ACCIDENT

Aircraft Type and Registration:	Piper PA-34-200T Seneca II, G-BTGV
No & Type of Engines:	2 Continental Motors Corp TSIO-360-EB piston engines
Year of Manufacture:	1979
Date & Time (UTC):	7 March 2011 at 1022 hrs
Location:	Gloucestershire Airport, Cheltenham
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nosegear doors, underside of nose, propellers
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	14,500 hours (of which 6,000 were on type) Last 90 days - 77 hours Last 28 days - 40 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional AAIB enquiries

Synopsis

During circuits at Gloucestershire Airport, the aircraft landed in what was described as a "slightly flat and firm" touchdown, following which the nose landing gear immediately retracted. The nose dropped, causing the propellers to contact the runway surface, and the aircraft subsequently came to a halt further down the runway. Neither occupant was injured.

The retraction may have occurred as a result of a slight 'out-of-rig' condition, although possible damage arising from an earlier heavy landing could not be ruled out. However, the PA-34 series of aircraft has a history of nose landing gear collapses, with no single cause having being identified, although there are a number of potential contributory factors. The aircraft manufacturer has introduced a number of measures, including a Service Bulletin, which have served to reduce the rate of this type of occurrence.

Circumstances of the accident

The aircraft had departed from Oxford on a Skills test for the student's Commercial Pilot's Licence. Following an uneventful navigation exercise the aircraft was routed to Gloucestershire Airport to conduct circuits. The student was instructed to descend on the 'dead side' and join the circuit downwind for Runway 09. The circuit was flown normally and on final approach the aircraft was cleared for a 'touch-and-go'. The

approach was stable and, in the calm conditions, the commander assessed that the touchdown point was deeper into the runway than normal, although still safe. He described the actual touchdown as "slightly flat and firm", although he did not classify it as heavy. However, the nose landing gear immediately collapsed, causing the nose to drop and the propellers to contact the ground. The aircraft came to a halt on the runway and both occupants evacuated without difficulty.

Nose landing gear description

The nose landing gear (NLG) of the Piper Seneca series of aircraft is of the forward-retracting type and is hydraulically operated. 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. There are no locking hooks for either position. When the NLG is extended and under load it is prevented from collapsing by the drag link assembly (Figure 1). When the NLG is fully extended, the offset drag link centre pivot is below the centre line of the two end pivots, preventing the drag link assembly from collapsing when the landing gear is under load.

The geometry of the NLG is such that the aircraft's weight on the nosewheel applies a compressive load to the drag link assembly, which will tend to drive it more firmly into the safe over-centre condition when the gear is properly extended. However, should the drag link assembly be in an under-centre condition, the applied load will tend to cause the drag link to fold and the gear to retract.

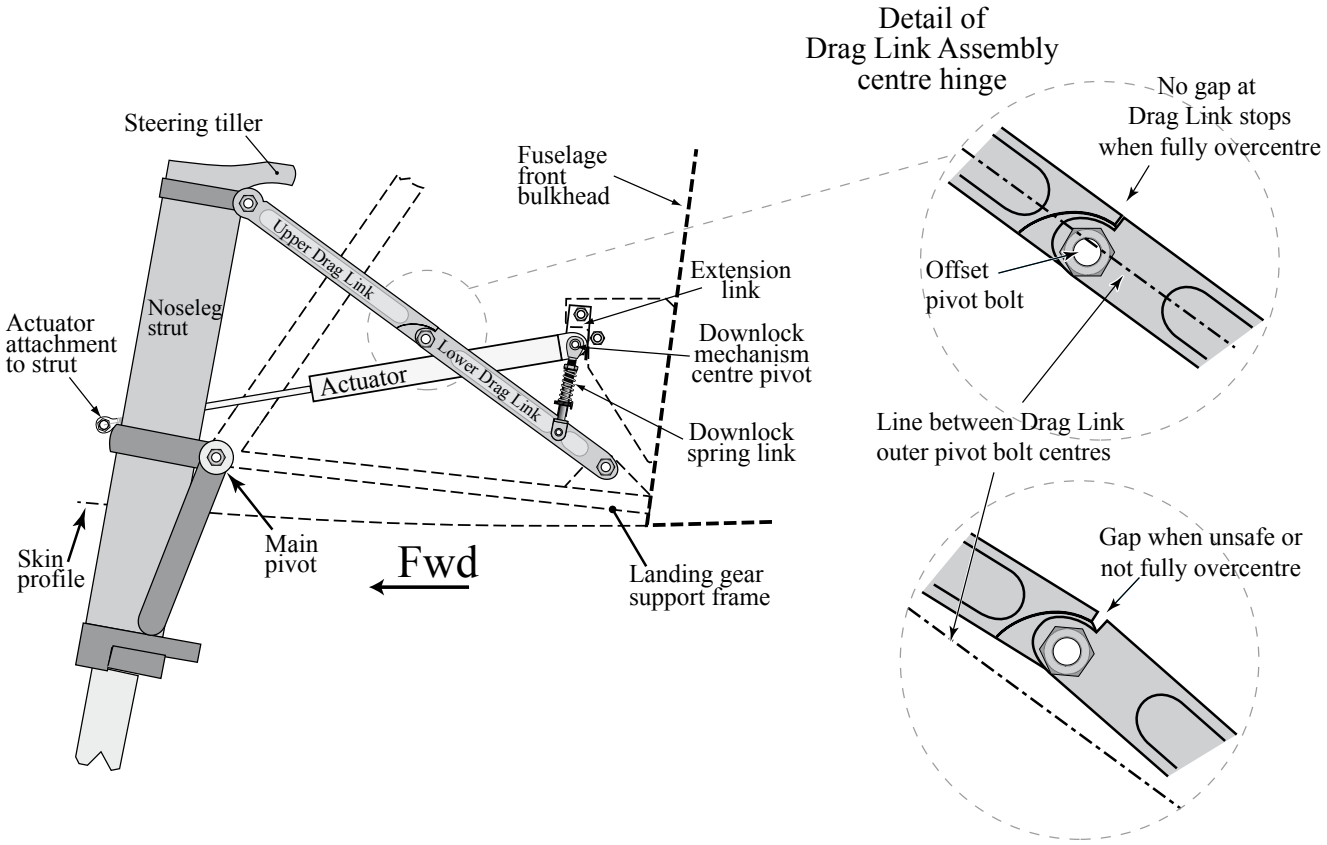

Figure 1

PA-34 nose landing gear side view showing main components in extended position

Examination of the aircraft

After the nose of the aircraft was raised, the nose landing gear was pulled into the locked-down position. It was then apparent that the upper eye end of the downlock link (Figure 1) was severely distorted, with additional damage to the front bulkhead, which can be seen in the photograph at Figure 2.

It is likely that the damage to the bulkhead and eye end was the result of the drag brace folding during the collapse, which would transfer the loads from the nose leg into the actuator and its attachment, at its upper end, to the bulkhead.

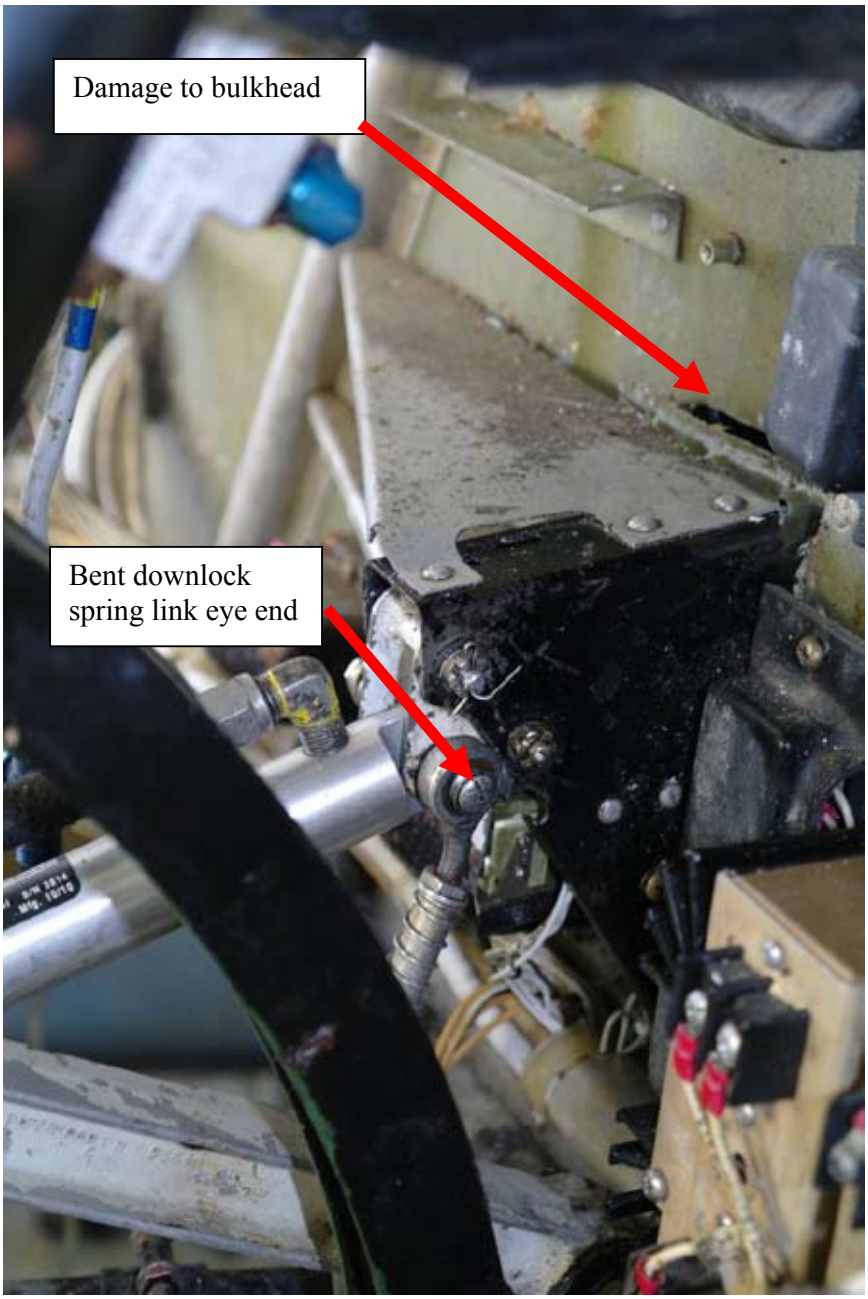

Figure 2

View of upper end of actuator attachment to structure, showing damage to bulkhead and bent eye end of downlock link

History of PA-34 NLG retraction problems

The Piper Seneca series of aircraft has a long history of nose landing gear collapses, with a number being investigated by the AAIB. The type has persistently suffered a noticeably higher rate of such incidents compared with most other 'light-twin' types. The historical aspects are described in more detail in reports on the accidents to G-EXEC and G-BEVG (amongst others), published in AAIB Bulletins 3/2002 and 6/2008 respectively; these reports also include detailed accounts of the rigging procedures for the NLG.

These investigations resulted in the AAIB making a number of Safety Recommendations and, in the USA, the Federal Aviation Administration (FAA) conducted a review of similar occurrences. The main outcome was that the manufacturer made a number of amendments to the Maintenance Manual and, in May 2003, issued Service Bulletin (SB) 1123. This introduced a number of maintenance actions and inspections which were to be conducted at intervals of 50 flying hours. This Service Bulletin was raised to Revision 'A' in November 2004 and Revision 'B' in April 2006. On 8 August 2005 the FAA issued Airworthiness Directive (AD) No 2005-13-16, which mandated SB 1123A and additionally required the replacement of the bolt that attached the upper drag link to the nose gear trunnion at 500 hour intervals. The 'comments' section of the AD includes the following:

> *'Piper conducted several ground and flight tests in an effort to determine the source of the [NLG retraction] problem. Unfortunately, due to the complicated design of the NLG, Piper could not isolate one specific problem.'*

The AD additionally listed a number of potential contributory factors identified in NLG collapses, including failure, or 'out-of-tolerances', of the retraction links and bolts, lack of cleanliness/lubricant in the components and an out-of-rig condition.

In the case of G-BTGV, the requirements of SB 1123B were most recently applied during a 100-hour inspection on 28 February 2011, some 28 flight hours prior to the accident. No flight cycle information was available, but training operations, such as that on which G-BTGV was engaged, can achieve up to 12 landings per hour. The maintenance personel were aware of the NLG system's vulnerability to misrigging and indicated that merely rotating the threaded eye end of the downlock spring link through 180º could potentially represent the difference between a correctly rigged and an out-of-rig condition. They also considered the possibility that one or more heavy landings since the previous compliance with SB 1123B may have caused some damage to the mechanism, affecting the rigging condition. Finally, they commented that the accident to G-BTGV was the first such occurrence they had seen for several years, which suggested that SB 1123B has been successful in reducing the number of NLG collapses.

Company investigation

Following the accident the aircraft's operator conducted an internal investigation, making a number of recommendations. One of these aimed to reinforce the use of the Technical Log for the purpose of making comments on engineering matters (including suspected heavy landings), as opposed to discussing them with the Operations department.

Discussion

This accident resulted from the uncommanded retraction of the nose landing gear and was the latest in a long history of similar occurrences. As with previous events, the NLG retraction could not be attributed to

a single cause. There were, however, a number of potential contributory factors and the possibility of damage arising from an earlier, heavy landing could not be discounted. However, the accident reinforces the necessity of accurately rigging the NLG, an issue which is addressed by SB 1123B. The relative lack of recent similar events suggests that this SB has been effective in containing the problem, if not completely eliminating it.