No: 11/92 **Ref: EW/C92/5/3** **Category: 1c**

Aircraft Type and Registration:	Partenavia P68 Victor, G-HPVC
No & Type of Engines:	2 Avco Lycoming IO-360-A1B piston engines
Year of Manufacture:	1973
Date & Time (UTC):	9 May 1992 at 1608 hrs
Location:	Near Bournemouth Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Severe damage to right engine, fire damage to right engine bay, nacelle fairing, wing, flap and tailplane
Commander's Licence:	Private Pilot's Licence with IMC and Night Ratings
Commander's Age:	48 years
Commander's Flying Experience:	254 hours (of which 11 hours were on type) Last 90 days - 14 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB Field Investigation

The pilot and two passengers had arranged to hire the aircraft for a proposed flight to La Rochelle and return. At about 0900 hrs they collected the aircraft from its hangar on the north side of Bournemouth Airport and, after engine run up checks had been completed satisfactorily, it was taxied to the international arrivals and departures Terminal apron. There it was refuelled to full tanks, and the pilot checked and replenished the engine oil.

The weather conditions both at Bournemouth and La Rochelle were not good, with heavy rain showers and high winds, and the pilot and his passengers elected to remain at Bournemouth hoping for a possible improvement. When this did not materialise by mid-afternoon, they decided instead to fly to Plymouth and the aircraft was booked out with Bournemouth ATC for a VFR flight. They boarded the aircraft and one of the passengers, who held a Private Pilot's Licence (A) and Radio-telephony Licence (VHF) occupied the front right side seat and assisted the pilot by operating the radios. All outside, pre-start and engine run up checks were again carried out satisfactorily and taxi clearance was obtained. At 1601 hrs ATC cleared the aircraft to take off from Bournemouth runway 26.

The pilot reports that the take off and acceleration were normal, flap retraction was carried out at 500 feet following which the after take-off checks, which include switching off the electric fuel pumps, were carried out. Shortly after the aircraft was established at 1,500 feet in the cruise there was an explosion in the right side engine, flames were observed to be emitting from the cowling and the whole aircraft vibrated violently. The pilot immediately turned off the fuel supply, shut down the engine and feathered the propeller. At the same time (1608 hrs) the passenger in the right seat transmitted a MAYDAY call to Bournemouth ATC advising them of the emergency. As flames were still visible the pilot then dived the aircraft to increase speed in an attempt to blow out and extinguish the fire. This was successful and the aircraft was levelled at about 250 feet agl heading back towards Bournemouth Airport, whilst the pilot looked for suitable fields should a forced landing become necessary. In the event the aircraft maintained height and speed comfortably on one engine, and the flight back to Bournemouth was continued at 250 feet.

Immediately the Bournemouth ATC controller received the MAYDAY call, he declared a full emergency. Three appliances from the Airport Fire Service were on station within 2 minutes. When the aircraft approached the circuit area the controller cleared the pilot to land anywhere on the airfield. The pilot reports that due to the strong surface wind conditions he preferred to land on runway 26. He climbed the aircraft to 450 feet and positioned for a short final approach from which he landed the aircraft without further incident at 1618 hrs. A special weather observation made immediately after the landing recorded the surface wind as 260°/22 kt gusting to 32 kt.

The Partenavia P68 is a high-wing monoplane with an engine mounted on each wing in front of the wing torque box. The engines are four cylinder, horizontally opposed, Avco Lycoming IO-360-A1B units, rated at 200 hp at 2700 RPM, driving constant-speed two-bladed propellers. Each engine is contained in an aluminium cowl, the aft end of which joins with aluminium and glass reinforced plastic (GRP) fairings attached to the undersurface of the wing. Two integral fuel tanks are incorporated in each wing torque box, separated by a dry bay in the section of the box immediately behind each nacelle. The aluminium wing torque box forward spar and undersurface within the engine bay are clad externally with stainless steel sheeting for protection from engine bay fires.

Inspection showed that the right engine had been very severely damaged, with large holes in the crankcase top and bottom, revealing gross internal disruption of the rear half of the engine. There was also considerable engine bay fire damage, concentrated in the aft outboard corner and indicative of fairly brief exposure to a quite intense fire. Parts of the engine cowling panels had been burnt away (Figure 1), including an area in the bottom cowl in the region of the overboard drain from the engine-driven fuel pump. Fire overheat had also caused extensive holing of the aluminium cowl/wing fairing and of the right flap; local scorching of the forward spar, undersurface and rear spar of the wing torque

box; and paint removal, skin scorching and de-icer boot blistering on the right tailplane. The evidence indicated that the stainless steel fireshield had probably reduced the severity of the fire damage to the primary structure of the wing, but that unprotected parts of the torque box external to the engine bay had been impinged and significantly overheated by fire that had burnt out of the engine bay through the aluminium cowl panels.

The fire had externally damaged a number of fuel system components in the engine bay but had not breached the system. However, there were signs indicating that fuel had probably been released via the engine-driven fuel pump overboard drain. The pump plunger had overtravelled, possibly due to interference with the operating mechanism by debris from the engine break-up, causing stretching of the rubberised diaphragms of the pump that could have interconnected the fuel and drain chambers.

No 2 engine strip examination showed that parts of the No 4 piston had broken off, causing separation of the piston from its gudgeon pin and hence from its connecting rod, which remained attached to the crankshaft. In addition, the No 3 connecting rod (Part No 75484) had fractured near the small end (Figure 2). The fracture showed clear signs of extensive transverse fatigue cracking that had extended over approximately 50% of the I-shaped cross section from a position close to one flange corner (Figure 3), before the remainder had failed under overload. Specialist examination concluded that the failure had been caused by fatigue cracking that had originated from a relatively large discontinuity in the material that was apparent on the connecting rod surface (Figure 4).

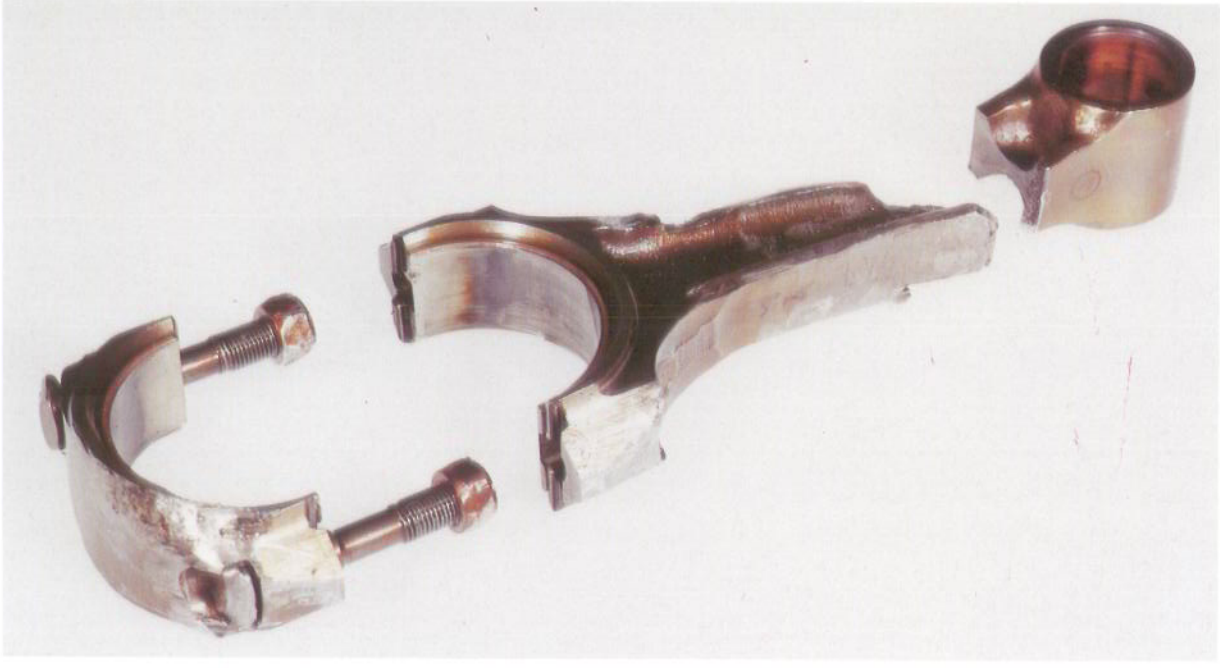
Microsectioning through the fatigue origin and X-ray spectra analysis revealed a number of folds in the material with included layers of steel oxide and decarburised material. The defect had clearly originated at manufacture either as a result of an inclusion from the original melt material or from a lap, or fold, of surface oxidised material at the forging stage. The surface marking caused by the defect was readily visible without magnification as a linear ridge several millimetres long and raised approximately 0.1 mm.

Thus the evidence was consistent with the No 3 connecting rod having fractured after suffering extensive long term fatigue cracking as a result of an undetected material defect and with the flailing long end of the rod having jammed the No 4 piston, causing overload failure of its gudgeon pin attachments. Extensive internal and crankcase damage had been caused by impact from the No 3 and No 4 connecting rods, flailing on their big end bearings as the crankshaft rotated.

It was not possible to establish the history of either of the aircraft's engines, as Aircraft and Engine Log Book entries did not coincide with the identifications on the data plates attached to the engines. The Log Books indicated that the failed engine (SN L-6945-51A) had been installed in the left

position, whereas it was found in the right position; and identified the right engine by a serial number that did not correspond to the data plate identification of either engine found installed. Exhaustive inspection of other records, including invoices and Certificates of Release to Service for replaced engines, cylinders and pistons, together with checks of a similar aircraft that had been under repair for a considerable period in the hangar in which G-HPVC had been maintained, failed to resolve the confusion.

Right Engine (viewed from right underside) Figure 1



Right Engine No. 3 Connecting Rod Figure 2

No. 3 Connecting Rod Fracture Figure 3

Material Defect at Connecting Rod Fracture Origin Figure 4