AAIB Bulletin No: 6/94	Ref: EW/G94/03/14	Category: 1.3

Aircraft Type and Registration:	Piper PA-28R-200 Cherokee Arrow II, G-BDKV	
No & Type of Engines:	1 Lycoming IO-360-C1C piston engine	
Year of Manufacture:	1973	
Date & Time (UTC):	27 March 1994 at approximately 1500 hrs	
Location:	Elmer Sands, near Bognor, West Sussex	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Extensive mechanical damage to engine and further airframe damage from ditching	
Commander's Licence:	Private Pilot's Licence with IMC Rating	
Commander's Age:	38 years	
Commander's Flying Experience:	187 hours (of which 12 were on type) Last 90 days - 7 hours Last 28 days - 4 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB examination of engine and airframe	

The aircraft was returning from Bembridge to Southend with the pilot and one passenger on board and was tracking towards the VOR beacon at Seaford. Checks before takeoff had been normal, including the engine oil temperature and pressure.

About 10 minutes into the flight, while cruising at 2,500 feet at 2,400 RPM and 24 in Hg manifold pressure, the pilot felt vibration through the control column and heard the engine running rough. He immediately changed fuel tank and selected fuel boost pump 'ON' but the vibration was worsening with a "clattering" sound. The pilot noted that the engine oil pressure was dropping rapidly and he turned towards land, making a MAYDAY call to London Information and attempting to find a power setting that would reduce the very severe vibration.

The pilot considered that he still had sufficient engine power to reach land and requested vectors for Goodwood. London Information requested a change to the 121.5 MHz frequency for Distress and Diversion guidance; the pilot changed frequency and make another MAYDAY call, selecting

transponder code 7700. By this time the aircraft was passing 1,500 feet and the vibration was such that the instruments were difficult to read. With almost no oil pressure and smoke coming from the engine, the pilot assessed that the aircraft would not reach the land and sought a suitable area of the coastline for a forced landing or ditching. At this point the automatic landing gear functioned; the pilot considered overriding the system but was too absorbed in finding a place to set the aircraft down.

Closer to the coastline, it was evident that the beach was steep and shingled so the pilot decided to ditch in the water, as close to land as practicable. Anxious not to stall, and very conscious of airspeed, he lined up parallel to the beach, unlatching the door and requesting the passenger to open it. In the last few feet of the approach he put the aircraft into a steep nose-up attitude. In the event, the aircraft rapidly came to a halt in the water, upright with both the occupants' lap and torso restraints intact. The pilot and the passenger both left the cabin through the door, onto the right-hand wing and then swam ashore, some 40 to 50 metres, assisted at the end by people on the beach.

The aircraft was later recovered from the shallow water and was examined. It was apparent that massive damage had occurred at the No 3 engine cylinder. Figure 1 shows the cylinder as found, with a complete fracture through the cylinder barrel and damage to the piston, and Figure 2 shows the connecting rod from this cylinder. The bearing cap and both big end bolts from the connecting rod were found in the engine's oil sump: one of the big end bolts had failed purely in tension, the bearing cap had then 'unwrapped' and the other bolt failed in bending. The state of the bearing surfaces throughout the engine indicated that they had been well lubricated and that loss of lubrication had not been a cause of failure.

Overall, the nature of the damage showed that the initial failure had been the circumferential fracture of the barrel section of the No 3 cylinder and the additional damage to the engine had resulted from continuing rotation of the crankshaft.

Detailed metallurgical examination of the circumferential fracture showed that it had initiated from a fatigue crack in the area marked 'A' in Figure 1. This crack had then progressed around the circumference of the barrel until complete separation occurred. Microscope examination of the fatigue initiation region showed that the crack had started at a point of surface pitting and that there were further oxidation products on the outer surface of the barrel.

The recent maintenance records for G-BDKV showed that, up to the time of the accident, the aircraft had accumulated just over 1,535 hours of operation (502 since 'top' overhaul), identical to the hours recorded for the airframe. The airframe manufacturer confirmed that the aircraft had been delivered from the factory in 1973 and that the engine installed during manufacture had been a Lycoming

IO-360-C1C with the same serial number as the engine installed at the time of the accident. The engine had, therefore, accumulated the 1535 hours in a span of 21 years and had not been subjected to a major overhaul within that time. The recommended TBO (Time Between Overhauls) for this engine is 2,000 hours.

In July 1992 the engine manufacturer issued a Service Instruction (No 1009AJ) entitled 'Recommended Time Between Overhaul Periods'. This document confirmed the recommended TBO for this model of engine as 2,000 hours but included the following provision, for the full range of reciprocating engines:

> 'Because of engine deterioration in the form of corrosion (rust), drying out and hardening of composition materials such as gaskets, seals, flexible hoses, fuel pump diaphragms and abnormal wear during starting on soft metal bearing surfaces due to the loss of a protected oil film during prolonged periods of inactivity, all engines that do not accumulate the recommended operating hours between overhaul in a twelve year period must be overhauled in the twelfth year.'

As to whether or not this constitutes a recommendation the engine manufacturer's index of Service Bulletins, Letters and Instructions, states that Service Instructions:

> '...describe modification, processes and other information pertinent to maintenance, repair and overhaul of Textron Lycoming engines...'

whereas Service Bulletins:

> '...describe mandatory procedures that must be observed for safety reasons and are readily identified by the mandatory heading printed in red.'

However, Section 3 (General Inspection Standards) of the CAA's 'Light Aircraft Maintenance Schedule Fixed Wing' (LAMS) states:

> 'Overhaul, Test Periods and Published Retirement Lives relating to aircraft parts, engines, propellers, instruments and accessories shall normally be those recommended by the Constructors/Manufacturers and those required by the recognised Airworthiness Authority of the country of origin.'