Beech C23, G-BBTX

AAIB Bulletin No: 12/2001	**Ref: EW/G2001/02/22**	**Category: 1.3**
Aircraft Type and Registration:	Beech C23, G-BBTX	
No & Type of Engines:	1 Lycoming O-360-A4J piston engine	
Year of Manufacture:	1974	
Date & Time (UTC):	27 February 2001 at 1142 hrs	
Location:	Blackbushe Airport, Hampshire	
Type of Flight:	Private	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Propeller, nose and left main landing gear, underside of fuselage	
Commander's Licence:	Basic Commercial Pilot's Licence with Flight Instructor rating	
Commander's Age:	52 years	
Commander's Flying Experience:	1,155 hours (of which 4 were on type)	
	Last 90 days - 13 hours	
	Last 28 days - 2 hours	
Information Source:	AAIB Field Investigation	

The flight was being conducted as a 'Single Engine Piston Class Rating, Dual Flight with Instructor' to form part of the licence re-validation requirement for the pilot. The flight departed from Blackbushe Airport with the pilot, who was a part owner of the aircraft, and the instructor on board. Refresher training was carried out in the local area and the aircraft then returned to the airfield.

Weather conditions were good and Runway 08 was in use with a surface wind of 090°/5 kt. The surface temperature and dew point were +3°C and +2°C respectively.

One practice forced landing (PFL) without power was successfully carried out from overhead the airfield at 2,000 feet. During the descent with idle power the carburettor heat was selected on and engine warming was carried out several times. A second PFL from a similar position was then carried out. During the final approach this time it became clear that the aircraft would not reach the runway. At approximately 100 feet agl the instructor called for the pilot to go-around. In fact the pilot was already applying power but the engine was not responding. During the attempt to reach the runway the airspeed decayed and the aircraft stalled, dropping heavily onto the paved undershoot, short of the displaced threshold but after clearing an earth bank. The aircraft was shut down and both pilots were able to vacate the aircraft normally.

Backround information

The aircraft was owned by a flying group, comprised of ten members. In September 2000 it had suffered propeller damage during a heavy landing, which had necessitated removal of the engine for shock loading inspections. On completion of these inspections, the cylinder bores were honed to remove corrosion and the engine was reassembled with a new camshaft, tappet bodies, main and big end bearings. The engine was test run prior to being released as serviceable and was reinstalled in the aircraft by an aircraft engineering organisation contracted by the flying group.

In addition to the routine work associated with reinstalling the engine, it was necessary to replace the carburettor heat flap box because of excessive play in one of the spindle bearings. The wear in the bearing was such that there was approximately 1/4" play in the carburettor heat flap. The heat flap return spring was also found to be broken and was replaced.

Several flights were made by the group members subsequent to the work detailed above and prior to the accident. During three of these flights, rough running was experienced when performing magneto checks during the pre-take off power checks and when leaning off the mixture in flight. The mixture control was also found to be overly sensitive. The latter problem was overcome by an adjustment to the mixture lever so that a greater travel of the lever was required before it would start to lean. One of the members of the flying group advised the other group members of the recent engine problems by e-mail. This was also recorded on the log sheets in the aircraft, which were used for recording flying times for the billing of the group members. When interviewed however, the group member who flew the aircraft on the day of the accident stated that he had not received any notification of the engine problems and did not recall seeing any log sheets on the aircraft. He further stated that had he been aware of the engine rough running problems, he would not have been inclined to carry out the PFLs.

Aircraft examination

The aircraft and engine installation were examined following recovery of the aircraft to a temporary storage area. The nose and left landing gears were collapsed and there was damage to the left wing and propeller from contact with the ground. One of the propeller blade tips was bent forward and both blade tips were heavily scored in the chordwise direction, indicating that the engine was producing power when the aircraft contacted the ground.

There was sufficient fuel on the aircraft and a sample of fuel from the fuselage drain was found to be visibly free of water and the correct colour for AVGAS 100LL. The engine throttle, carburettor heat and mixture controls were checked for smooth operation and full range of travel and were found to operate satisfactorily. The carburettor heat air supply ducting was inspected and found to be intact and free from obstructions. The carburettor cold air, inlet ducting was also inspected and found to be satisfactory. The ignition system was examined but no defects were found. The engine was hand turned and the ignition timing checked using a test box. The ignition timing was found to be correctly adjusted, in accordance with the manufacturers recommendations. Correct operation of the mechanical fuel pump was verified by turning the engine by hand and checking for fuel pumping out of the outlet pipe.

As no defects were found during the on-site examination, the decision was taken to remove the engine for test running. The engine was removed complete and no components other than the damaged propeller were removed prior to testing.

Engine testing

The engine was taken to the same facility which had performed the shock loading checks and carried out restoration of the engine following the propeller strike. The engine had been test run after reassembly, and it was deemed that testing at the same facility would provide a meaningful comparison of the engine's performance.

After confirming the crankshaft flange runout to be within acceptable limits, the engine was placed in the test cell and prepared in the same configuration as for the test run after the shock loading checks. After several operations of the priming pump the engine started and ran normally. After a short warm-up the engine rpm was set at 2,200 and several checks of the magnetos performed. The rpm drops were noted to be within acceptable limits. During repeated acceleration checks from 600 to 2,700 rpm the engine responded smoothly and without hesitation. Idle checks were carried out satisfactorily. The idle mixture setting was checked and found to be correct and similar values were obtained for engine power output and specific fuel consumption as for the post shock loading test run, when corrected for the differing ambient conditions.

Discussion

No defects were found during the inspection of the aircraft and the engine testing that could have explained the failure of the engine to respond to the pilot's demand on the throttle, nor that would have accounted for the rough running reported by some of the group members. It is possible that the rough running may have been caused by intermittent plug fouling, resulting from oil blow-by due to the piston rings not yet having fully bedded in, or there may have been an intermittent defect in the engine which was not detected during the engine testing, though this seems unlikely.

The failure of the engine to respond to throttle inputs on the second PFL is not consistent with the reports of rough running and is more symptomatic of the effects of carburettor icing. According to CAA General Aviation Safety Sense Leaflet No. 14 'Piston Engine Icing', the forecast conditions on the day of the accident were such that severe carburettor icing could be expected at all power settings. The engine was being operated at low throttle settings during the course of the two PFLs, which would have rendered it more susceptible to carburettor icing and allowed the engine to cool down in the descent. More significantly, at low power settings, the exhaust manifolds cool quickly so that there is much less heat available to supply the carburettor heat system, meaning that regular engine warming in the descent is vital to avoid/clear carburettor icing.

The carburettor heat flap, return spring on G-BBTX biased the flap to the cold air position. It is possible that prior to rectification the broken return spring could have prevented the flap from fully closing, allowing warm air to be fed to the carburettor all the time, thereby reducing its susceptibility to icing. Replacement of the faulty carburettor heat flap box and broken return spring may in fact have made the engine more susceptible to carburettor icing.

The AAIB made previous Safety Recommendations to the CAA in Bulletin 12/2000 recommending that single-engined aircraft be fitted with carburettor icing detection systems. However, the CAA has not pursued this because of concerns with the reliability of such systems and instead places the emphasis on training and good airmanship. The AAIB has seen no data to substantiates the CAA's claim that currently available carburettor ice detection systems are inherently unreliable. A recent review of accident statistics by the AAIB showed that there are approximately six accidents every year which may be attributable to carburettor icing and this rate has remained constant for several years. In the AAIB's experience the instructions given to PPL students regarding the use of carburettor heat are sometimes unclear as to when it should be used and for how long it should be applied.

There is no requirement for General Aviation aircraft to carry a Technical Log and so the promulgation of information on the serviceability of aircraft belonging to flying groups is problematic and tends to rely on certain members of the group keeping the others informed. This task can be particularly difficult when there are a large number of members in the group, as in this instance.

Conclusions

No defects were found that could have explained the failure of the engine to respond to the throttle. The weather conditions at the time indicated that severe carburettor icing could be expected at any power setting. The aircraft was being operated at low throttle settings during the PFLs, which would have rendered it more susceptible to carburettor icing. The most likely cause of the accident is therefore believed to be carburettor icing. There was no system fitted on the aircraft which could have warned the pilot of the formation of carburettor icing, although several such systems are commercially available at relatively low cost.