ACCIDENT

Aircraft Type and Registration:	Vans RV-9A, G-CDCD
No & Type of Engines:	1 Wilksch WAM-120 diesel engine
Year of Manufacture:	2004 (Serial no: PFA 320-13925)
Date & Time (UTC):	6 August 2013 at 1020 hrs
Location:	1 mile South West of Wellesbourne Mountford Airfield, Warwickshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Damage to both wings, nose landing gear and fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	195 hours (of which 27 were on type) Last 90 days - 1 hour Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional investigation by the AAIB

Synopsis

The aircraft was flying circuits but on the downwind leg of the second circuit the engine stopped and appeared to windmill. The pilot turned the aircraft into wind and selected a field for a forced landing. Unfortunately, the aircraft overran and struck a fence, hedge and small trees, tipping onto its nose and coming to rest in a vertical, nose-down attitude.

Two anomalies were subsequently found which could have caused the engine to fail. Contaminated fuel was drained from the filter bowl and three of the four bolts which secured a timing gear to the crankshaft were found to have failed and exhibited extensive high cycle fatigue. It could not be confirmed which mechanism had caused the failure.

History of the flight

The pilot intended to fly a detail comprising three circuits. The first circuit was completed successfully and the pilot commenced the second, calling downwind as required adjacent to the upwind end of the runway. All the checks had been completed, including changing the fuel tank selector from right to left[1] when, at the end of the downwind leg and at about

Footnote

[1] The pilot has stated that he did this largely from force of habit following a long flight, after which there could be an issue with balancing fuel. With hindsight, he believes this was probably not an appropriate action in the circuit.

© Crown copyright 2014

1,000 ft agl, the engine stopped. The propeller appeared to be windmilling but the fuel pressure gauge was indicating zero. He switched the fuel tank back to right but all attempts to restart the engine were to no avail.

The pilot turned the aircraft into wind and chose a suitable field for a forced landing. The aircraft touched down in the selected field with about 60 m to run before a wire fence and hedge. On striking the fence and a small tree it tipped onto its nose and came to rest slightly over the vertical, resting against some trees and an overhead cable on the other side of a single-track road. The pilot was released from the aircraft by the emergency services some time later with only a minor injury.

Engine examination

The engine was removed and returned to its manufacturer for examination. It is an indirect-injection two-stroke diesel engine with three inverted cylinders and is designed to run on AVTUR fuel. It does not require electrical power to continue running after starting, and the fuel injection system is entirely hydro-mechanical. The exhaust valves are the only conventional valves and these are opened and closed by a camshaft which is driven from a timing gear bolted to the end of the crankshaft (Figure 1). If the timing is lost, the valves will invariably make contact with the pistons.

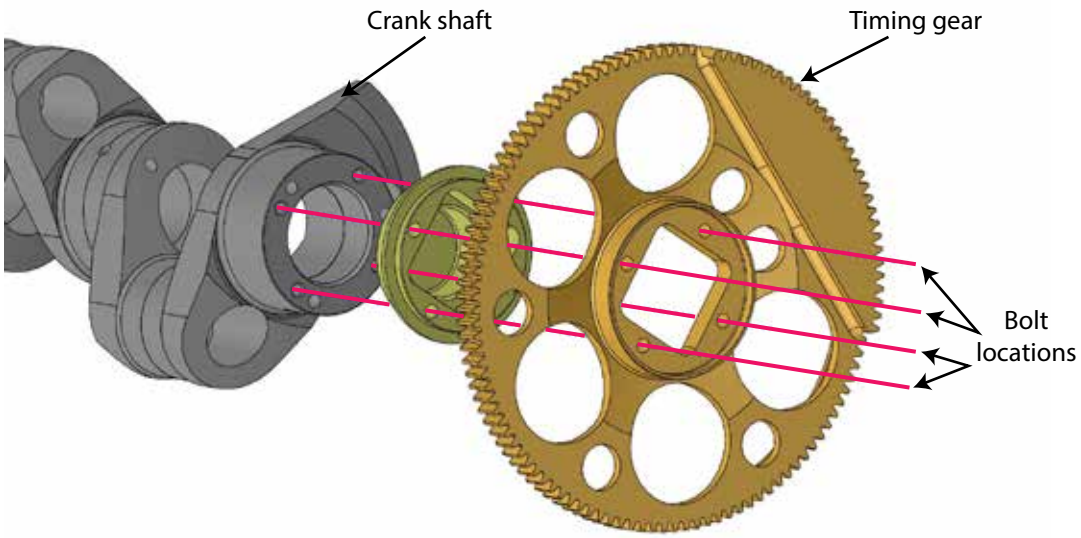

Figure 1

Exploded diagram showing attachment of timing gear to crankshaft.
(Diagram courtesy Wilksch Airmotive)

The AAIB examined the engine at the manufacturer's premises in the company of an engineer from the Light Aircraft Association (LAA). All three pistons had made repetitive contact with the exhaust valves, although the impacts did not appear to have occurred over a long period of running. It was found that three of the four bolts holding the timing gear to the crankshaft had failed; all three bolts had fractured at the head/shank interface and one had failed in the thread as well. They were recovered and sent for metallurgical

© Crown copyright 2014

examination, which found that all the fractures bore the characteristics of high-cycle fatigue cracks whilst the two that only had head fractures had fatigue cracks developing in the threaded region where the third had failed. The manufacturer advised that the bolts were made from AISI 8740 chrome molybdenum steel.

Two of the bolts were also tested for hardness, and for their elemental composition using Energy Dispersive X-Ray (EDX) techniques. The bolts appeared to be deficient with respect to chromium and nickel content and were somewhat below minimum specification when tested for hardness (as a guide to calculate the tensile strength).

The manufacturer advised that the bolts were to a revised standard introduced by Wilksch Service Bulletin WA-SB-005 dated 8 July 2009. This had followed an in-service failure and introduced a change, in the specification of the bolts, from a commercial grade steel with relatively loose tolerance of the thread form to a higher standard of both material and thread form. The SB requested owners to send back the replaced bolts and it is understood that no failure or cracks in these have been found. It also contained detailed instructions for the bolt replacement to ensure that the correct torque is achieved.

Fuel contamination

As part of the engine dismantling, the manufacturer had emptied the fuel filter bowl and was concerned at what was found (Figure 2). The fuel was a dense black colour and there was a high percentage of water present: in the manufacturer's estimation, there was enough to cause the engine to stop.

Figure 2

Photograph of fuel taken from filter bowl. Upper, dark layer is discoloured fuel and the lighter, lower layer is water

© Crown copyright 2014

Discussion

There are at least two potential reasons why this engine failed, contaminated fuel being, in the estimation of the engine manufacturer, the more likely. Metallurgical examination of the failed timing gear bolts showed evidence of high-cycle fatigue but, because of the nature of the internal damage to the engine, the manufacturer considers it unlikely that this failure occurred in flight. It is more likely that the damage occurred when the rotating propeller struck the fence.

Whether the cause of this engine failure was contaminated fuel or bolt failure, safety issues have been exposed and are being addressed. The apparent gross fuel contamination is beyond the control of the manufacturer but the LAA advise that they intend to highlight the need for regular fuel quality checks in their monthly publication, '*Light Aviation'.* The WAM-120 diesel engine is only in service in small numbers and all owners are known to the manufacturer. The LAA will be working with the manufacturer to ensure that critical internal engine work, such as was involved in this incident, is overseen by competent and authorised personnel.

© Crown copyright 2014