Star-Lite SL-1, G-FARO

AAIB Bulletin No: 7/2004	Ref: EW/G2003/09/04	Category: 1.3
Aircraft Type and Registration:	Star-Lite SL-1, G-FARO	
No & Type of Engines:	1 Rotax 447 piston engine	
Year of Manufacture:	1990	
Date & Time (UTC):	2 September 2003 at 0945 hrs	
Location:	Old Sarum, Wiltshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Engine, propeller, nose leg and main gear damaged	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	53 years	
Commander's Flying Experience:	702 hours (of which 111 were on type)	
	Last 90 days - 25 hours	
	Last 28 days - 9 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot, metallurgical examination of the engine and laboratory examination of the fuel and oil	

History of the flight

The aircraft was on a VFR flight from its home airstrip in Dorset to an airfield in Northamptonshire. As the aircraft approached Salisbury from the south-west the pilot/owner made radio contact with Boscombe Down ATC and requested a low-level routing following the railway line from Salisbury to Andover. After a perceived misunderstanding the pilot was given the necessary clearance with an altimeter setting and a request to climb to 2,500 ft. As the aircraft entered the climb the pilot noticed that the engine RPM reduced which was consistent with the propeller load increasing. Shortly after the initial decrease in engine RPM the pilot noticed a significant and unusual RPM drop. The pilot stopped the climb, put the aircraft into a level attitude and retarded the throttle, but the engine RPM did not recover. The pilot then advanced and retarded the throttle but with no effect on restoring engine RPM. After a very short period of time, the engine failed completely. The pilot transmitted a 'MAYDAY' call to inform Boscombe Down ATC of his problem and put the aircraft into a glide approach to Old Sarum Airfield which was nearby and visual. ATC advised the pilot of Old Sarum's frequency which he then called with a further 'MAYDAY' stating his intentions. During the glide approach to Runway 24 the pilot made some 's-turns' to lose excess height but during the final turn the

aircraft 'pancaked' onto the runway which caused the nose landing gear to break and fold under the aircraft bringing it to an abrupt halt.

Engineering examination

Following its disassembly by the owner, an AAIB Inspector and a metallurgist examined the engine. It was an air-cooled two-stroke twin-cylinder petrol engine lubricated by the addition of oil to the fuel. Initial examination showed that there had been a catastrophic failure of the crankshaft bearing housing of the front piston's connecting rod. The metallurgical examination of the engine parts indicated a sequence of events that led to the final failure. A breakdown in lubrication resulted in a general overheating of the internal moving parts of the engine. Evidence indicated that both ends of the front piston connecting rod and the associated bearings had overheated more that those of the rear piston assembly. A breakdown of lubrication between the front piston and its cylinder wall resulted in piston seizure during a downstroke. The seizure of the piston resulted in the application of a tension load on the connecting rod. This load was sufficient to fail the crankshaft bearing housing end of the connecting rod which had been weakened by the overheating. Following the failure of the connecting rod the rear cylinder continued to run for a short period before its piston also seized or partially seized within its cylinder. The big end needle bearing rollers and the bearing cage from the front cylinder had been heated and rolled to form a metal sleeve around the crankshaft. It was not possible to examine either these needle rollers or the bearing cage for any pre-existing defects. The needle bearing rollers from both little end bearings and the rear big end bearing, together with the bearing cage, showed good evidence of heat damage which had softened the material from which they were made. There was no evidence of a pre-existing defect or corrosion on any of these needle rollers or the bearing cage.

There was no oil tar found within the engine. The absence of oil tar indicated that there had been no long term overheating and that the lubrication breakdown had most likely occurred during the accident flight.

Following the accident the owner had drained the aircraft's fuel tank back into a part-filled fuel can that had been used to refuel the aircraft prior to the accident flight. A fuel sample from this can and samples from the engine's carburettor bowls were sent to a fuels laboratory for analysis. The oil found in the samples was of the correct type approved by the engine manufacturer. The mix ratio of fuel to oil in the fuel can sample was found to be around 36:1. Some of the petrol in the carburettor bowls had evaporated before it was sampled and the analyst estimated the original mixture to be between 29:1 and 35:1. The engine manufacturer's recommended minimum fuel to oil mix ratio is 50:1.

The engine's previous history

In September 2002 the engine, which had completed 148 flight hours since new, had a rear piston seize within its cylinder. The engine was stripped, examined and rebuilt. During the rebuild the rear piston and little end bearing were replaced and the rear cylinder bore and head were 'cleaned up'. All the main bearings were inspected and there were no signs of excessive heating. An entry in the engine log book states that a 'lubrication failure' was associated with this seizure.

In August 2003 the engine, which had completed 27.8 hours since the rebuild in September 2002 had a strip examination and rebuild following foreign object ingestion into the rear cylinder. During the examination it was noted that the rear cylinder had some pitting and scoring of the cylinder head, cylinder wall and piston crown. It was also noted that the rear cylinder connecting rod little end had some overheat damage. No overheat damage was seen on the front cylinder connecting rod's big or little end bearings or on the crankshaft. At the time of the accident the engine had completed approximately 9.5 hours since this rebuild.

Conclusion

The engine failed in flight due to a lubrication failure which could not be explained.