

Evans VP-1, G-AYUJ, 16 June 1996

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Aircraft Type and Registration: Evans VP-1, G-AYUJ

No & Type of Engines: 1 Volkswagen 1776 piston engine

Year of Manufacture: 1983

Date & Time (UTC): 16 June 1996 at 1150 hrs

Location: Ainsdale Beach, Southport

Type of Flight: Private

Persons on Board: Crew - 1 Passengers - None

Injuries: Crew - Minor Passengers - N/A

Nature of Damage: Roll-over bar bent and windscreen cracked; plus effects of seawater immersion effects

Commander's Licence: Private Pilot's Licence

Commander's Age: 57 years

Commander's Flying Experience: 241 hours (of which 8 were on type)

Last 90 days - 4 hours

Last 28 days - 3 hours

Information Source: Aircraft Accident Report Form submitted by the pilot and additional AAIB inquiries

The take off and initial climb from Runway 22 at Woodvale were normal, with the aircraft attaining 500 ft by the end of the runway. However, after turning crosswind, the pilot noticed that the aircraft was no longer climbing, even with full power (2800 RPM) applied. Oil temperature and pressure were normal, but the pilot became aware of a "hot smell, like burning paint". He turned the aircraft downwind, over a beach, and was planning on transmitting a PAN call, when the engine RPM suddenly increased and went off-scale. The pilot immediately closed the throttle and the engine 'stopped dead', although the propeller continued to rotate. As the airfield was beyond gliding range, and the beach was crowded, the pilot made a radio call advising of his situation, turned the aircraft through 180°, and steered towards a sandbank that was free of people. In the event, he was unable to reach the sandbank, and the aircraft stalled into the water close by. Almost immediately, the aircraft inverted. The pilot's head and upper body were under water, but he held his breath whilst releasing

his harness, and was able to vacate the aircraft, only injuring his thumb in the process. He was helped to the shore by bathers, and the scene was later attended by the emergency services.

Subsequent examination of the engine revealed that the propeller hub was free to rotate on the end of the crankshaft. The hub had been retained by means of a bolt which passed through the hub and located into a hole tapped, in an axial direction, into the end of the crankshaft. The bolt was found to be loose, with a tab washer under the bolt head having 'opened out'. The engine was removed from the aircraft and sent to an aircraft engineer with considerable experience of Volkswagen engine conversions.

When an engine is converted, it involves fitting a propeller hub onto the crankshaft stub which, in its automotive application, drove the fan pulley. The forces on a propeller hub, generated from aerodynamic loads and gyroscopic moments, are greater than those transmitted by a fan pulley, and it is therefore important that the manufacture and fitting of the propeller drive components are carefully controlled. Most converter-companies use a hub which is an interference fit on the original parallel shaft, although some choose to grind a taper on the shaft and manufacture a taper fit hub.

The subject engine had retained the parallel shaft, and the fact that the hub had been rotating relative to the shaft had resulted in severe 'galling' of the mating surfaces. A woodruff key on the crankshaft (which had been there since its automotive use), had sheared over most of its length.

The engineer who examined the engine emphasised the importance of; (a) machining the hub bore to be a correct interference fit on the shaft, and (b) fully tightening the retaining bolt against the hub. If either is not complied with, the propeller hub will begin to fret on the shaft, leading to the woodruff key shearing, followed immediately by the failure of the assembly.

The engineer made the following comments following his examination of the engine:

1. The propeller hub bore was badly damaged over most of its length, but measurement of the small amount of undamaged bore suggested that it had not been a good interference fit.
2. The propeller hub retaining bolt was too long for the application and had bottomed in the threads in the crankshaft before the tightening torque was effective.
3. The situation had been further exacerbated by the locking tab washer having an oversize outside diameter so that it had been dishd into the propeller hub bolt head relief as the bolt was tightened.
4. The fact that the woodruff key had not sheared over its entire length suggested that the hub was never forced fully home on the shaft.

He then went on to recommend that:

- (i) The propeller hub should be checked prior to assembly, using a slip gauge, for a satisfactory interference fit, ideally 0.002-0.003 inch smaller than the crankshaft outside diameter.
- (ii) The retaining bolt should be checked to ensure that it will tighten against the hub prior to any washers being fitted. It should then be re-assembled using 2 spring disc washers (VW Part No. 111105259) in addition to some locking device, and fully tightened to about 100-105 ft lb torque.

The aircraft records indicated that the engine had been removed from a car in November 1983, and had subsequently undergone a recognised conversion, which had been the subject of a PFA (Popular Flying Association) report. The engine had last been inspected during an overhaul in 1990. In September 1995 (only a few flying hours before the accident), an in-flight vibration had occurred: this was found to be due to a small area of delamination on the rear of the (wooden) propeller, which had probably occurred as a result of being struck by a fastener that had detached from the engine cowling. It is not clear whether this had any relevance to the subsequent event, although the nature of the damage noted on the hub and shaft suggested that the process had occurred over a period of time.

Converted Volkswagen engines equip a variety of aircraft types in addition to the Evans VP-1, and they fall largely within the jurisdiction of the PFA. This organisation has stated their intention to publish a technical article on the issues raised by this accident in a forthcoming issue of their magazine.