Point B). However, instead of remaining parallel to the runway, the aircraft maintained a near parallel track relative to a strip of mown grass (Figure 1).

Footnote

[1] Lenovo manufactured IdeaTab model A2107, operating a SkyDemon-manufactured flight navigation software application.

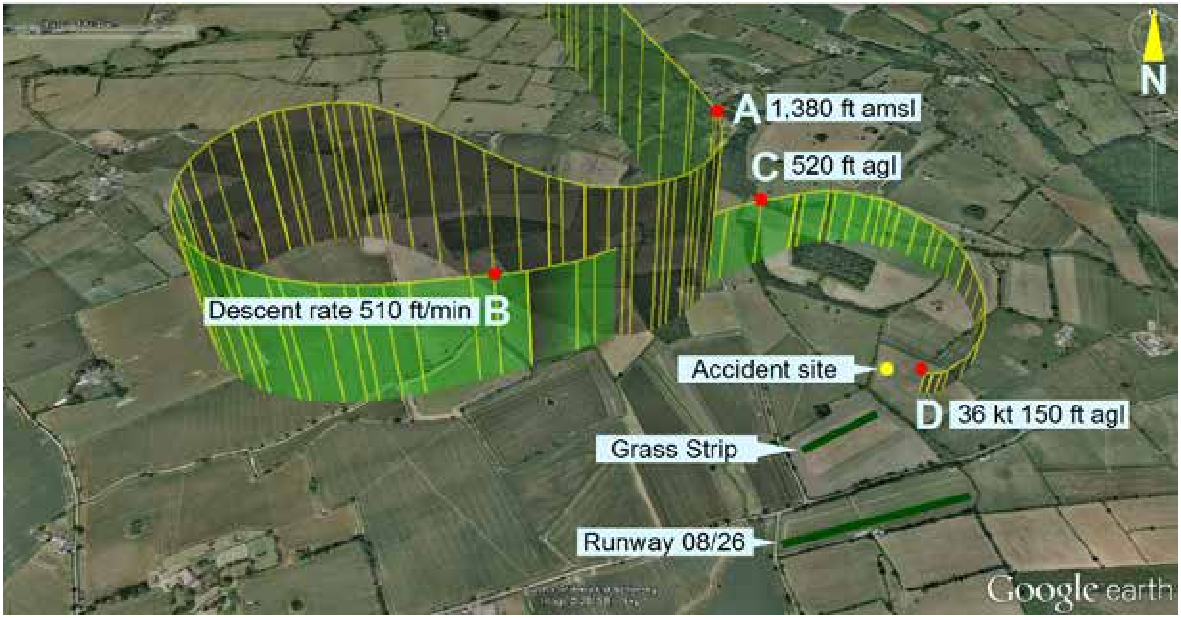

Figure 2

GPS track of approach to Stoke Golding Airfield[2]

When the aircraft was almost abeam the threshold of Runway 26 (which coincided with the easterly boundary of the adjacent mown strip), it started a gradual 180º right turn from an altitude of approximately 800 ft (520 ft agl) (Point C). The aircraft's groundspeed was then about 51 kt. The turn rate remained constant at about 4.5º per second and the descent rate remained at about 510 ft/min. However, rather than positioning onto the final approach for Runway 26, the aircraft turned onto an inbound track consistent with lining up to land on the mown grass strip in the field north of the road. The final seconds of the data indicate that when the aircraft was about 150 m from the field boundary and at a height of about 170 ft agl, the aircraft turned to the right (Point D). At the final data point, recorded approximately 110 m to the south-east of the wreckage position, the groundspeed was about 36 kt, and the aircraft was at a height of about 150 ft agl.

No further data points were recorded. Possible explanations for this were considered. The nominal logging rate of each data point is once every 5 seconds, although some points were recorded more frequently, resulting in the average logging rate of 2.5 seconds. It is possible that the next data point was to be logged 5 seconds later, and the aircraft struck the ground prior to this. Further possibilities are that the device buffered the data for several seconds prior to writing to memory, or satellite signals to the GPS device were lost, perhaps with the aircraft in an attitude that resulted in the signal becoming obscured.

Footnote

[2] The grass strip and runway at Stoke Golding have been highlighted in green to give an indication of their location, the actual appearance of these are shown in Figure 1.

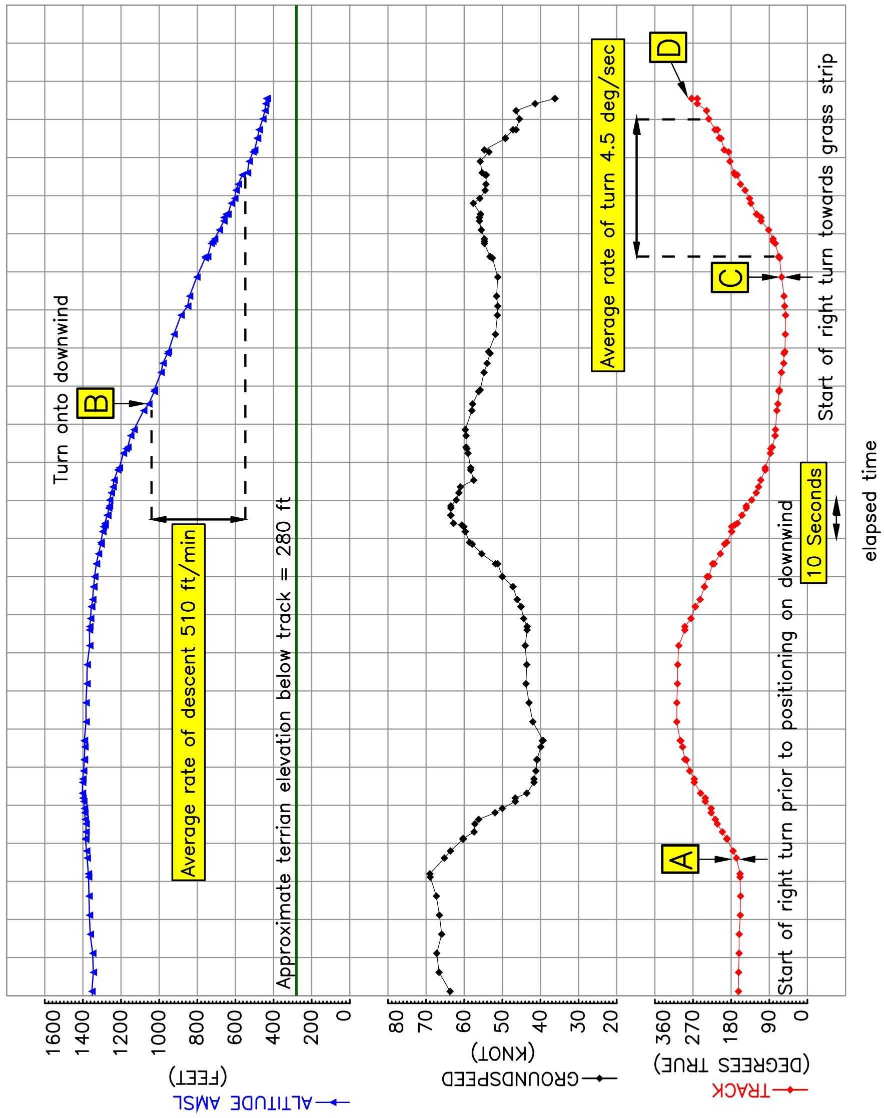

Figure 3

Time history plot of approach

Previous approaches to land

On 6 July 2013, the pilot landed G-BYMV at Wellesbourne Mountford Airport. The turn from downwind to base and then onto the final approach was recorded on the device and was similar to the final 180º turn during the accident flight, with an almost identical turn rate of about 4.5 degrees per second. The turn radius was also similar at about 370 m compared to approximately 340 m during the accident flight. Both final turns also commenced from altitudes of about 750 ft (600 ft agl) and 810 ft (520 ft agl) respectively and the average descent rates from having positioned onto the downwind leg were 450 ft/min compared to 510 ft/min.

Engineering

Description of the aircraft

The Rans S6-ES is a high wing microlight aircraft with two side-by-side-seats. The airframe is constructed mainly from aluminium tube, with the forward fuselage structure consisting of a welded tubular steel cage. The entire airframe is covered with pre-sewn polyester fabric envelopes.

A number of power plants are available for this type of aircraft; G-BYMV was fitted with a Rotax 582 two-stroke engine driving a two-bladed propeller. Whilst many two-stroke engines use fuel that has been pre-mixed with the two-stroke oil, this example was equipped with a direct injection system in which oil was supplied from a 2-litre cylindrical reservoir in the engine compartment via a metering pump on the engine to a jet in the mixture manifold of each carburettor.

G-BYMV had completed approximately 241 flight hours since it was built in 2000. The Light Aircraft Association (LAA) Permit to Fly was valid until 18 April 2014. The engine was also constructed in 2000 and had achieved a similar number of operating hours. The records indicated that the engine had suffered a seizure in June 2010 after coolant fluid had entered the oil system via a shared collection bottle. The engine was subsequently rebuilt, with both cylinders honed and one piston and ring set being replaced. The coolant overflow pipe was subsequently routed out of the engine bay in order to avoid a recurrence of the problem.

On-site examination

The aircraft had crashed in a level grass field approximately 400 m north of the Runway 26 threshold at Stoke Golding, coming to rest in an inverted attitude. The disposition of the wreckage indicated that the impact heading was due south, ie towards the airfield. It was clear that the impact had been steeply nose-down, estimated at around 70-80º, with a lack of damage to the tail fin indicating that little momentum was involved in the process of the aircraft nosing over onto its back.

The engine and nosewheel had made indentations in the ground, although the main landing gear had not made contact, thus confirming the steep nature of the impact. The only other mark on the ground was a light impression from the leading edge of the left wing; this was parallel to, and only a few centimetres from where the wing itself had come to rest and suggested that the aircraft was not spinning at impact. Some relatively minor damage was noted to the outboard sections of both wings, the symmetrical nature of which suggested that little roll or yaw had been present.

The aircraft was recovered to an upright attitude to facilitate additional examination. It was observed that the front of the aircraft, including the engine compartment, windscreen and cabin roof area, had sustained severe damage in the impact. However the fuselage aft of the seats, together with the empennage, had remained relatively intact. The overall pattern of damage was indicative of a low speed but steep impact, consistent with a stall from a low height.

The aircraft was equipped with two polythene fuel tanks, each of approximately 30 litres capacity, located in the inboard sections of the wings. Both tanks fed the engine jointly, as opposed to a left or right selection. It was noted that the fuel selector was in the ON position. Approximately 25 and 23.5 litres of motor gasoline were drained from the left and right tanks respectively. An odour of fuel had earlier been observed around the accident site, which suggested a small leakage of fuel, perhaps from the carburettors, which had broken off the engine during the impact.

It was noted that the fabric on the underside of the fuselage to the rear of the engine compartment was covered in an oily deposit that had the appearance of two-stroke oil. A small amount of oil was observed in the indentation in the ground made by the engine and propeller.

One propeller blade had broken off in the impact following a bending failure in the hub. The bend direction was aft, as opposed to against the plane of rotation, which suggested little or no propeller rotation at the point of impact. Neither blade displayed any evidence of leading edge damage nor chord-wise scuffing, which again was indicative of lack of propeller rotation. It was apparent that the propeller shaft had become slightly bent in the impact; this had allowed the tails of two of the propeller attachment bolts to contact the front of the reduction gearbox casing, resulting in impressions in the surface of the metal. The absence of any circumferential aspect to these marks provided further evidence of a lack of propeller rotation at impact.

Several pairs of spectacles including one on a neck lanyard, and sunglasses, were found in the cockpit area.

Following an on-site inspection the wreckage was recovered to the AAIB's facility at Farnborough for a detailed examination.

Detailed examination of the wreckage

Airframe

The examination confirmed that the primary flying control operating system was intact prior to the accident. The flaps were operated by means of a lever located between the seats and which was connected to a series of Teleflex cables. The lever had four detented positions and was found in the lowermost detent, indicating that the flaps had been retracted at the time of the accident.

Elsewhere in the cockpit it was noted that the throttle lever was in its fully retarded position.

The airspeed indicator appeared intact and was subsequently tested. It was found that the instrument consistently under-read by approximately 10% throughout its range. Whilst it is possible that the mechanism was damaged at impact, it was noted that the indicating needle displayed no off-set from zero before being connected to the test set.

Engine

The engine was subjected to a strip-inspection at a Rotax overhaul facility. Whilst extracting it from the airframe, it was observed that the gascolator contained fuel and the associated fuel screen was clear of debris. It was also noted that the two-stroke oil reservoir for the direct injection system was full.

Disassembly of the engine revealed that all the components were in good condition, with no evidence of a defect, failure or malfunction that could have had a bearing on the cause of the accident. The examination also included the ancillary components such as the water, fuel and oil injection pumps, the carburettors and the reduction gearbox. It was found that the rotary disc valve (which admits the fuel/oil mixture to the engine) was correctly timed, and the oil injection tubes were primed with oil.

Propeller

One propeller blade was found at a near neutral pitch angle, with the other in a markedly negative pitch position. The blades had been manufactured with cylindrical root sections which were then clamped between two halves of an alloy hub. While it seemed probable that the as-found blade angles were a consequence of impact with the ground, the advice of the propeller manufacturer was sought. They commented that, in their experience, any tendency for the blade to migrate in pitch would be in a coarsening direction. Moreover, the action of centrifugal force on a tapered knuckle on the end of the root section would tend to lock the blade in position, even if one or more of the hub bolts were insufficiently tight. It was therefore concluded that the blades became displaced in pitch as a result of reacting the forces exerted by the ground on the blade faces during the impact.

Fuel

A sample of the fuel from the aircraft was subjected to a laboratory analysis. This indicated that the fuel was consistent with motor gasoline (mogas) with no evidence of contamination. The laboratory report additionally stated that there was a '*small amount*' of ethanol, although this was significantly below the 5% limit stipulated by the engine manufacturer. Finally, the report commented that the vapour pressure was slightly higher than would be expected for UK summer grade fuel; it was however, within the range for spring and winter grade mogas. This in turn suggested that either the fuel was marginally out of specification, or 'old' fuel was being used.

Additional information: the use of mogas

The LAA provides advice on the use of mogas and refers to the CAA publication CAP 747, Section 2, Part 4, General Concession 4. (This information is also contained in the CAA Safety Sense Leaflet No 4, '*Use of Mogas*'). The Operating Limitations section requires that a placard be attached to the instrument panel, displaying the following:

USE OF UNLEADED MOGAS

(see CAP 747)
- only legal in aircraft specifically approved for the purpose
- fuel to be fresh, clean, water and alcohol free
- verify take-off power prior to committing to take-off
- tank temperature not above 20ºC
- fly below 6000 ft

CARB ICING AND VAPOUR-LOCK MORE LIKELY

(Note: a placard to this effect was found in G-BYMV.)

The reason for these restrictions is the higher vapour pressure of mogas in comparison to AVGAS, with an associated higher risk of vapour lock. However, gravity-fed fuel systems such as in the high-wing configuration of G-BYMV are generally less susceptible.

The pilot

The pilot began learning to fly in 2003, obtaining a National Private Pilot's Licence (NPPL) on AX3 and AX2000 aircraft. He owned and flew two tail-wheel-equipped Rans S6 aircraft, one between 2004 and 2008, and the other between 2008 and 2012. He then bought G-BYMV, which was equipped with tricycle landing gear. He flew G-BYMV regularly, usually with his wife as a passenger.

In December 2012, during training prior to a General Skills Test (GST), the instructor at the time assessed that the pilot had shown weakness in navigation, circuit flying, speed control and use of rudder. However, after subsequent training he passed his GST and his licence was renewed.

The pilot's medical declaration

The holder of an NPPL demonstrates his fitness to fly by making a medical declaration, in consultation with, and countersigned by, his General Practitioner. The declaration may be made in either Group One or Two. The Group One standard is closely equivalent to the Driver and Vehicle Licensing Authority (DVLA)'s standard for private driving; the Group Two standard is aligned with the DVLA standard for professional driving. The pilot of G-BYMV held a medical declaration in Group One.

The pilot's medical history and pathology

A specialist aviation pathologist carried out post-mortem examinations of the pilot and passenger. His report mentioned transverse bruising on the pilot's right foot, which:

> *'suggests that the pilot's foot was resting on something at the time of ground impact; the most likely structure would be the right rudder pedal, and this injury provides some limited evidence to suggest that the pilot was conscious at the time of the crash.'*

The pilot's last eye test, before the accident, was in May 2012. His corrected acuity allowed him to meet the DVLA Group One standards, but not those for Group Two. He was advised of some early cataract and macular degenerative changes. The pathologist's report noted the low angle of the sun and that the angle between the sun and the runway heading was only 20º and stated:

> *'It is not known whether [the pilot's] vision had changed in any way between the time of this eye examination and the accident, although both of these conditions can be progressive.'*

Toxicological tests revealed nothing remarkable.

Discussion

The accident occurred at the conclusion of a routine private flight in benign conditions. The engineering investigation did not identify any technical cause for the accident. The witness evidence suggests that the aircraft entered a stall followed by an incipient spin whilst approaching to land. There was also a consensus that the engine was running whilst the aircraft was visible to them. Nobody witnessed the impact with the ground, but examination of the accident site indicated that the aircraft had struck the ground in a steep nose-down attitude at a relatively slow speed. The marks on the ground did not indicate any airframe rotation at impact that could be associated with a spin, although it is possible that the pilot may have arrested any such rotation during the descent.

The on-site and subsequent examination of the wreckage revealed no evidence of engine power at impact. However, the fact that the engine was heard to be running until the aircraft disappeared from the view of the witnesses leaves a limited window for engine failure. Also, the engine was found to be in good condition internally, with the fuel and lubrication systems still primed with fuel. An oily deposit on the fuselage underside was probably the result of spillage after completely filling the oil reservoir.

The use of mogas increases the possibility of vapour lock, especially as the analysis of the fuel sample indicated a vapour pressure slightly higher than that normally found in summer-grade mogas. In addition, the accident occurred late in the afternoon on a day in which the temperatures had been in the mid to high 20's; it is thus probable that the fuel in the tanks was above the 20ºC figure stated in CAP 747. However, the engine fuel system was gravity-fed and the aircraft had apparently experienced no earlier problems on its short flight; it is thus considered unlikely that vapour-lock was a factor in the accident.

A two-stroke engine such as the Rotax 582 produces comparatively low torque at idle power setting. The throttle lever in G-BYMV was found on its idle stop. It is therefore possible that the steep impact angle allowed a large proportion of the propeller disc to contact the ground, which overcame the engine torque such that the engine stopped immediately.

Comparison of the recorded data recovered from the pilot's tablet computer of the circuit flown at Stoke Golding with a previous circuit at Wellesbourne, showed similar initial flight profiles and validated the eyewitnesses' accounts of events. The data indicates that the pilot possibly mistook the distinctive mown grass strip in the field north of Fenn Lanes and flew his approach towards it. Factors influencing this may have been his eyesight, and, once on final approach, the setting sun and any glare it caused on the windscreen. It is also possible that some other unidentified factor that degraded his performance accounted not only for this but also the unusual terminology in his final radio transmission.

The training which the pilot undertook, beginning in December 2012, prior to satisfactorily passing a General Skills test to renew his licence, highlighted weaknesses in navigation, circuit flying, speed control and use of rudder. Departure from controlled flight into a spin typically occurs as a result of yaw, which itself may arise from a lack of co-ordinated rudder input, at low speed[3] (usually below the normal approach speed). The accident also occurred at the conclusion of a visual circuit which did not follow the normal path.

A realisation, close to the ground, that he was not approaching the runway, may have prompted the pilot to rapidly consider his options and significantly increase his workload. He may have considered the possibility of continuing the approach and manoeuvring towards the correct final approach, or going around. Any nose-up pitch input, necessary in either case, without an accompanying increase in power, would have caused the angle of attack to increase and speed to reduce toward a stall; no witnesses recalled the engine power increasing prior to impact. Inattention to appropriate rudder pedal inputs to control yaw could then have led to an incipient spin following the stall.

Footnote

3 high angle of attack