

No: 11/88

Ref: EW/C1069

Category: 1b

Aircraft Type and Registration: Max Holste Broussard 1521, G-BKPU

No & Type of Engines: 1 Pratt & Whitney R985 AN-4 piston engine

Year of Manufacture: 1960

Date and Time (UTC): 7 June 1988 at 1730 hrs

Location: M62 Motorway near Barton Airfield, Manchester

Type of Flight: Private (pleasure)

Persons on Board: Crew - 2 Passengers - None

Injuries: Crew - None Passengers - None

Nature of Damage: Damage to propeller, cowlings, landing gear, right wing and tail

Commander's Licence: Private Pilot's Licence

Commander's Age: 26 years

Commander's Total Flying Experience: 1800 hours (of which 33 were on type)

Information Source: AAIB Field Investigation

History of Flight

On the evening of 7 June 1988, G-BKPU was prepared for a local flight from Liverpool Airport. The purpose of the flight was to familiarise a prospective purchaser with the handling of the aircraft. The captain who was the owner of the aircraft and held a Private Pilot's Licence with an Instructor's Rating, occupied the right-hand seat and the other pilot, who also held a Private Pilot's Licence, occupied the left-hand seat. The weather was fine with a light north-easterly wind. Before take-off, some oil was noticed on the windscreen but neither pilot considered that it warranted any action. Following an uneventful take-off during which the engine and propeller functioned normally, some minutes were spent in the local area before it was decided to visit Barton. Liverpool ATC was informed and G-PU set course for Barton. On approaching Barton, some 20 minutes into the flight, an adjustment to the engine controls resulted in a significant increase in the amount of oil on the windscreen. The captain was unconcerned but the pilot in the left-hand seat thought that he might have problems with visibility for landing. Shortly after this, Barton radio passed the airfield information which gave the landing runway as 09 with a left hand circuit.

When cross-wind at a height estimated by ground observers to be about 500 ft agl, the captain selected the propeller control to fully fine as part of his pre-landing checks. Coincident with this action, the windscreen and side windows became covered with a large quantity of oil which totally obscured both

pilots view of the outside world. The operation manual recommends that under these circumstances the propeller be selected to coarse pitch to reduce the flow of oil. The captain did not execute this procedure because he considered that configuring the aircraft for an immediate landing ie fine pitch was his priority in the prevailing circumstances. Both pilots opened their direct vision panels which enabled them to see the ground abeam the aircraft but no forward vision was possible because of the large amount of smoke that was by now streaming back from the engine. The presence of smoke led the crew to believe that the aircraft might be on fire. Since the pilot in the left-hand seat could see towards the runway, it was decided that he should retain control and attempt to position the aircraft for a landing on runway 09. The captain made a radio call requesting priority in the circuit but the radio operator in the control tower received only carrier wave and assumed the call to be the captain's downwind report and replied accordingly. The aircraft's permanent radios were not functioning and a hand held transceiver was being used by the pilot. Previous radio communications had been satisfactory.

When it was judged that G-PU was at the end of the downwind leg, a turn onto base leg was initiated and a descent commenced. After turning towards the estimated position of the runway 09 threshold, the captain realised that he was high and selected full flap. It then became apparent to him that not only was the aircraft too high but that it had also flown through the runway centre-line and he judged that, because of the presence of houses in the over-run area of runway 09, a safe landing could not be made. He therefore elected to go-around and increased power. The engine responded normally but the aircraft failed to either climb or accelerate. G-PU was now at a height estimated to be between 200 and 300 ft agl and the captain decided to retain full flap for a further circuit. During the subsequent left turn and downwind leg the aircraft was observed to be steadily losing height and the radio operator in the control tower alerted the emergency services in anticipation of a crash. G-PU continued its turn towards the airfield at a very low altitude but the crew did not have enough visual reference to determine their position. When it became apparent to the handling pilot that he was very close to the ground, he levelled the wings and waited for the inevitable impact.

G-PU struck a stand of small trees on the top of the M62 motorway embankment while on a heading of 180°, it then struck a motorway sign and several vehicles before coming to rest on the hard shoulder on a westerly heading. Neither pilot was aware that they had landed on the motorway until they vacated the aircraft. Neither pilot was injured but a car passenger sustained serious injuries.

Examination of Aircraft

The aircraft was examined after it had been removed from the motorway. The front of the engine, the cowlings, cockpit transparencies and the wing leading edges inboard were covered in a film of oil. When the oil contents were measured it appeared that 6 to 7 litres had been lost. Oil was found puddled inside the spinner. Also, lying loose inside the spinner, was the locking ring for the end cap on the propeller actuating cylinder. (See diagram). The disengagement of the ring was later dismissed as irrelevant and a result of the hammering crash loads suffered by the propeller. The cylinder cap itself was still tight.

The phenolic bush was found loose on the propeller shaft having been ejected rearwards from its location in the actuating cylinder.

The engine and propeller were removed and taken to an overhaul agent for dismantling and detailed examination. The main investigation concerned the propeller, a Hamilton Standard 2D-30-237, which had evidently suffered an internal failure but other possible contributory problems were considered. The propeller governor was rig tested and was found to behave normally and within limits. Two valve pushrods were removed from the engine and examined for evidence of overspeeding. None was found. Other than the propeller no other source of an oil leak was found on the engine.

When the end cap of the propeller actuating cylinder was removed debris was found inside which proved to be fragments of the outboard leather gasket (oil seal). One portion was jammed between the actuating cylinder and the fixed piston on to which the gasket pair is normally clamped by a ring nut. Other portions were loose in what had been the oil filled, pressure side of the actuating system. One

fragment had a sliver of the phenolic bush pressed into it. Other fragments of phenolic were found on both sides of the seal location.

When the hub was further dismantled the inboard gasket was found to be out of its locating groove having moved aft on the fixed piston. This gasket does not function as a seal but provides a sliding surface between the cylinder and fixed piston. Its sliding surface was in good condition and undamaged but the internal lip by which it would normally be clamped did show some distortion and variation of lip depth. It was considered that the gasket had been forced out of its normal position by oil pressure following loss of clamping load occasioned by the break-up of the outboard seal. The distortion seen could have been the result of the gasket being forced over the lip on the fixed piston rather than an indication of its pre-existing condition.

The phenolic bush was examined and, again, its condition suggested that it had been damaged and dislodged following the failure or partial failure of the seals. It had suffered break-up of both outboard and inboard edges most probably caused by "cocking" of the cylinder once it was not properly restrained by the leather gaskets at its forward end. The fact that this damage was evenly distributed around the circumference indicates that the bush was in position in the cylinder when this damage was sustained. The bearing surface of the bush appeared to be in good condition. Measurements showed that the bush was within wear limits and had not suffered uneven wear. Attached to the outside surface of the bush there were beads of adhesive which had been keyed into grooves in the inside surface of the cylinder. Similarly, some adhesive was still sticking to the cylinder surface and in the grooves. This evidence suggested that there had not been an initial failure of the adhesive which had allowed the bush to be displaced. It is most probable that the edge loading on the bush caused shear loads which disrupted the adhesion and, aided by the outward flow of oil, ejected the bush. The bush had suffered two, diametrically opposite, axial fractures but the above evidence on the edge damage implies that these are subsequent to that damage and were incurred when the bush was ejected from its location.

The most probable sequence, therefore, leading to the anomalies found in the propeller hub is, firstly, the break-up of the outboard leather seal, secondly the displacement of the inboard gasket by oil pressure following the loss of clamping loads and, coincident with the disruption of the gaskets, the damaging and ejection of the phenolic bush. The rest of the propeller pitch change system was examined for anything which could have caused excessive or asymmetric loading on the actuating cylinder but none was found.

One puzzling aspect of the evidence is the presence of phenolic debris on the pressure side of the gasket assembly. It can only be surmised that fragments from the forward edge of the bush, had been picked up by the seals and transported as the seal moved through its stroke over a number of cycles.

Aircraft Maintenance History

The aircraft had been operated by the French Air Force before being imported into the UK and put on the civil register. The propeller had been overhauled in 1965, stored until 1981 and then installed on G-BKPU. When the aircraft was imported in 1983 the propeller (with 241 hours usage) was dismantled for inspection in accordance with Airworthiness Notice 75 during the work required for the issue of a Permit to Fly. It is not known whether the gaskets were renewed at that time. It was again subjected to AN75 in February 1987. At that inspection the gaskets were considered fit for further use and were re-installed. In the 16 months following that inspection the aircraft performed 75 hours flying. It had two major periods of inactivity between the end of October 1987 and the end of January 1988 and in the month of March 1988.

There is no requirement, either in AN75 or in the Manufacturer's instructions for such gaskets to be renewed at major inspections or when disturbed. The manufacturer recommends that they be replaced only if there is evident oil leakage or if their condition appears suspect through wear, fraying or oil soakage. The manufacturer's instructions also contain the following warning.

Warning

Under no circumstances should the piston gaskets be soaked in oil. Preoiling can soften the portion of the gasket under the retaining nut sufficiently to cause failure of the gasket and serious oil leakage from the propeller. Gaskets that have been preoiled or are otherwise not in satisfactory condition are to be replaced.

An FAA approved modification is available to replace the leather seal assembly in this family of propellers with an assembly employing "O" rings.

There was a current Certificate of Registration and a current Permit to Fly for the aircraft and it had been certified as fit for release to service following its last annual inspection for renewal of the Permit to Fly 4 months and 20 flying hours before the accident.

G-BKPU

PROPELLER PITCH CHANGE MECHANISM

