

## Piper PA-28-161 Warrior II, G-BTSJ

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| <b>AAIB Bulletin No:</b> 12/2004       | <b>Ref:</b> EW/G2004/09/02  | <b>Category:</b> 1.3 |
| <b>Aircraft Type and Registration:</b> | Piper PA-28-161 Warrior II, G-BTSJ                                |                      |
| <b>No &amp; Type of Engines:</b>       | 1 Lycoming O-320-D3G piston engine                                |                      |
| <b>Year of Manufacture:</b>            | 1978  |                      |
| <b>Date &amp; Time (UTC):</b>          | 3 September 2004 at 1121 hrs                                      |                      |
| <b>Location:</b>                       | Plymouth City Airport, Devon                                      |                      |
| <b>Type of Flight:</b>                 | Training  |                      |
| <b>Persons on Board:</b>               | Crew - 1  | Passengers - 1       |
| <b>Injuries:</b>                       | Crew - None   | Passengers - None    |
| <b>Nature of Damage:</b>               | Left landing gear detached, damage to the left wing and left flap |                      |
| <b>Commander's Licence:</b>            | Commercial Pilot's Licence  |                      |
| <b>Commander's Age:</b>                | 41 years  |                      |
| <b>Commander's Flying Experience:</b>  | 1,950 hours (of which 530 were on type)                           |                      |
|  | Last 90 days - 193 hours  |                      |
|  | Last 28 days - 77 hours   |                      |
| <b>Information Source:</b>             | Aircraft Accident Report Form submitted by the pilot              |                      |

### Synopsis

During takeoff, the left main landing gear lower torque link pivot bolt failed, resulting in the complete detachment of the wheel and inner cylinder of the oleo assembly. The aircraft was damaged during the subsequent landing. The investigation revealed that the torque link pivot bolt had suffered a fatigue failure and was generally in a poor condition. This failure was similar to one that occurred recently to another PA-28-161 (G-BTBC, AAIB Bulletin 9/2004), following which safety recommendations were made to EASA and the FAA calling for improved inspection procedures. At the time of writing, no response has been received from EASA to these recommendations; the FAA are in the process of considering their response.

### History of flight

During the takeoff from Runway 31 at Plymouth City Airport, the pilot heard a thud just as the aircraft became airborne. The pilot continued the climb out and levelled off at 300 feet before contacting Plymouth Tower about the noise. The tower informed the pilot that part of the left landing

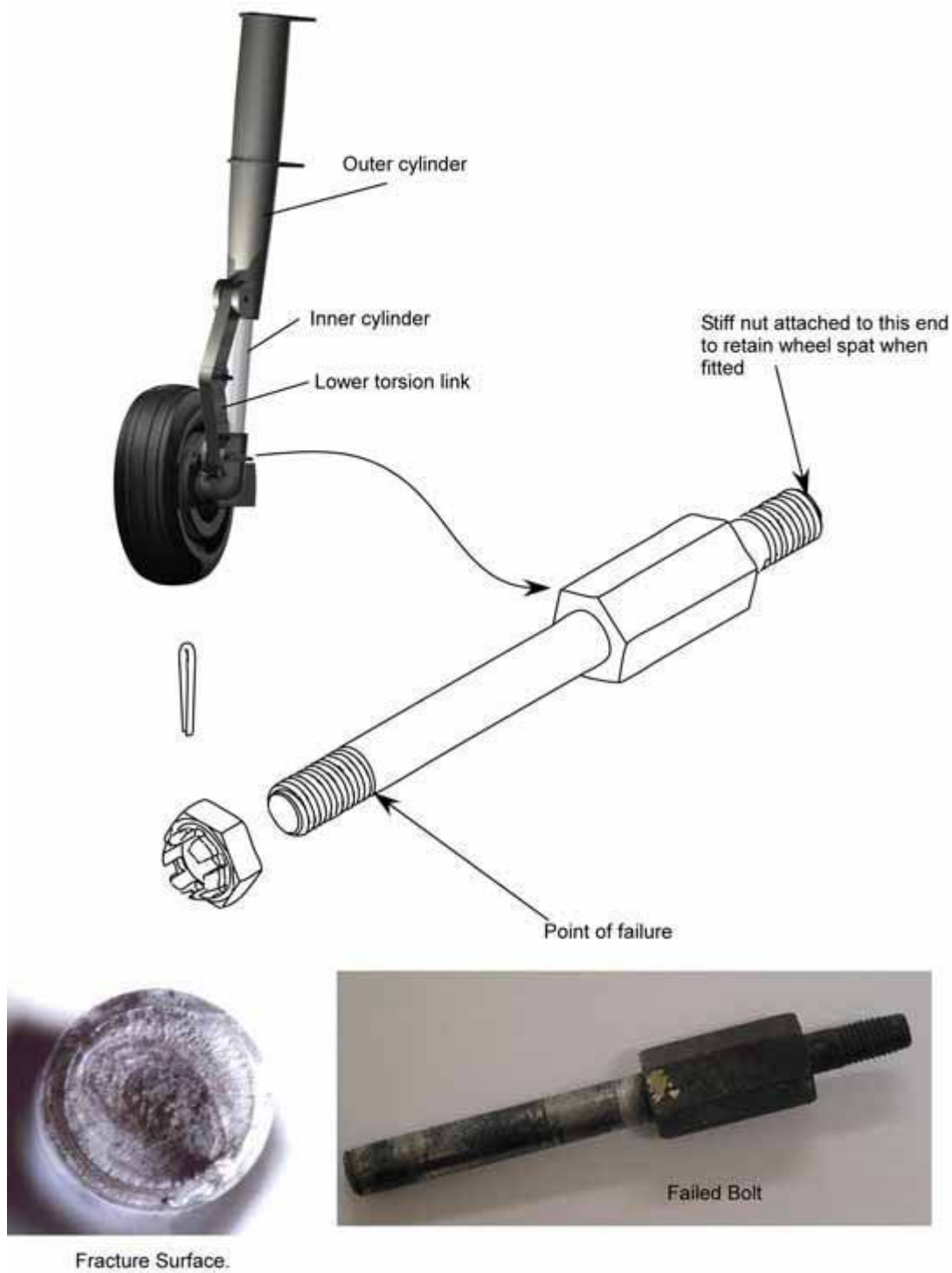
gear had departed the aircraft and that the inner cylinder, with the wheel still attached, as well as some debris had been recovered from the runway.

The aircraft continued to be flown in the circuit and included a fly past of the tower to confirm that the left landing gear was indeed missing. Whilst the runway was inspected for additional debris, the pilot flew an orbit pattern. During the approach for the eventual landing, the pilot prepared the aircraft by shutting down the engine and isolating the electrical systems. To further reduce damage to the aircraft during the landing the pilot landed on the right landing gear and held the left wing up as long as possible. Once the aircraft had stopped the pilot and his student evacuated the aircraft, unhurt. The damage to the aircraft was limited to the left wing, left flap and left landing gear.

## **Engineering Examination**

Examination of the left landing gear revealed that the lower torsion link attachment bolt had fractured. This had allowed the inner cylinder to become detached from the torsion link, and eventually fall from the outer cylinder when the aircraft became airborne. (The torsion links not only prevent rotation between the inner and outer cylinder; they also provide a means of retaining the inner cylinder in place during flight.)

The lower torsion link attachment bolt on the PA-28-161 can be one of two designs. The simplest installation is an AN 5-22 hexagonal head bolt, castellated nut and split pin arrangement. However, on aircraft fitted with wheel spats, the bolt is manufactured with a small threaded section, a hexagonal spacer section, followed by the bolt shank and a final threaded portion, see Figure 1.



**Figure 1**

The small threaded portion is used to attach to the wheel spat using a stiff nut. The spacer portion provides clearance between the wheel spat and the torsion link and the bolt shank passes through a sleeve in the torsion link and inner cylinder assembly. All of this is fastened together using a castellated nut and split pin on the remaining threaded portion. G-BTSJ was not fitted with wheel

spats, but did have the latter bolt arrangement. This indicated that at some point in the past the aircraft had been fitted with wheel spats which were subsequently removed.

Metallurgic examination of the failed attachment bolt revealed that it had failed as a result of a rotational reverse bending fatigue mechanism with multiple crack initiation points. The shank of the bolt showed signs of corrosion and polishing of the surface due to rotation inside the sleeve, indicating that the bolt had become loose in its fitting. The castellated nut and split pin were recovered from the runway, with the split pin still inserted; however, this had been mislaid and was not available for examination.

The last maintenance input was seven hours prior to the accident. However, there was no requirement to inspect the torsion link attachment bolts. The only maintenance requirement defined by Piper, for the attachment bolts, was to carry out a lubrication of the lower torsion link fitting every 100 hours. It was not known how long the bolt had been fitted, or when it was last disturbed. It was also not possible to determine why the bolt became loose in the first instance.

## **Previous Incident**

A similar occurrence, to a Piper PA-28-161, was recently investigated by the AAIB, G-BTBC EW/G2003/10/19 published in the September 2004 Bulletin (Bulletin 9/2004). This accident also resulted from a failure of the lower torsion link attachment bolt, which caused the landing gear to collapse on landing. The failure mode was slightly different in that the fracture occurred in the shank of the bolt and was possibly due to over-torque of the nuts. As a result of the investigation, recommendations were made to the FAA and EASA calling for improved inspection procedures of the torque link attachment bolts, Safety Recommendations 2004-20 and 2004-14 refer. At the time of writing, the FAA are considering their response to these recommendations but no response has yet been received from EASA.

Since this incident, the maintenance organisation responsible for this aircraft has undertaken to replace all torque link attachment bolts during the next maintenance input on any Piper PA-28-161 aircraft they maintain.