Rans S10 Sakota, G-BVCB

AAIB Bulletin No: 7/2003	Ref: EW/G2002/06/03	Category: 1.3
Aircraft Type and Registration:	Rans S10 Sakota, G-BVCB	
No & Type of Engines:	1 Rotax 912-UL piston engine	
Year of Manufacture:	1998	
Date & Time (UTC):	2 June 2002 at 1306 hrs	
Location:	Lower Whitley, Cheshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - 1 (Minor)	Passengers - N/A
Nature of Damage:	Damage to landing gear, propeller, engine mount, wing and tailplane	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	58 years	
Commander's Flying Experience:	497 hours (of which 25 were on type)	
	Last 90 days - 4 hours	
	Last 28 days - 3 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

History of flight

The aircraft was flying from a private airstrip in Cambridgeshire to Blackpool, routing via the Manchester Low Level Corridor. The pilot reported that this was the longest flight he had planned in this aircraft and that, in his eagerness to complete the journey, he cruised at a faster speed than normal. Throughout the flight fuel was being fed from the left tank, and on arrival at the Corridor the pilot recalled that the fuel level in that tank appeared to be low. While transiting the Low Level Corridor the aircraft entered the Liverpool Control Zone and the pilot's concentration was devoted to regaining the correct track and altitude. He next noticed that the fuel in the vapour return line, situated under the instrument panel, was becoming "agitated" and that the reading on the fuel pressure gauge was falling. He switched the electric fuel pump on and selected the fuel to feed from the right tank, which he estimated was half full; although the light was poor, making it difficult for him to see the fuel levels in the tanks clearly. No fuel appeared to flow and the engine stopped. The aircraft was at an altitude of 1,200 feet amsl.

The pilot transmitted a 'MAYDAY' call and selected a field for a forced landing. He commented that, while executing this, he was distracted by a radio request for the number of people on board. On final approach, at a height of approximately 25 feet, the aircraft struck a powerline, cutting it with its propeller. Thereafter, the pilot was not sure of the aircraft's movements. It seemed to turn through 360° before coming to rest in the field the right way up. Although there was substantial damage to the aircraft, the pilot reported that the tubular steel fuselage survived well and he was able to exit

normally with only minor injuries. All three emergency services attended the scene. There was no fire.

The same journey had been attempted the day before. The pilot had abandoned that flight after 35 minutes because he smelled fuel and, on investigation, found a slow leak in the vapour return line. He returned, rectified the leak and took the aircraft for a further 20 minute flight, during the course of which fuel was successfully fed from each tank in turn. On completion the aircraft was fully refuelled with AVGAS.

The pilot remarked that there had been no evidence that any fuel had been lost overnight, nor had he been aware of any fuel leak or fumes during the flight. He estimated that the aircraft had been flying for one and a half hours at the time of the accident.

Description of Fuel System

The fuel on board the aircraft was held in two separate wing tanks. These tanks were permanently connected by a crossfeed pipe, which allowed fuel to flow freely between them. The pilot, who assembled the aircraft, believed that the routing of this pipe was such that, as one tank ran dry, some fuel would remain in the other tank. This remaining fuel could then be supplied to the engine by switching the three-way fuel selector to the appropriate position. The three positions for the fuel selector were OFF, LEFT and RIGHT.

The fuel tanks, which were located at the inboard ends of each wing, were translucent. This enabled the pilot to make a visual assessment of the amount of fuel on board by looking at the side of each tank through the wing roots. There were no calibration marks or gauges, so the pilot's estimate of the fuel remaining was somewhat subjective. The pilot stated that the maximum fuel capacity was 48 litres (24 litres per tank) and that the average fuel consumption was approximately 16 litres per hour, giving a total endurance of about 3 hours.

At the beginning of the year the pilot had modified the fuel system to allow the use of unleaded Mogas fuel. This included fitting a vapour return line to circulate a small amount of surplus fuel, and any vapour, back to the fuel tank. The 'spilled' fuel was returned to the left fuel tank via a T piece that doubled as a vent. After installation, a PFA inspector tested the modification. The inspector stated that this involved disconnecting the vapour return line upstream of its connection to the T piece leading into the left fuel tank and checking that the correct amount of fuel was being returned. He commented that his test did not establish whether fuel was reaching the left fuel tank via the T piece.

The aircraft was reported to have flown for a total of 20 hours before the fuel system was modified and 3.5 hours after. These subsequent flights had all lasted less than an hour.

In September 2001, the Popular Flying Association (PFA) sent a letter to all owners of Rotax 912, 912S and 914 powered aircraft stating the procedure to follow if they wished to modify their aircraft to use unleaded Mogas fuel. The letter stated that:

> *'Approval can be obtained by the simple process of having your PFA inspector check the aircraft against the enclosed checklist PFA/ULM2, and carry out an engine ground run using unleaded fuel. It may be that the inspection will show up the need for changes to the aircraft fuel system to bring it up to scratch, in which case you must have the work certified in the usual way'.*

The procedure stipulated that:

> *'Unless.... already PFA-approved, any modifications to the design of the aircraft, engine or systems must be submitted to PFA Engineering for approval.*
>
> *When all modifications have been cleared by PFA Engineering, and your inspector is satisfied that the aircraft complies in every respect with the requirements then he must:*

- *Fit a mandatory cockpit placard (enclosed)*
- *Sign the checklist at its base and staple it into the airframe logbook along with this letter*
- *Make an entry in your aircraft and engine logbooks (see below)*
- *Attach 'Operating Information - Unleaded Mogas' to your aircraft's Flight Manual, Pilot's Notes or Airframe Logbook (see below)*

  Logbook Entry

  'With effect from (date) this (aircraft/engine) may be run on unleaded petrol to BS EN 228 95 RON in accordance with Airworthiness Notice 98B (if it is a microlight or SLA)/98C (if it is a Group A aeroplane or gyroplane)'.

  The above wording has been agreed by the CAA to meet the intent of the Airworthiness Notices.

  Operating Information

  Attach the enclosed sheet titled 'Operating Information - Unleaded Mogas' to the aircraft's Pilot's Notes, Flight Manual or, in the absence of these, to the airframe logbook, and operate the aircraft in accordance with the guidance provided.

Inspection Checklist PFA/ULM2 stated that:

> *In the event that the aircraft is not already fitted with a vapour return line, and the manufacturer has no option available for adding one, normal PFA modification procedures apply regarding the approval of the modification'.*

The embodiment of the modification to the fuel system in G-BVCB required PFA approval. The PFA have no record of such approval and there was no evidence in the airframe or engine logbooks that the PFA/ULM2 checklist procedure had been completed. However, it is possible that elements of the procedure were carried out during the PFA inspection.

Discussion

a) Fuel consumption

The aircraft had been fully refuelled the day before. There was no evidence that it had lost any fuel overnight, and the pilot was not aware of any fuel leak or fumes during the flight. However, he did comment that the light was poor, making it difficult for him to see the fuel levels in the tanks clearly.

The pilot estimated that the aircraft had been flying for one and a half hours at the time of the accident. Expected fuel consumption would have been approximately 24 litres of fuel. If the right tank had been half full (as reported) when the left tank was empty, then only 12 litres of fuel remained out of the original 48 litres on departure. This would have represented a total consumption of 36 litres - 50% more than that expected.

This was the pilot's first attempt at a flight of this duration in this aircraft. In his eagerness to complete the journey, he reported that he had cruised at a faster speed than normal. This could, to an extent, have been responsible for the higher than normal fuel consumption. The damage to the aircraft prevented an assessment being made of the likelihood of a fuel leak or unexpected fuel venting. However, these possibilities could not be eliminated and they would also have accounted for the higher than normal rate of fuel depletion.

Unlike the previous day's flight, the pilot did not check that fuel could be fed satisfactorily from each tank and only selected the half full right tank when there were signs of fuel starvation. All his previous experience had been in aircraft in which the fuel was fed from both tanks simultaneously.

The pilot concluded that the engine stopped because he had delayed switching to the right fuel tank until the level of fuel in the left tank was too low.

b) Approval of fuel system modification

The ground test carried out following the MOGAS modification fell short of checking that the fuel was indeed 'spilled' back into the left tank. The PFA had no record of this modification to the fuel system being submitted to their Engineering Department for approval. Nor was there documentary evidence that the PFA/ULM2 checklist procedure had been completed after the modification had been installed, although a PFA inspector did remember carrying out an inspection on the aircraft.

Safety Recommendation

Safety Recommendation 2003-05

It is recommended that the Popular Flying Association reviews its procedures for ensuring that engineering inspections and relevant documentation are correctly completed, when required, following modification to an aircraft system.