

Cessna 152, G-BNKP

AAIB Bulletin No: 2/0000 **Ref: EW/C99/05/04** **Category: 1.3**

Aircraft Type and Registration: Cessna 152, G-BNKP

No & Type of Engines: 1 Lycoming O-235-L2C piston engine

Year of Manufacture: 1978

Date & Time (UTC): 27 May 1999 at 1530 hrs

Location: Clacton Airfield, Essex

Type of Flight: Private (Training)

Persons on Board: Crew - 2 - Passengers - None

Injuries: Crew - None - Passengers - N/A

Nature of Damage: Severe damage to the engine

Commander's Licence: Commercial Pilot's Licence with Assistant Flight Instructor Rating

Commander's Age: 26 years

Commander's Flying Experience: 616 hours (of which 308 were on type)

Last 90 days - 101 hours

Last 28 days - 28 hours

Information Source: AAIB Field Investigation

Following a pre-flight briefing of the student, the instructor made all the necessary checks including the fuel and engine oil contents and found them to be normal.

Following a normal take off, with the student handling, the aircraft had turned crosswind and was in a climbing left turn at 850 feet, intending to level at 1,000 feet to commence the downwind leg, when the engine 'coughed'. The instructor took control immediately and within two seconds the propeller had stopped in the horizontal position. He completed the engine failure drill and attempted to restart the engine, but without success. He then contacted Clacton, declaring an engine failure, and then turned the aircraft into wind and selected a wheatfield which was of a suitable length for a forced landing. He selected flap and conducted a successful landing in the field. He then contacted Clacton again and informed them that the forced landing had been successful and that there were no injuries.

The aircraft was subsequently recovered to the operator's engineering facility where an examination of the engine revealed substantial damage to the No 4 cylinder and piston which appeared to have been caused by the No 4 inlet valve having fallen into the cylinder.

Metallurgical examination of the No 4 cylinder, piston and related components revealed that the event had been initiated by fatigue failure of the inlet valve spring cap which had allowed the valve's keys (or 'collets') to disengage from the key-way in the top of the valve stem. Once the keys had disengaged, the valve had dropped into the combustion head of the cylinder. Microscopic examination of the fractures showed that two cracks had initiated at the lower inboard edge of the spring cap, almost diametrically opposite each other and in line with the split between the valve's keys. These two cracks had extended by a tensile fatigue mechanism until final failure of the spring cap had occurred. It was not possible to determine the number of cycles over which the crack had propagated. No defects were found associated with the material of the spring cap or its manufacture which may have initiated the cracks.

All of the other spring caps from the engine were examined, but no other cracks were found. Various mechanisms for initiating the cracks were considered, including the possibility that the No 4 inlet valve tappet may have been maladjusted, at some time, to an extent that would have put the valve spring into a 'coil-bound' situation, resulting in a direct mechanical force from the cam shaft being applied to the top of the spring cap via the two keys.

An engine overhaul organisation was therefore requested to check if it was possible to adjust a tappet to the extent that the valve spring would become coil-bound. However, although they found that such adjustment was possible, the degree of maladjustment would have been extremely obvious and the tappet adjustment thread would have been clearly 'out of safety'.

A cylinder repair and overhaul facility was therefore consulted. They confirmed that they had encountered cracked valve spring caps, which had been associated with engines that had been returned for inspection checks following instances of overspeeding. In such cases more than one spring cap had been found cracked and these were found on one side, with the front cylinder spring cap showing more damage than the rear cylinder.

This engine had been overhauled 'to zero hours' in May 1998 and had subsequently achieved 447 hours up to the time of this incident. During that overhaul, all of the spring caps had been inspected and found to be serviceable before they had been refitted to the engine.