

Jabiru UL-450, G-TUBB

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Category:1.3

Aircraft Type and Registration:	Jabiru UL-450, G-TUBB	
No & Type of Engines:	1 Jabiru Aircraft Pty 2200A piston engine	
Year of Manufacture:	1999	
Date & Time (UTC):	13 June 2002 at 1449 hrs	
Location:	Near Brynmawr, South Wales	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Engine failure. Damage to right wing and propeller.	
Commander's Licence:	Private Pilots Licence	
Commander's Age:	67 years	
Commander's Flying Experience:	15,186 hours (of which 280 were on type)	
	Last 90 days - 28 hours	
	Last 28 days - 10 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and Engine examination by the AAIB.	

History of Flight

The intended flight was from Kemble to the Methyr Tydfil area with a return to Kemble. The pre-flight checks were all carried out satisfactorily without any indicated problems. After about an hour of flying, the engine began to run rough. The aircraft was at 2,800 feet, observed weather conditions were a temperature of +17°C with a wind from 250° at 16 kt and scattered clouds at 4,000 - 5,000 feet. Carburettor heat was selected on, but this had no effect. Shortly after this the engine stopped.

An attempt was made to restart the engine using the starter motor, as defined in the airstart checklist. However the engine and propeller didn't turn over, indicating a completely seized engine.

A forced landing was carried out onto a hill 2 nm south of Brynmawr. The landing was on a plateau on the hill with steep downslopes to the north, east and west and a steep upslope to the south. On landing the landing gear detached and the right wing and flaps were slightly damaged. The pilot was wearing a lap and diagonal harness and escaped from the aircraft without injury.

Engine Description

The aircraft was fitted with a Jabiru 2200A engine. The engine was a four cylinder, four stroke horizontally opposed air cooled engine. The engine developed 80 hp at 3,000 RPM. The propeller was driven directly by the crankshaft with no reduction gearbox.

Cooling of the engine was effected by two ram air ducts mounted either side of the engine cylinders. The ducts took air from scoops at the front of the engine and directed this cool air over the cylinders and cylinder head fins, exhausting the air below the engine.

The engine had completed 281.05 hours.

Engine Examination

The engine was recovered to the AAIB at Farnborough for examination.

The engine was then progressively stripped. On initial examination it was evident that the engine had completely seized. The number three cylinder spark plug was damaged so the cylinder head was removed. Upon removal of the cylinder head it was evident that a catastrophic failure had occurred. The number three piston was completely destroyed and the connecting rod was bent. Remains of the piston were still in the cylinder between the head and the connecting rod (Figure 1 (*jpg 95kb*)). The head of the number three exhaust valve was missing, and subsequently retrieved from the oil sump. The valve stem from the exhaust valve was stuck in its valve guide. The cylinder and the cylinder head were extensively discoloured on the lower quarter indicating several hours of 'blowing' (Figure 2 (*jpg 95kb*))). There was also discoloration consistent with overheating around the rockers for the inlet and exhaust valves on the number three cylinder.

The fins on the cylinder head were distorted indicative of overheating and the head bolts were interfering with the cylinder head. Inspection of the bores of the holes for the head bolts revealed deep indentations from the threads of the bolts, normally these holes are clean with the threaded portion in the cylinder. This showed that at some point the distortion of the head from overheating allowed the bolts to interfere with the head.

The cylinder heads were removed from the remaining three cylinders. Number one and two cylinder heads showed some signs of 'blowing' with slight discoloration. The number four cylinder showed a similar level of 'blowing' to that of the number three cylinder. In addition thread marks were evident in the bolt holes of the cylinder heads, coupled with distortion of the fins.

The design of the cylinders is such that there is no gasket between the cylinder and the head, achieving a gas seal by relying solely on the recessed fit between them and the torque of the cylinder head bolts. The head bolts have to be checked for correct torque every 25 hours, with the interference of the bolts with the head bolt holes, an incorrect torque would result. This is due to the bolts tightening up against the head rather than pulling the head onto the cylinder. This will then compromise the gas seal.

The remainder of the engine was stripped down. There was impact damage to the crankcase, which was due to the break-up of the piston. The oil sump was removed and contained a large quantity of oil, from this area the remains of the piston, piston rings and the head of the number three exhaust valve were recovered. The oil pump was also removed and this included several small fragments from the piston, indicating that the piston failed whilst the engine was still turning. All the oil paths in the engine were clear.

The damage to the crankcase was to the extent that the number three cam followers were jammed in position. The push rods for the number three valves were both intact and not bent.

The exhaust valve stem was removed from its valve guide on the number three cylinder. The stem had considerable carbon deposits, some of which were disturbed during its removal. The carbon had increased the diameter of the valve by approximately 0.0065 inch.

Jabiru state that compression checks should be carried out every 100 hours. However when the manuals for this engine were examined it was not very clear. The periodic checks are detailed in the manual for the daily, 25 hour, 50 hour and 100 hour intervals. The only tasks listed for 100 hours in the manual are to carry out the 25 hours check requirements and to renew the spark plugs, there is no mention of the compression check. However a check list provided by Jabiru lists the compression check at 100 hours. The UK Jabiru agents recommend that the compression check should be carried out every 50 hours.

There is no mention of compression checks in the engine log book, however the maintenance engineer responsible for the engine did quote that compression checks had been carried out in accordance with the manual and that no problems had been experienced. The last check to be carried out was a 50 hour check in March 2002.

The ram air duct on the right-hand side of the engine, which supplies cool air for the number three cylinder had been modified. The modification was to add an orifice at the aft end of the duct, close to the number three cylinder. The orifice was connected to a hose, which then fed hot air from the engine into a cockpit heating system.

There is a modification available for the Jabiru 2200A ram air system to improve cooling of the aft cylinders. This modification involves the insertion of baffles to direct more air over the rear cylinders. This had not been accomplished on this engine.

There have been two previous occurrences of Jabiru 2200 engine failures due to sticking exhaust valves.

Discussion

The engine suffered a catastrophic failure due to the number three cylinder exhaust valve becoming stuck open in the valve guide. The piston then struck the valve, causing the valve head to detach. This led to the destruction of the piston and bending of the connecting rod. Following the piston break up the engine seized.

The exhaust valve became jammed due to excess carbon build up as a result of overheating of the number three cylinder.

The modified ram air ducting which tapped some of the cooling air from the right-hand side of the engine to supply a cockpit heating system exacerbated the overheating.

Overheating had also caused distortion of the cylinder head allowing the gas seal for the cylinder to be compromised. In addition the head bolts had interfered with the cylinder head bolt holes, which would have resulted in incorrect torque of the bolts. Although not a factor in the accident the 'blowing' cylinder coupled with the modified ram air duct that tapped air into the cabin, could have caused carbon monoxide to enter the cockpit.

The accomplishment of compression checks every 50 hours may have indicated the problem of head distortion and 'blowing' and could have led to the valves and guides being checked for excess carbon build up. The Jabiru UK agents are to communicate the recommended compression check intervals to all UK Jabiru 2200A engine operators. They are also considering amending the manuals to clarify the compression check requirements.