**ACCIDENT**

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| **Aircraft Type and Registration:** | Piper PA-34-200T, G-BEJV |
| **No & Type of Engines:** | 2 Teledyne Continental TSIO-360-EB piston engines |
| **Category:** | 1.3 |
| **Year of Manufacture:** | 1976 |
| **Date & Time (UTC):** | 30 March 2004 at 1810 hrs |
| **Location:** | Oxford Airport, Oxfordshire |
| **Type of Flight:** | Training |
| **Persons on Board:** | Crew - 2 Passengers - 1 |
| **Injuries:** | Crew - None Passengers - None |
| **Nature of Damage:** | Damage to bulkhead aft of nose wheel |
| **Commander's Licence:** | Commercial Pilot's Licence, with Instrument and Instructor ratings |
| **Commander's Age:** | 68 years |
| **Commander's Flying Experience:** | 12,300 hours (of which 5,100 were on type)<br>Last 90 days - 102 hours<br>Last 28 days - 45 hours |
| **Information Source:** | Aircraft Accident Report Form submitted by the pilot and additional AAIB enquiries |

**Circumstances**

During final approach following an NDB let-down procedure, both the student and commander confirmed the 'three greens' indication of the landing gear assemblies being locked down. There was a 10 kt crosswind component which caused the student to take some time to align the aircraft with the runway and reduce airspeed. Touchdown was made slightly to the left of the runway centreline. After touchdown, the nose was lowered in the normal manner and the commander immediately became aware that the aircraft attitude was excessively nose-down. He thought that this could have been due to a deflated nosewheel tyre, or a collapsed oleo; however the nose continued to drop until its underside contacted the runway surface. Both propellers also struck the runway, stopping the engines. The aircraft was brought to a halt using the wheelbrakes, following which the fuel and electrical systems were turned off and the occupants vacated the aircraft.

**Description of the landing gear**

The landing gear on this type of aircraft is operated by means of hydraulic actuators. Hydraulic pressure is supplied from a "power pack" consisting of an electrically driven hydraulic pump with an integral fluid

reservoir. When the gear is retracted, a pressure switch signals the pump to operate if the hydraulic pressure falls below 1,800 psi.

The nose landing gear of the Seneca is of the forward retracting type which, when extended, has the wheel axle forward of the oleo pivot. When retracted, the gear is held up by hydraulic pressure in the actuator and, when extended, it is held in the down position by a geometric downlock mechanism. When the nose landing gear is extended and under load the primary brace against collapse is the drag link assembly. When the landing gear is fully extended, the drag link centre pivot should be offset below the line between its two end pivots and, in this position, the fixed stops of the drag link centre joint, which limit the over-centre travel of these links, should be in abutment. (See Figure 1 Details, next page.)

The overall geometry of the landing gear is such that aircraft weight on the nose-wheel applies a compressive load to the drag link assembly, which tends to drive it more firmly into the safe 'over-centre' condition when the gear is properly extended. Conversely, if the load is applied when the drag link assembly is in an 'under-centre' condition, it will tend to cause the drag link to fold and the gear to retract.

The downlock assembly, which forms the geometric lock to keep the drag links in the extended position, also acts as an integral part of the retraction/extension mechanism. The retraction actuator attaches to the centre pivot bolt of the two part, articulating, downlock linkage. During the retraction cycle, the first movement of the actuator causes the downlock linkage to pull the drag link out of the over-centre condition; during the extension cycle the final movement of the actuator causes the downlock assembly to push the drag link into the fully over-centre position. There is a downlock spring, which pulls the downlock centre pivot rearwards, assisting the downlock assembly into the 'gear locked down' position, particularly during 'free fall' extensions.

The lower part of the downlock link assembly is a spring strut (see Figure 2, below) which has a spring force of about 2-3 lbs and is compressible by about 0.06 inch. The sprung travel is limited by a cross-pin, fitted through the shank of the lower eye fitting, running in a control aperture in the barrel of the lower downlock link body. This aperture is described in the Service Manual as a 'slot'. The length of the lower downlock link is adjustable and is correct if, when the drag link assembly is driven to the fully over-centre position, the lower downlock link is almost fully compressed. The clearance of the cross-pin from the upper end of the slot, established by the rigging procedure, is a half turn of the adjustment thread, which is about 0.018 inch.

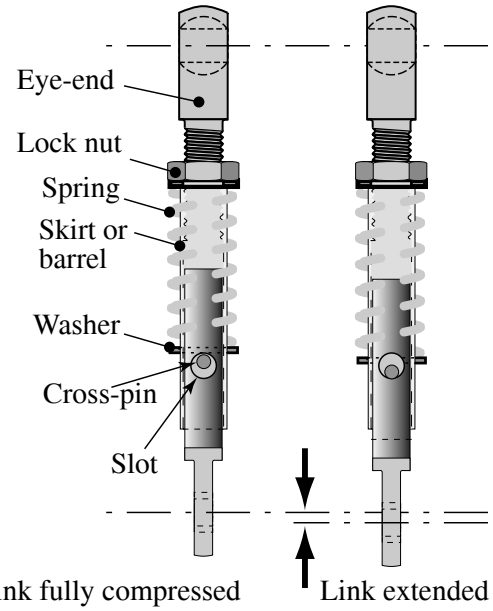


**Figure 2**

Downlock link
Sectioned assembly)

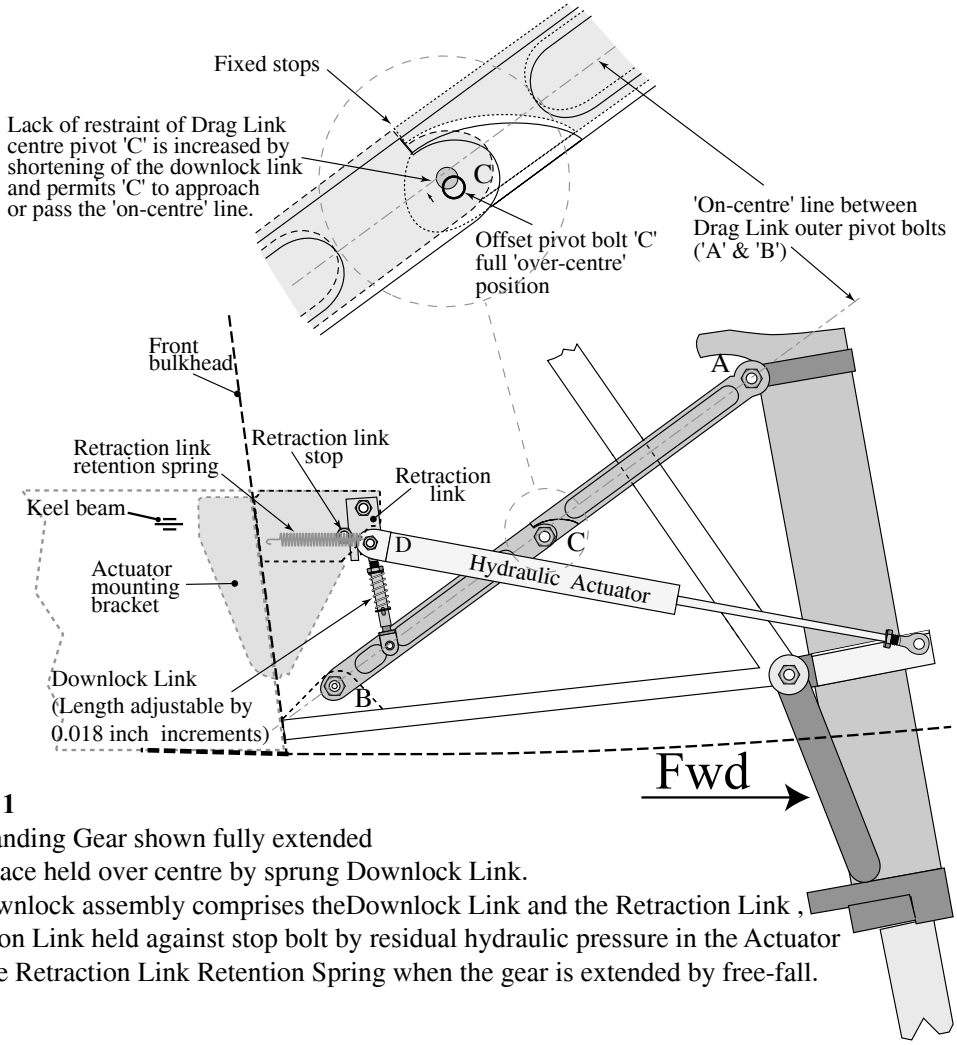


**Figure 1**

Nose Landing Gear shown fully extended

Drag Brace held over centre by sprung Downlock Link.

The Downlock assembly comprises theDownlock Link and the Retraction Link , Retraction Link held against stop bolt by residual hydraulic pressure in the Actuator or by the Retraction Link Retention Spring when the gear is extended by free-fall.

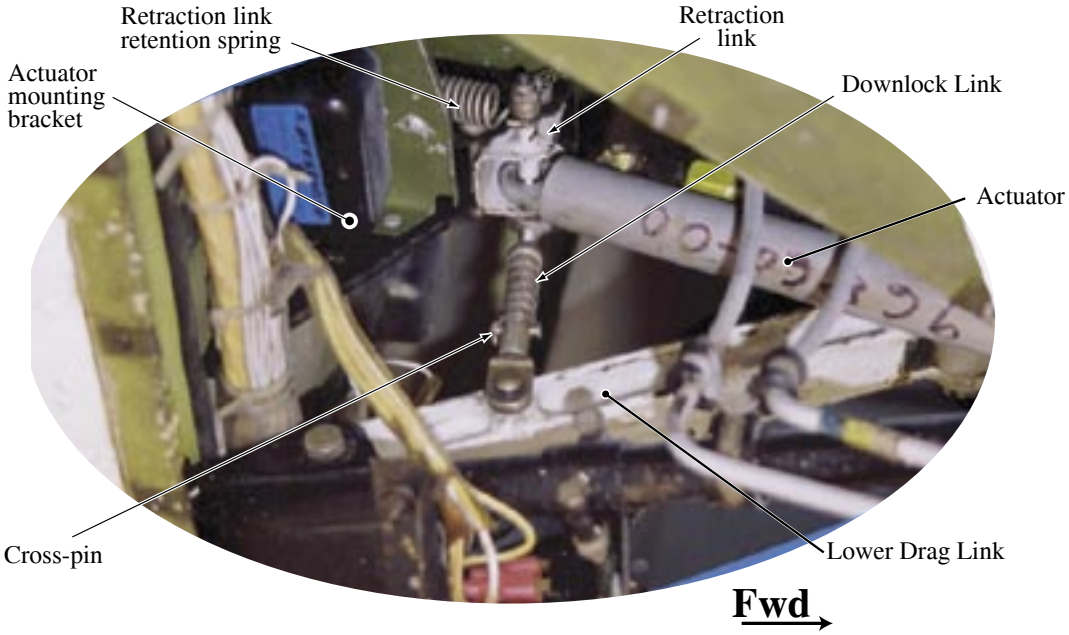


**Figure 1a**

PA-34 nose landing gear - view from below and right side showing lateral stagger of downlock linkage components.

The procedure for rigging the nose landing gear drag links, retraction actuator and downlock mechanism is laid down in the PA34-200-T (Seneca II) Service Manual, Chapter VII (Landing gear and brake system), Paragraph 7–11d.

**Examination of the aircraft**

Apart from that to the propellers, the damage associated with the collapse of the nose leg was mainly confined to cracks and distortion in the fuselage front bulkhead close to the attachment of the actuator. In addition, a number of sheared rivets were observed on the actuator mounting structure which was attached through the bulkhead to the keel structure on the bottom of the fuselage. This damage could only have occurred as a result of an excessive load transmitted to the bulkhead/keel area through the actuator itself. Such a load path would be created only in the event that the drag link was not in its locked, over-centre position.

The downlock link had suffered some distortion in its upper eye end, and the aperture, or slot, had been slightly elongated to the extent that a burr had been raised at the upper end, with the result that the spring-end washer rested on the burr, rather than the shank of the pin (see Figure 3, right). It was not clear if the slot elongation had occurred over a number of landings, or as a result of this incident.

It was considered that a hydraulic system failure could result in the landing gear not achieving the downlock position, ie with the nose gear drag links remaining in an 'under-centre' position. However, this would not result in the green 'down and locked' indication reported by the crew. Nevertheless, a test of the hydraulic pump was conducted, with satisfactory results. The associated pressure switch was also found to function within its permitted limits, and the hydraulic reservoir was found to be full after the incident. Therefore, it was concluded that a failure in the hydraulic system had not occurred. Accordingly, attention was once again focused on the downlock mechanism.

**Similar events**

The AAIB is aware of around seven incidents to UK registered Piper Seneca aircraft which involved uncommanded nose landing gear retraction. These, together with others around the world had caused the manufacturer to issue, in May 2003, Service Bulletin (SB) 1123. The purpose of the SB was described as follows:

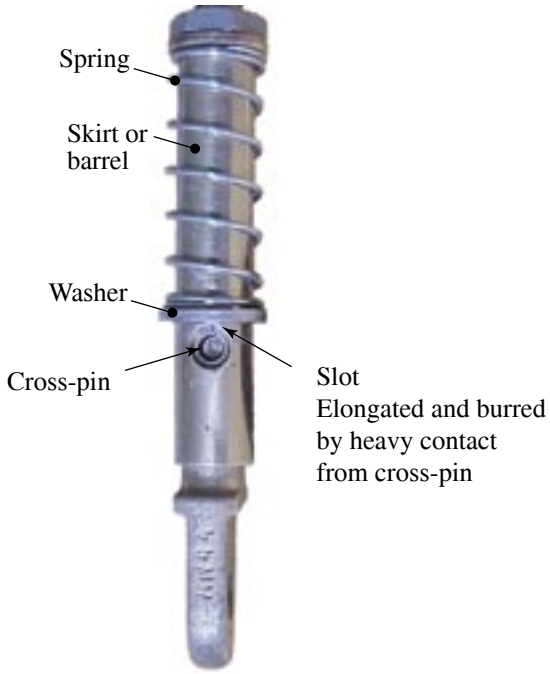


**Figure 3**

Damaged Downlock link showing distortion of slot and washer jammed on burr

"A review of the service difficulty report concerning PA-34 Nose Landing Gear failures and inadvertent retractions indicates a need to emphasise and expand upon the periodic inspection requirements currently listed in the applicable PA-34 series Maintenance Manuals. In addition, a design review of the installation identified a few components that could be modified to improve their long term service life. This publication introduces the revised inspection requirements and identifies those parts that have been modified to improve their service life. Also included are corrections and clarifications of the rigging procedures pertaining to the Nose Gear installation."

The inspections detailed in SB 1123 had been performed on G-BEJV at its annual inspection 180 flying hours prior to the incident.

Whilst the exact mechanism of failure of the nose landing gear in this accident is different in detail from that reported on in the next Report in this Bulletin (G-BNEN), both have been the result of a failure of the downlock mechanism to retain the drag link in an 'overcentre' condition. The 'Discussion' and subsequent sections of that report have, therefore, been used to draw conclusions and make Safety Recommendations relevant to both accidents.