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Aircraft Type and Registration:	Stampe SV4C; EI-BAJ
No. and Type of Engines:	One Renault 4P03
Aircraft Serial Number:	171
Year of Manufacture:	1946
Date and Time (UTC):	29 July 1999; 10:40 hrs
Location:	Dunningstown, Co. Kilkenny
Type of Flight:	Private
Persons on Board:	2
Injuries:	Nil
Nature of Damage:	Extensive
Commanders Licence:	ATPL
Commanders Age:	35 years
Commanders Flying Experience:	Total 8670 hours On type 78 hours
Information Source	AAIU Field Investigation

Synopsis

While routing from Abbeyshrule to Waterford Airport, the engine started to run intermittently and lost power. The pilot selected a large field as a suitable site for an emergency landing. On landing in this field the aircraft over-turned and was substantially damaged. The engine failure was found to have been caused by a blockage in the fuel line.

History of the Flight

The Aircraft is owned by a syndicate and was normally flown from Trim Airfield. The aircraft was usually operated using Avgas, which is available at Trim. On the weekend prior to the accident, the aircraft was flown to Abbeyshrule for a 50 hr inspection and some minor cosmetic repairs, in preparation for participation in a vintage aircraft rally in the UK. On the morning of the accident the pilot and passenger arrived at Abbeyshrule Airfield. No Avgas was available at Abbeyshrule, so they purchased 20 litres of leaded car fuel (Mogas) at a local petrol station. There was initially approx. 70 litres of Avgas in the aircraft's tank, and the 20 litres of Mogas filled the tank to its capacity of 90 litres. The Mogas was funnelled through a chamois cloth during the filling operation.

The aircraft then departed Abbeyshrule at approx. 10.30 hours, for Waterford. The flight was conducted in clear weather at a height of approx. 1500 AGL. The flight was uneventful until the aircraft was approximately 8 miles NW of Kilkenny. The engine started to run rough and lost power for a few seconds. It then resumed normal operation for a few seconds, and again started to loose power. The pilot decided to divert to Kilkenny Airfield, which was approx. 4 miles from his position.

He found that by pumping the throttle, engine power would pick up briefly, only to die away again. The aircraft lost height during this period, and at about 800 ft, the pilot abandoned the attempt to reach Kilkenny Airfield, and selected a large field for an emergency landing. During the final approach to this field, made into wind, the pilot, who was flying from the rear seat, noted a considerable slope in the selected field, at right angles to his approach. He then turned the aircraft to land up slope. The aircraft landed heavily, the undercarriage partially collapsed and the aircraft nosed over, and came to rest inverted. The field contained a crop of tall barley, which probably contributed to the nose-over. The upper wing partially collapsed, but both occupants were uninjured and were able to scramble out of the aircraft.

Injuries

Both occupants were uninjured.

Damage to the Aircraft

The aircraft was substantially damaged, including damage to the undercarriage, wings, propeller and the rear fuselage, which sheared off just in front of the tailplane.

Other Damage

The selected field contained a crop of standing barley. An area of the crop was damaged as a result of the accident.

Aircraft Information

The Stampe SV4C is an aerobatic biplane design of 1940's vintage. Construction is mostly of wood and fabric. The engine is an inverted four cylinder normally aspirated engine. The fuel tank is located in the centre section of the upper wing and is gravity fed through a copper pipe, of 8 mm bore, to a fuel filter, then to a shut off valve and then to a pair of engine driven fuel pumps. The fuel filter bowl is made of metal. Therefore, to inspect the contents of the filter bowl, it is necessary to remove the bowl. When the bowl is removed, a gravity-operated valve closes, thereby preventing the fuel draining from the tank out through the filter assembly. This is necessary because the fuel cut-off valve is located downstream of the filter. The main fuel pipe is connected to a flap tube within the fuel tank. This flap tube consists of a length of flexible rubber tube, approx. 30 cm long, with a hollow weight at the end. The purpose of this system is to ensure that the opening at the end of the flexible fuel pipe is immersed in fuel, even when the aircraft is inverted during aerobatics.

The fuel tank has a small sump, into which the fuel pipe is connected. The tank is not fitted with a standard type fuel drain. There is a bolt screwed into the sump through which the tank can be drained, but this drain is unsuitable for taking fuel samples because once opened, it cannot be easily closed, and the entire contents of the fuel tank could then spill onto the fuselage.

The normal fuel flow of this engine is given in the flight manual as 7.4 gallons per hour at 2,250 RPM.

Examination of the Aircraft

The aircraft's wooden propeller had been broken in the accident. The fuel tank was cracked but still contained about 20 litres of fuel and approximately 0.5 litres of water. The carburettor bowl was found to be dry, but was clean and free from debris. The spark plugs showed indications of lean running. A fuel flow test was conducted and a fuel flow rate of 2 gallons per hour was measured in the intake to the filter assembly. Further inspection indicated a partial blockage in the fuel pipe leading from the fuel tank to the filter assembly. This pipe was routed down the inner wing strut on the port side of the aircraft and featured a number of bends. At some of these bends, the pipe was somewhat oval, reducing the cross sectional area of the bore. The pipe was secured to the aircraft's structure at various points using clamps and tie wraps. When the tie

wraps and clamps were cut, the pipe moved slightly and the blockage suddenly cleared itself.

The sudden rush of fuel missed the container that was being used to collect and measure the fuel. The material in the line, which caused the blockage, was carried away by this flow. A subsequent search of the lower engine cowlings failed to positively identify the material which caused the blockage, due to the presence of a large volume of other debris, include soil, pieces of crop and also normal oil, grease and other debris that were present in the engine cowl before the accident.

The fuel flow test was then repeated and a flow rate of approx. 11 Gallons/hr through the pipe was measured. This fuel flow rate is satisfactory for this aircraft.

The aircraft fuel tank was removed and inspected. It was found to be in a clear condition, with only a very small amount of small debris inside. The particle size of these pieces of debris was only about 0.4 mm in the largest dimension and was deemed to be incapable of causing the blockage. However, a small Yale type key was found in the tank.

The flexible flap tube in the fuel tank was removed and inspected. It carried a cure date of "3/69", indicating 1969 manufacture. While it was not leaking, it was in poor condition, and cracked when flexed.

The copper fuel pipe was connected to the fuel tank sump via a brass compression type fitting, which fitted into a tapered receiver in the sump. A liberal amount of white sealant had been used to seal this joint. It is possible that a piece of this sealant had broken away and caused the blockage. No records of recent work on this fitting could be found, and, according to the aircraft's logbook, the last recorded time that the tank was removed from the aircraft was 1993. However, the sealant appears to be significantly fresher that 1993.

Some other defects were noted on the aircraft. This included a failed link rod in the engine mixture control linkage, which had been previously removed and not replaced. To deal with this problem, the mixture control had been wire-locked in the fully rich position at the carburettor. The bolts attaching the main undercarriage to the main spar cross tie, were only finger tight. Neither of these defects are considered to have a bearing on the accident. A fitting, brazed and riveted to the top of the right main undercarriage leg, showed indications of poor brazing.

Fuel

A sample of motor fuel was taken from the fuel tank in the garage which supplied the Mogas fuel used to top-up the fuel tank on the day of the accident. This sample was taken on the day after the accident. This sample proved clear, free of water and other contaminants, and was analysed as standard quality leaded car fuel.

Maintenance History

This aircraft was originally transferred on to the Irish register in 1985, and was operated under the IAA's permit-to-fly scheme for Classic and Vintage aircraft. The Permit to Fly annual renewal was completed on 17/5/1999 at a total airframe time of 2,333-50 hours. The 50-hour inspection, at approx. 2,383 hours, was completed immediately prior to the accident.

Survival

It was the intention of the flight to make a lengthy sea crossing on the next leg of the flight, from Waterford Airport to the UK. It was noted that both persons on board had significant survival equipment in preparation for this crossing.

Both occupants were wearing full 4-point aerobatics harnesses at the time of the accident. This was undoubtedly a major factor in the absence of injuries in this accident.

Other Information

This aircraft type had not been manufactured since the 1950's. As a result, a manufacturer no longer technically supports it. Consequently the airworthiness authorities in some countries, which are not the state of manufacturer, notably the UK's CAA, have found it necessary to issue AD's and bulletins for this aircraft type.

Analysis

The available fuel flow rate of 2 gallons per hour, as measured after the accident, was insufficient to sustain the engine, as it was only 27% of the nominal requirement, as given in the Flight Manual.

Foreign matter in the main fuel pipe, which restricted the fuel flow to the engine, caused the engine failure. While it could not be determined as to what was the blocking material, at least two possibilities exist:

(a) Some of the excess sealing material became detached and entered the pipe.

(b) A piece of foreign material entered the fuel tank during fuel replenishment. The presence of the key in the tank demonstrated the possibility of such an occurrence.

The sudden onset of the engine stoppage, the absence of any significant contaminants in the fuel filter or the fuel tank suggests that the blockage was caused by a single object, of somewhat less that 8 mm major dimension, which was present in the fuel system.

The action of the cut-off valve in the filer assembly would make the detection of a partial blockage of the main fuel pipe difficult to detect during inspections of the fuel filter.

At the time of the accident there was approximately 60 litres of fuel and water in the aircraft fuel tank. Approximately 40 litres were lost in the accident as a result of the crack in the fuel tank. It is impossible to estimate the amount of water, if any, in the lost fuel. Therefore it is not possible to calculate the amount of fuel in the tank prior to the crash. While the presence of a considerable volume of water in the fuel tank was probably not a factor in this accident, the accumulation of water in the aircraft fuel tanks is a cause of concern. In this case the absence of a suitable modern push-to-drain type of fuel drain inhibited the taking of fuel samples from the tank. The only method to take samples from the tank was to open the bolt in the sump, and this would have resulted in the discharge of a considerable volume of fuel onto the fuselage, to the rear of the engine, creating a major fire hazard, particularly in a wooden aircraft.

The fuel tank flap tube was in a very poor condition, and it considered that replacement would have been accomplished because of its age. While not a factor in this accident, it had become cracked and brittle, and was in imminent danger of failure. The failure of this tube could lead to fuel starvation, especially during aerobatic manoeuvres. The pipe is not inspectable without considerable dismantling, and therefore many operators may not be aware of the condition of this tube, which is manufactured from a material that becomes embrittled and perishes with age.

The poor quality of the brazing that attached the fittings to the top of the main undercarriage leg is a matter of concern. Detection of this fault by the naked eye, prior to failure is probably impossible. More sophisticated inspection procedures would be required to detect this fault. It is not possible to state that if this attachment had been at full strength, that the leg would not have collapsed, and that subsequent overturn of the aircraft would not have occurred, but it may have been a factor in the severity of damage to the aircraft.

The failure to repair the broken link rod of the fuel mixture control was not a factor in the accident, but it was not good aviation practise to operate the aircraft with the rod missing and the mixture control wire-locker permanently in the fully rich position.

Conclusions

1. The engine failure was caused by a restriction in the main fuel pipe.

2. The nature of the material that caused the restrictions was not established.

3. The flexible flap tube in the fuel tank was 38 years old and in poor condition.

4. A poor quality brazed joint in the undercarriage may have been a factor in the collapse of the undercarriage.

5. While probably not a factor in the accident, the absence of a proper fuel tank drain resulted in a considerable quantity of water accumulating in the fuel tank.

Safety Recommendations

1. The airworthiness authorities which have Stampe SV4C aircraft on their national register should consider issuing a safety notice to operators of this aircraft type drawing attention to the necessity to inspect the fuel tank flap tube for ageing. **(SR 3 of 2000)**

2. The airworthiness authorities, which have Stampe SV4C aircraft on their national register, should consider issuing a safety notice that would provide for the installation of a self-closing water sample drain on the fuel tank of this aircraft type. **(SR 4 of 2000)**

3. The airworthiness authorities, which have Stampe SV4C aircraft on their national register, should consider issuing a safety letter requiring inspection of the security of the fitting at the top of the main undercarriage leg. **(SR 5 of 2000)**