

**No:** 12/91

**Ref:** EW/G91/06/23

**Category:** 1b

**Aircraft Type and Registration:** Piper PA-23-250, G-TTEL

**No & Type of Engines:** 2 Lycoming IO-540-C4B5 piston engines

**Year of Manufacture:** 1969

**Date & Time (UTC):** 21 June 1991 at 1520 hrs

**Location:** 15 nm NW of Le Touquet, France

**Type of Flight:** Private

**Persons on Board:** Crew - 1                      Passengers - 1

**Injuries:** Crew - None                      Passengers - None

**Nature of Damage:** One cylinder detached from right engine, impact and fire damage to cowlings, wing de-icing boot burned.

**Commander's Licence:** Private Pilot's Licence with Instrument and Night ratings

**Commander's Age:** 37 years

**Commander's Flying Experience:** 595 hours (of which 310 were on type)

**Information Source:** Aircraft Accident Report Form submitted by the pilot and engine examined by AAIB.

The aircraft had departed from Le Touquet for Lydd and the pilot was making the transition from climb to cruise at 3000 feet. The cowl flaps had been closed and power reduced to the cruise setting (22 inches Hg) when the instrument panel began to vibrate. Within a few seconds the manifold pressure on the right engine began to fluctuate. The fuel cocks, pumps and the magneto switches were checked for correct selection. Meanwhile, the vibration became severe, affecting the whole airframe, and the passenger saw fire from the outboard side of the right engine nacelle. The right mixture control was shut off and the propeller feathered. During this time the aircraft had banked to about 50° and on recovery to wings level it was seen that the fire was out. An emergency was declared and a successful single-engined recovery was made to Le Touquet.

The pilot-in-command was familiar with the aircraft, having flown it for the previous 30 months, and in the days prior to the accident there had been no untoward temperature or pressure variations. However, following the previous two or three flights there had been a tendency for the right engine to "run on" after shut-down.

On inspection after the landing it was seen that the right engine's rear outboard cylinder (No 5) had detached but was still lying within the damaged cowling. The short-lived fire, probably fed from a ruptured fuel injector pipe, had caused damage inside the cowling and had partially consumed the inboard end of the leading edge de-icing boot. The aircraft was eventually shipped to the UK for repair and the opportunity was taken by AAIB to examine the engine.

On initial inspection it was noted that the alternator mounting bracket was loose allowing the alternator some free movement and also that one of the cylinder base nuts on the No 6 cylinder was loose and had backed-off sufficiently for some stud threads to be exposed.

Each cylinder base flange is attached to the crankcase by eight studs (four  $\frac{1}{2}$  inch and four  $\frac{3}{8}$  inch diameter) with a hold-down plate on top of the flange under each group of four nuts (top group and bottom group comprising two  $\frac{1}{2}$  inch and two  $\frac{3}{8}$  inch nuts) Of the studs exposed by the missing cylinder, five were intact but with varying degrees of secondary damage. None showed any evidence of thread stripping either of the stud or the nut. Three studs had fractured; two adjacent small studs and one large stud almost diametrically opposite them. The failed studs showed some indications of fatigue in their fractures; the small studs had failed in the plane of what would have been their first loaded threads and the large stud had failed in the necked area between the crankcase engaging thread and the nut engaging thread. The detached portion of the large stud was found in the engine compartment with its nut and one of the small studs was also found with its nut. These nuts as seen were fully engaged on their studs and did not appear to have unwound on their threads to any large extent. This evidence indicates that five nuts fully disengaged from their studs before the cylinder detached. The remaining three studs finally failed in fatigue.

The torques of the nuts on the remaining cylinders were checked by marking the positions of the nuts, releasing them and then re-tightening them to the previously scribed mark. The prescribed torque for the small nuts was 25 ft-lbs. Of the 20 nuts checked, 15 gave torques of 20 ft-lbs or less and nine gave 15 ft-lbs or less. The prescribed torque for the large nuts was 50 ft-lbs and six check torques out of 20 were found to be 35 ft-lbs or less (two of these being loose). Of the remaining large nuts the majority approximated to the book torque but with three it would have required a very high torque (greater than 70 ft-lbs) to restore their as found condition. Therefore, while the small nuts showed generally low torque the large nuts showed a majority correctly torqued but with extremes of overtorquing or looseness. In the specified sequence in the relevant Avco Lycoming Textron Service Instruction, No 1029D, the large nuts and the small nuts are tightened in separate groups; the large nuts are installed and brought up to half torque, the small nuts are brought up to full torque, the large nuts are then fully torqued and the small nuts are finally checked at full torque. Provision is made on the nuts for wire locking but its use is optional ( S.I. No.1029D ) and it had not been employed here.

nuts are then fully torqued and the small nuts are finally checked at full torque. Provision is made on the nuts for wire locking but its use is optional ( S.I. No.1029D ) and it had not been employed here. During the partial strip of the engine nothing was seen to indicate that there had been any cause of unusual vibration or distressed running within the engine.

One known cause of loss of torque is the mistaken application of paint between the clamped surfaces of the hold-down plate, cylinder flange or crankcase. There was no evidence that this had occurred here; the residue of a light primer coat was found on the hold-down plate but this was not considered significant.

The engine's final log book recorded that the engine had accumulated 1521 operating hours since overhaul at some time before March 1980 and no subsequent maintenance was recorded which would have entailed disturbing the cylinder base nuts.