AAIB Bulletin No: 7/2005 **Ref: EW/G2005/04/07** **Category: 1.3**

INCIDENT

Aircraft Type and Registration:	Cessna F152, G-BHFC
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1978
Date & Time (UTC):	19 April 2005 at 1100 hrs
Location:	Near Hardwick Airfield, Norfolk
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Significant damage to the engine, minor damage to the airframe structure
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	39 years
Commander's Flying Experience:	4,451 hours (of which 1,153 were on type) Last 90 days - 133 hours Last 28 days - 36 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

History of flight

The aircraft had completed two stalls without incident as part of a Private Pilot's Licence renewal. On application of full power for a third stall recovery at an altitude of 3,000 feet, the pilot noticed severe airframe vibration which appeared to be coming from the engine. The pilot made a MAYDAY call to Norwich Approach and started to look for a suitable location for a forced landing. Shortly afterwards the pilot reported seeing some pieces of the engine departing the aircraft through the cowling and, a few moments later, there was a loud bang and the propeller stopped rotating.

The pilot subsequently completed a forced landing at Hardwick, a disused American wartime airfield, with no further damage to the aircraft and with no injury to the pilot or the student.

Engine Description

The Lycoming O-235-L2C engine is a flat four engine and has a single camshaft on which there are six cams that drive eight followers (cam Nos 2 and 5 drive two followers each, the remaining cams drive only one follower). This engine was operating on an extension, at some 2,600 hours, to its nominal 2,400 hour engine life.

Engine examination

The engine was removed and the bare engine was returned to the AAIB in Farnborough for detailed strip examination. This revealed several significant areas of damage, the most notable of which was to cylinder No 4 (aft left) which had failed around its base where it attached to the crankcase. The fracture surfaces were heavily damaged in the failure and this precluded their detailed examination. All four of the cylinders had evidence of pitting corrosion but due to the size and pitch of the cooling fins, it was not possible to make an accurate assessment of its extent.

There was extensive damage to the lower portion of piston No 4 below the centre line of the gudgeon pin, the piston had seized inside its cylinder and the connecting rod had failed approximately half way along its length. Both the upper part of the connecting rod and the gudgeon pin were found in the oil sump. The remaining part of the connecting rod (attached to the crankshaft) had been subject to significant abnormal loads and was severely twisted. There was also some damage to cylinder No 3 in the region of its base (this is opposite to cylinder No 4).

The crankcase was cracked over a length of approximately 6 cm and this was approximately 2 cm wide at its widest. There was extensive internal damage to the crankcase over an area of approximately 5 x 15 cm in which most of the crankcase structure that formed the 'roof' of the oil sump had broken away. Both the crack and the internal damage were located opposite cylinder No 4 and were likely to have been caused by the remaining part of the No 4 connecting rod that had become detached from piston No 4.

Inspection of the camshaft, and subsequent measurement of the dimensions of the six cams, revealed that two of the cams were significantly worn and that their respective cam followers were pitted and worn. The height to width ratio for cam Nos 1, 3, 4 and 5 were found to be in the range of 1.30 to 1.32, but the ratios for cam Nos 2 and 6 (the two cams with significant wear) were 1.15 and 1.20 respectively. Whilst such wear is unlikely to have been a major factor in the engine failure, it is likely that the resultant reduction in valve lift would have caused some loss of engine performance.

It was concluded that the most likely cause of the engine failure was the failure of cylinder No 4 due to pitting corrosion induced fatigue cracking around the base of the cylinder, and that this allowed the cylinder to break free and subsequently cause all the observed damage.

The French DGAC have reported a significant number of cylinder barrel failures on Lycoming O-235 engines, including the -L2C mark, and these failures had been initiated by corrosion pits near the base area of the cylinder. As a result of this, Textron Lycoming issued Service Instruction No 1504 in January 2001, in which the replacement of the cylinder assemblies with new assemblies, with improved corrosion resistance, was recommended.