Reims Cessna F172N Skyhawk, G-BSHR

AAIB Bulletin No: 4/2003	**Ref: EW/C2001/11/2**	**Category: 1.3**
Aircraft Type and Registration:	Reims Cessna F172N Skyhawk, G-BSHR	
No & Type of Engines:	1 Lycoming O-320-H2AD piston engine	
Year of Manufacture:	1978	
Date & Time (UTC):	3 November 2001 at 1350 hrs	
Location:	Norton Farm near Exeter, Devon	
Type of Flight:	Training	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - 1 (Minor)	Passengers - N/A
Nature of Damage:	Aircraft beyond repair due to substantial damage to the fuselage and wings	
Commander's Licence:	Private Pilots Licence	
Commander's Age:	28 years	
Commander's Flying Experience:	342 hours (of which 40 were on type)	
	Last 90 days - 11 hours	
	Last 28 days - 6 hours	
Information Source:	AAIB Field Investigation	

Background

During the late afternoon of the day before the accident, the aircraft, operated by a local flying club at Exeter, had been refuelled to full tanks. G-BSHR was the eighteenth aircraft to be replenished from the airport's refuelling point that day and no bulk deliveries of fuel had been received during that period. Following the refuelling, the aircraft was flown for 1 hour 15 minutes and it operated satisfactorily. During the morning of the day of the accident, the aircraft had been flown for 1 hour 5 minutes and it was serviceable at the end of that flight. It was not refuelled prior to the accident flight.

History of flight

After a thorough check of the aircraft, which included taking fuel samples from the drain points to check for contamination and water, the pilot was cleared for takeoff. During the initial climb out he was cleared by ATC to operate to the west of the airfield at altitudes up to 2,500 feet. The pilot levelled the aircraft at 2,000 feet to maintain separation from the cloud base. Shortly after changing the fuel tank selector from BOTH to LEFT, the engine started to run roughly. The pilot immediately re-selected BOTH fuel tanks and called ATC requesting a rejoin at the departure

airfield. Whilst positioning the aircraft for the approach, at approximately 1,800 feet and 80 KIAS, the engine suffered a total loss of power. The pilot attempted three unsuccessful airborne engine restarts with LEFT, RIGHT and BOTH fuel tank selections. By this time the propeller had come to a complete stop. The pilot selected a field and transmitted a Mayday call to Exeter Radar and prepared the aircraft for an emergency landing which included selecting full flap. After touchdown in the field, the pilot tried to keep the nose wheel from digging into the very soft ground by maintaining back pressure on the control column but the aircraft became airborne again and struck a hedge and some trees. The pilot evacuated the aircraft with minor injuries.

The pilot assessed the cause of the accident as fuel contamination because he had been carrying out regular carburettor ice checks and had not noticed any icing symptoms.

Examination of the wreckage

The wreckage was removed from the accident site by locally based aircraft engineers to a hangar at Exeter airfield where the AAIB Inspector carried out a technical examination. During the wreckage recovery, it was noted that there were reasonable quantities of fuel in and around both fuel tanks.

A visual examination by the AAIB of the aircraft, its engine and associated systems did not reveal any obvious fault. There was fuel in the gascolator which appeared, in colour and smell, to be AVGAS which was free of contamination and water. The gascolator filter was found to be exceptionally clean. The engine was free to rotate, had good compressions on all four cylinders and had sufficient clean oil. The throttle, fuel mixture, carburettor heat and fuel tank selector systems were connected and functioning correctly. The carburettor air intake filter was clean and in good condition.

The engine, which had not been damaged in the accident, complete with its associated systems, was removed from the aircraft and taken to a CAA approved engine overhaul organisation where it was installed on a test bed. Five engine runs, totalling 1 hour and 19 minutes, were carried out. No faults were found.

Meteorology

The Meteorological Office provided an aftercast. At 1200 hrs on 3 November 2001 the synoptic situation showed a weak ridge of high pressure covering southern England with a slack air mass over the Exeter area. In that area there was no weather, a surface visibility of 25 km and a few cumulus clouds with bases between 2,000 and 2,500 feet. The air temperatures and humidity were:-

Height agl	Temperature	Dewpoint	Humidity
Surface	PS 14	PS 08	67%
500 ft	PS 10.5	PS 07	79%
1000 ft	PS 10	PS 07	82%
2000 ft	PS 08	PS 07	93%

The 2,000 foot temperature and humidity figures were plotted on the carburettor icing probability chart (Figure 1) as shown in the CAA General Aviation Safety Sense Leaflet 3A titled Winter Flying and Leaflet 14A titled Piston Engine Icing. The chart showed a probability of serious carburettor icing at any engine power setting.

Previous occurrence

During this investigation it was brought to the attention of the AAIB that the pilot involved in this accident was involved in a similar occurrence on the 2nd May 2001.

The aircraft, a Cessna 152 registration G-BMFZ, had departed Exeter for a local flight. About 30 minutes into the flight the pilot descended from 3,000 to 2,000 feet to maintain in-flight visibility. He then noticed that the engine was losing power so he selected the carburettor heat control to HOT. However, since this selection of hot air appeared to further reduce engine power, he pushed the carburettor heat control back to COLD, but the engine then stopped. He twice tried to restart the engine without success and then transmitted a Mayday call before selecting a sports field for a forced landing. He subsequently carried out a successful landing in this field. The aircraft was undamaged and the occupants were not injured.

Extensive checks of the aircraft, its engine and engine systems, the fuel system and fuel filters by locally based aircraft engineers found no cause for the engine failure. A number of successful engine ground runs were carried out and the aircraft flown out of the sports field and back to Exeter Airport. After further checks, the aircraft was returned to service. In light of this information, the AAIB classified this incident as non-reportable.

The Meteorological Office provided an aftercast for this earlier incident. The 2,000 foot temperature and humidity figures were plotted on the carburettor icing probability chart (Figure 1 *(jpg 72kb)*) which showed a probability of serious carburettor icing at any engine power setting.

Additional observation

During the recovery of the wreckage of G-BSHR it was noted that during the impact both wings had folded rearwards forcing the inboard ends of the flaps into the rear passenger cabin at about the rear seat passenger head height (Photographs 1 & 2 *available from links at the bottom of the page*).

Analysis

It appears that both events were probably caused by carburettor icing. Certainly, the atmospheric conditions were at or near their most conducive to such icing on both occasions. The first indications of carburettor icing (assuming a fixed pitch propeller) are a slight drop in rpm and airspeed. The loss of rpm can be smooth and gradual and the usual reaction is to open the throttle slightly to compensate. However this action, whilst temporarily restoring the power, hides the growing problem of ice accretion in the carburettor. As the icing builds up, rough running, vibration, loss of airspeed and ultimately stoppage of the engine can occur.

As Safety Sense Leaflet 14A makes clear, the selection of hot air, when ice is present, may at first make the situation appear worse due to an increase in rough running as the ice melts and passes through the engine. If this happens, the temptation to return to cold air must be resisted so that the hot air has time to clear the ice. This time may be in the region of 15 seconds, which will, in the event, feel like a very long time!

The AAIB is currently investigating a number of accidents where carburettor icing is strongly suspected as being the initiator. It is proposed to make a safety recommendation to the CAA in a future AAIB Bulletin.

The ingress of the inboard ends of the flaps into the rear of the cabin at about passenger head height is of concern. If there had been passengers occupying the rear seats and they had not adopted the

brace position as detailed in CAA General Aviation Safety Sense Leaflet 2B titled *Care of Passengers* then serious or fatal head injuries could have occurred.