Replica Viking Spitfire, G-BRDV

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Aircraft Type and Registration:	Replica Viking Spitfire, G-BRDV
No & Type of Engines:	1 Jaguar V-12 piston engine
Year of Manufacture:	1984
Date & Time (UTC):	22 September 1997 at 1230 hrs
Location:	Keevil Airfield, Wiltshire
Type of Flight:	Test Flight
Persons on Board:	Crew - 1 - Passengers - None
Injuries:	Crew - None - Passengers - N/A
Nature of Damage:	Damage to propeller, underside of aircraft and fuselage structure
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	10,796 hours (of which were on type)
	Last 90 days - 111 hours
	Last 28 days - 41 hours
Information Source:	AAIB Field Investigation

The aircraft was a full size wooden replica based on the prototypeSupermarine Spitfire and it carried the markings K5054. It wasmuch lighter than an original Spitfire, with a basic weight under3,000 lb. It was powered by a Jaguar V12 motor car engine whichhad been extensively modified to increase the capacity and wasfitted with a 2.77:1 reduction gearbox driving a Hamilton StandardHydromatic two bladed constant speed propeller. Although thenormal Electronic Control Unit (ECU) for the engine was retained,the installation was modified by the addition of dual ignition,dual fuel pumps and a variable mixture control. It had not beenflown for several years and had been sold on to a new owner, butbefore he could fly the aircraft it was necessary for a Permitto Fly renewal flight to be undertaken. This was the purposeof the accident flight, and the aircraft was being flown by aCAA test pilot when the accident occurred.

While the aircraft closely resembled an original Spitfire, therewere some differences and the test pilot was carefully briefedon these by the builder of the replica, before the flight. Inparticular a tendency to 'float' during the flare, due to thelight weight, was discussed as was the use of the mixture control,which was unconventional in layout.

A video of the entire flight including the ground running andpower checks was available and this, together with the pilot reportand assistance from the builder and owner, provided the basicinformation on the circumstances associated with the accident.

Following engine start, the aircraft was taxied to the hold wherelengthy power checks were made. From the video, it appearedthat at times during these power checks the engine sounded ratheruneven. However, during the take off the engine had acceleratednormally and the aircraft climbed away satisfactorily. It wasthen lost from the video coverage for a few minutes while thepilot familiarised himself with the aircraft and conducted hischecks. When the aircraft appeared again on video, it was onfinal approach with the landing gear down and the flaps retracted. There is some doubt about the intention of this approach; thepilot stated that he had intended to go-around from this firstapproach and that he had discussed this beforehand, but the builderthought that he was landing. There had also been some discussionover the RT between the pilot and the builder about the oil andcoolant temperatures, which the pilot thought were high, but whichthe builder advised were allowable.

From the video, the aircraft was observed to cross the thresholdand power was then reduced. However, at about the point wherethe flare would have been initiated, the power was again increased.The engine accelerated normally at first, but then began to runroughly. The aircraft was seen to continue down the runway ata very low height. After about 20 seconds, the landing gear wasretracted but the aircraft continued, without climbing, for afurther 15 seconds until it disappeared from view some 35 secondsafter power had been applied, still low and apparently on therunway heading. Shortly after this, the pilot reduced power andmade a forced landing in a field beyond the runway. The damageto the aircraft was considerable and some difficulty was encounteredin opening the cockpit door due to distortion of the fuselage. However the pilot was uninjured, and the aircraft was later recoveredto a hangar.

Audio analysis

The harmonic content of the audio recording from the domesticcamcorder was analysed and a time history of propeller rotationalspeed was derived. Following the accident, the aircraft was inspectedto determine the engine-to-propeller gearbox ratio, which wasfound to be 2.77 to 1. The analysis showed that the increase inengine speed prior to the take-off had been smooth and in twostages, culminating in a constant speed of approximately 5,890RPM. During the attempted go-around, the engine speed smoothlyincreased to 5,000 RPM, following the same rate change profileas during the take-off. However, at 5,000 RPM the speed held constantfor half a second before reducing to approximately 4,800 rpm.This speed was maintained for at least the next two seconds afterwhich the amplitude level of the recorded audio dropped belowthat required to analyse the harmonic content.

Examination of the aircraft

The propeller was found at a pitch setting corresponding to aposition several degrees above the fine pitch stop. This typeof propeller relies on oil pressure and centrifugal twisting momentsto control the pitch; there are no springs controlling the pitchangle. However the audio analysis had

confirmed that the enginehad accelerated normally at first and so propeller pitch was notconsidered to have been a factor.

The engine seemed to have suffered no mechanical distress, butexamination of the spark plugs and exhaust ports indicated thatit had been running rather 'lean'. The engine behaviour was consideredto have been consistent with lean operation.

The ECU, of a type normally used in cars, is programmed to compensatefor altitude and pressure changes. It was not reprogrammed forthis installation. A further two fuel injector nozzles were fittedin the inlet manifold to richen the mixture, and a rotary mixturecontrol rheostat was wired into the ECU. This allowed the mixtureto be made rich, or leaned-out as required. The normal full-richsetting was at less than the full rotation of the rheostat. Theinduction air was supplied by a ram air chin intake, with alternateair from static ports located adjacent to the wing leading edgeroot fillet fairing. A fuel pressure regulator which referencedinlet air pressure, as for the normal car installation, was alsofitted.

It was decided that the behaviour of the fuel/air system couldnot be fully investigated without a programme of flight test measurements,which was not practical in this case. The aircraft had made areasonable number of flights over past years with different pilotsand no fuel mixture problems had been reported. Since this wasthe only aircraft of its type, there was no possibility of furtherevaluation. It was therefore concluded that the engine had probablylost power due to an incorrect fuel/air mixture which could havearisen as a result of either a technical malfunction or inappropriateuse of the mixture control.