AAIB Bulletin No: 12/93 **Ref: EW/G93/07/09** **Category: 1.2**

Aircraft Type and Registration:	Piper PA-31-350 Navajo Chieftan, G-OLLY
No & Type of Engines:	2 Lycoming TIO-540-J2BD piston engines
Year of Manufacture:	1974
Date & Time (UTC):	8 July 1993 at 1822 hrs
Location:	Bristol (Lulsgate) Airport, Avon
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to fuselage underside and propellers; engines shock loaded
Commander's Licence:	Airline Transport Pilot's Licence with Instrument and Flying Instructor Ratings
Commander's Age:	28 years
Commander's Flying Experience:	2,734 hours (of which 266 were on type) Last 90 days - 125 hours Last 28 days - 64 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent examination of failed gear selector cable

Following an uneventful flight from Blackbushe, the pilot selected the landing gear to the down position after turning onto final approach at Bristol. He noted that the lever could be moved to the fully down position without the usual resistance, and that the landing gear remained in the retracted position. ATC were informed and the aircraft was flown in the circuit at 1,000 feet during which the gear lever was recycled and the emergency hand-pump system was operated, without success. Due to other traffic in the area, the aircraft was flown to the south of Bristol, and climbed to FL 50. At about this time, another aircraft, a PA-28 with a pilot and and a licenced engineer on board, took off from Bristol and formated on G-OLLY. Two way communication was established between the aircraft on a company frequency, and a discussion ensued between the engineer and the pilot of G-OLLY. Further attempts were made to extend the gear, and included a visual inspection of the landing gear operating cable under the instrument panel. The PA-28 maintained a lookout during this operation.

After 1 hour and 20 minutes, it was concluded that the gear could not be lowered, and that a gear up landing was inevitable. The pilot decided that in order to minimise damage to the flaps, the landing would be made in the clean configuration. He reviewed the stalling speeds and, after conducting four practice stalls, left FL 50 and proceeded towards Bristol Airport. ATC were informed of the pilot's intentions. After burning off additional fuel, three practice approaches were made to a grass area adjacent to Runway 27. With the emergency services standing by, the aircraft was landed following the fourth approach and touched down tail first after the airspeed had been reduced to a minimum. The aircraft slid to a halt in about 85 metres and the pilot, who was uninjured, vacated via the normal exit.

During the recovery of the aircraft, it was noted that the actuator lever on the hydraulic selector pack in the nose of the aircraft did not move in response to operation of the selector lever in the cockpit. This indicated that the selector cable had broken. After placing the aircraft upon jacks, the down selection was made directly on the selector pack actuator lever and, after operating the emergency hand-pump, the gear extended normally. Operation of both the normal and emergency gear extension systems is dependent on movement of this lever to the 'DOWN' position. Upon inspection, it was found that the operating cable had failed 15 mm from the end of a steel rod into which it had been crimped, the other end being connected to the cockpit selector lever. The part number of the failed component was 55416-02, and it was a non-lifed item. It had been on the aircraft since new, and had achieved 6,061 hrs. A sketch of the cable is shown at Fig 1.

The cable was subjected to metallurgical examination. A photograph of the component is shown at Fig 2. One half of the failed cable can be seen, the mating half being located within the tubular sheath close to the swaged joint that attaches the flexible outer covering. Both halves of the cable failure are shown at Fig 3. All the individual wires had been bent, especially those attached to the steel rod. The fractured ends appeared 'burnished' and were worn due to rubbing contact within the tubular sheath and, as a result, none showed any evidence of fatigue damage when examined using an electron microscope. The wire ends were removed and then ground to produce longitudinal sections before being optically examined. This revealed the presence of multiple fatigue cracks growing transversly from the surface. This indicated that the failures were the result of bending fatigue.

The tubular sheath was attached to the flexible outer covering by means of a swaged joint. When this was separated, it was evident from the wear pattern (see Fig 4) that the joint may have been deformed in bending at some stage, thereby causing a 'kink' in the cable. It is possible that this could have been responsible for the fatigue in the individual wires. The inside of the tubular sheath displayed longitudinal scoring from the broken ends of the wires, over a length of some 60 mm extending from the joint.

The CAA's SDAU database has no record of similar failures, although the aircraft manufacturer has indicated that they are aware of one other failure; whilst full details were not available, the time in service is believed to be approximately the same as for the component from G-OLLY. This particular cable is also used on PA-31T and 42 aircraft. However information from the CAA has indicated that cable installation on the PA-31 is sufficiently unique not to require action on the other two models.

The organisation that maintained G-OLLY is considering implementing a procedure whereby the operating cables are changed at 5,000 hour intervals on the aircraft in their charge. The cables are relatively easy to fit and such action would not constitute an expensive precaution.

As a result of this investigation, the following Safety Recommendation has been made to the CAA:

93-61 The CAA should consider the amendment of the Piper PA31 Maintenance Schedule to require renewal of the landing gear operating cable at fixed intervals, to preclude the fatigue failure of such cables. (Issued 22 November 1993)

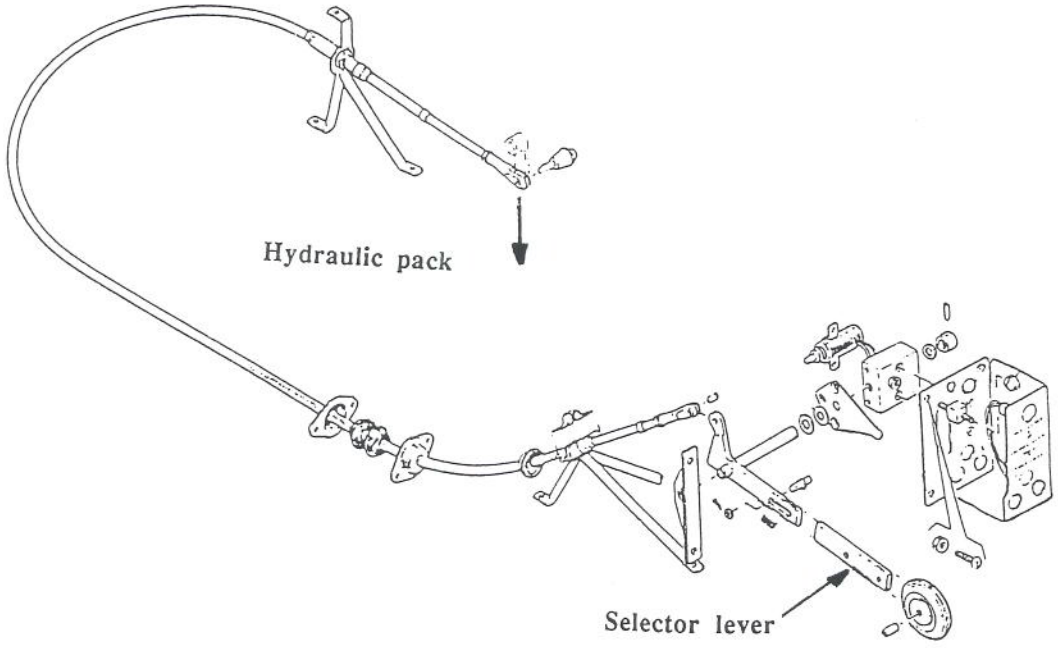


Fig 1 Landing gear selector cable installation

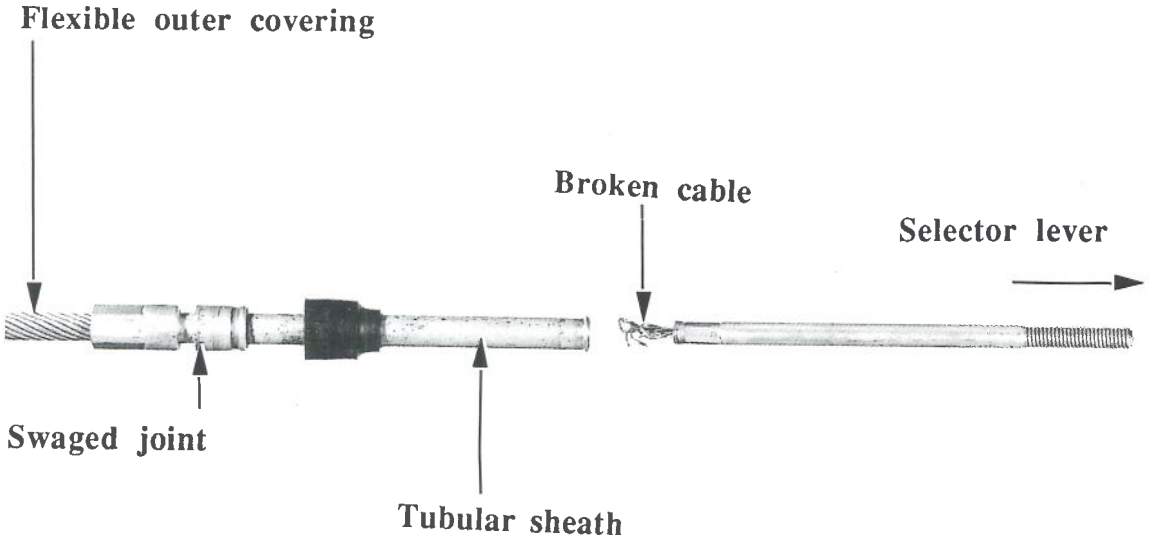


Fig 2 Failed cable assembly

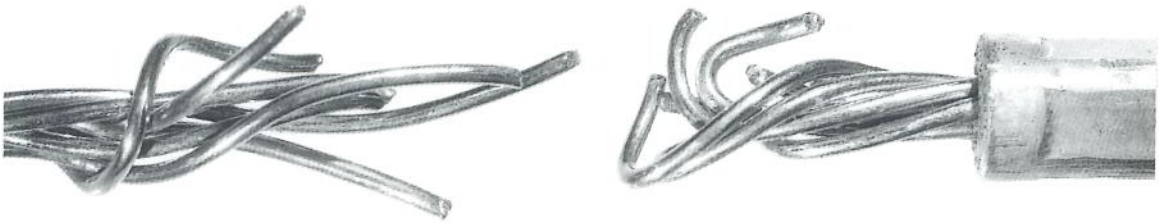
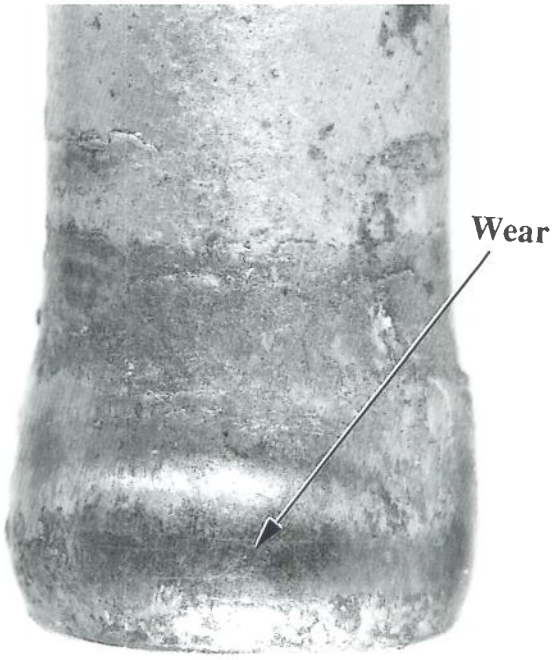


Fig 3 Bent wires on both sides of cable break



End of tubular sheath

Fig 4 Both halves of swaged joint

Swaged fitting