

Piper PA-24-250, G-BUTL

AAIB Bulletin No: 5/99 Ref: EW/C98/10/5 **Category: 1.3**

Aircraft Type and Registration: Piper PA-24-250, G-BUTL

No & Type of Engines: 1 Lycoming O-540-A1D5 piston engine

Year of Manufacture: 1960

Date & Time (UTC): 15 October 1998 at 1712 hrs

Location: Lasham Airfield, Hampshire

Type of Flight: Private

Persons on Board: Crew - 1 - Passengers - None

Injuries: Crew - None - Passengers - N/A

Nature of Damage: Moderate damage to underside of fuselage, undercarriage and propeller

Commander's Licence: Private Pilot's Licence

Commander's Age 60 years

Commander's Flying Experience: 1,900 hours (of which 274 were on type)

Last 90 days - 80 hours

Last 28 days - 18 hours

Information Source: AAIB Field Investigation

Flight history

The pilot was on a flight from Bembridge to Blackbushe. On entering the circuit at Blackbushe the pilot attempted to lower the landing gear using the electrically operated transmission system. The landing gear failed to fully extend and the electric transmission motor circuit breaker for the landing gear tripped.

The pilot informed the tower at Blackbushe that he would fly to the west and try to lower the gear using the manual system. However, on releasing the motor from the transmission screw and attempting to operate the manual system, the landing gear still failed to fully extend. He discussed the problem using the radio with an engineer from his maintenance company at Lasham airfield but this did not succeed in solving the problem. He then resolved that the best solution was to divert to Lasham, during which time he continually attempted to lower the landing gear using the manual

telescopic lever without success. The pilot noted that the stiffness of the mechanism increased with repeated attempts to lower the gear via the manual system.

The pilot contacted Lasham ATC and explained the nature of the problem and his intention to perform an emergency landing. He made one fly past of the airfield in order for the emergency services to assess the situation. The gear was reported to be partially deployed. He then flew an approach for Runway 09 and performed a successful emergency landing. The runway conditions at the time were dry. Fire and ambulance emergency services were in attendance but were not required. The pilot, who was wearing a lap and diagonal harness, safely vacated the aircraft.

Landing gear retraction system

The landing gear is a tricycle type, fully retractable through an electrically operated retraction mechanism. The retraction/extension mechanism consists of an electric motor and transmission assembly, torque tube assembly, push-pull cables for each main landing gear (MLG) and a push-pull tube to the nose gear (Figure 1). Limit switches are installed in the system to shut off the motor when the gear is fully extended or retracted. These switches also operate landing gear indicator lights on the instrument panel.

When the landing gear selector switch is placed in the down position the motor operates the transmission. The transmission rotates the torque tube assembly causing the torque arms to move back, which pushes on the MLG cables and pulls on the nose gear tube extending the landing gear. When the landing gear is fully extended, the landing gear down switches stop the motor and the green gear down and locked indicator on the instrument panel illuminates.

In the event of a problem with the electric transmission system then it is possible to disconnect the retraction transmission motor by pulling on an emergency release lever in the cockpit. This action releases the motor from the transmission screw and allows for the use of an emergency telescopic extension lever which is pushed forward to manually lower the gear.

Aircraft examination

The aircraft was recovered to the maintenance hangar where a full examination was undertaken by the maintenance engineer. The transmission motor was found to be serviceable. The push-pull control cables and rods were removed and examined. It was found that the right MLG outboard sliding sleeve guide had detached from its swaged housing to the fixed sleeve (see Figure 2). The push-pull cables were tested by hand. The cable that operates the right MLG was found to be very stiff and a significant force was required to move it through its limits of travel. The left hand MLG push-pull cable required a considerably smaller force to operate. The landing gear, once detached from the push-pull control cables and rods, was found to be free from obstruction and easily swung down into the extended position.

The push-pull cables were taken back to the AAIB for further investigation. The inner cables were removed from the fixed sleeves and examined. It was found that the right hand cable had kinks at either end at a point where its limits of travel in each direction would be coincident with the position of the swaged joint used to join the fixed sleeve to the sliding sleeve guide.

Radiographs of both of the fixed sleeves showed no evidence of broken strands on the inner surface. The stiffness of the right hand push-pull cable therefore appeared to be associated with the kinks in the cable as both the left and right hand cables appeared to be in a similar condition in terms of

wear and lubrication. These kinks should not normally occur with the sliding sleeve guide properly in place. The only way the guide sleeve can come free from its swaged housing is with excessive friction on the sliding sleeve guide, which did not appear to be the case, or during maintenance.

Previous related incidents

On the 24th of June 1998 the nose and main landing gear assemblies had been overhauled. The retraction systems were tested and found to be satisfactory. On the 18th of September 1998 the landing gear failed to extend and the pilot was forced to use the manual system. In this case, however, the manual system operated satisfactorily and the aircraft landed safely. Subsequent examination by the maintenance engineer revealed that the landing gear transmission assembly was the source of the problem. The transmission motor screw thread and gear wheel had worn leading to partial break-up of the assembly. In hindsight it was agreed that this occurrence could have been attributed to over stiffness of the assembly. A new transmission motor and transmission assembly was fitted and the operation of the landing gear was checked and found to be satisfactory.

Since the main landing gear overhaul the aircraft has flown 99 flight cycles lasting a total of 59 hours and since the motor replacement the aircraft has flown 17 flights and 10 hours.

Discussion

As stated above, the excessive friction experienced during operation of the right MLG push-pull cable appeared to be associated with the kinking of the inner cable. At the outboard end of the cable, the kinking occurred at a position roughly adjacent to the swaged joint with the MLG in the down position. At the inboard end, the kinking occurred at a position adjacent to the swaged joint with the landing gear retracted. The swaged joints are designed to accommodate a small amount of angular movement of the guide sleeve but if one, as in this instance, were to separate completely, then it is conceivable that the unsupported inner cable could kink under compressive forces.

Examination of the failed swage indicated that it had been subjected to a single, lateral load beyond the range of movement it could accommodate. This could have been done inadvertently during maintenance with the cable assembly disconnected from the MLG itself. However, it was not possible to determine when the lateral loading had occurred, nor was it possible to explain how the aircraft had successfully operated for 99 flights since maintenance overhaul work was done in the area.

The engineer acknowledged that, when the motor problem had been discovered, he suspected that excessive friction in the MLG bushes and bearings might have been responsible and several items were inspected and lubricated. He did not specifically check the freedom of the cables and there was no Maintenance Manual requirement to do so. Equally so, there is no provision for lubrication or requirement to lubricate the push-pull cables, which would anyway require considerable work, including some disassembly of structure, to accomplish. He had, however, as a matter of routine applied lubricant to the more accessible guide sleeves, rods and pivot pins.