

ACCIDENT

Aircraft Type and Registration:	Piper PA-34-200T Seneca II, N43GG	
No & Type of Engines:	2 Continental TSIO-360-EB piston engines	
Year of Manufacture:	1976	
Date & Time (UTC):	27 September 2005 at 1438 hrs	
Location:	Humberside Airport, Ulceby, South Humberside	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Both propellers bent, engines shock loaded, nose cone and nose landing gear doors damaged	
Commander's Licence:	UK Private Pilot's Licence (A)	
Commander's Age:	43 years	
Commander's Flying Experience:	470 hours (of which 119 were on type) Last 90 days - 36 hours Last 28 days - 9 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB Engineering examination	

Synopsis

On approach to Humberside Airport the pilot selected the landing gear to the down position; the landing gear position indicators showed that all three units were down and locked. After landing on the main wheels the nose of the aircraft was lowered and the nose landing gear collapsed. The aircraft continued along the runway on its main landing gear and nose fairing for approximately 120 m before coming to a halt. The collapse of the nose landing gear was caused by the geometric locking mechanism becoming ineffective.

History of the flight

The aircraft was being flown by its owner and returning to Humberside Airport. During the approach when the landing gear was selected DOWN the pilot reported seeing three green lights on the landing gear position indicator, indicating that all landing gear units were down and locked. After completing a normal approach, the aircraft landed on its main wheels, with the nose raised. As the pilot lowered the aircraft's nose it continued to fall smoothly until it hit the runway surface. The aircraft continued along the runway for approximately 120 m before coming to a halt. Both the pilot and passenger were unhurt and they opened the forward cabin door, with some difficulty, and left the aircraft prior to the

arrival of the airport fire service. Both propellers had come into contact with the runway and were severely damaged; the nose cone and nose landing gear doors were also damaged in the accident.

Maintenance history

The aircraft had suffered a previous nose landing gear (NLG) collapse on 8 May 2003 when it was registered as G-ROLA (see AAIB Bulletin 4/2004). The aircraft was repaired in accordance with the recommendations of the New Piper Aircraft Inc, which included the replacement of the downlock spring link with a new item and, on completion of functional checks, the aircraft was declared serviceable. The aircraft was subsequently sold and transferred to the US register on 25 June 2004, the operator reported no problems with the landing gear or its indication system from the date of acquisition to the accident date.

Nose landing gear mechanism

The NLG of the Piper Seneca is of the forward retracting type which, when extended, has the wheel axle forward of the oleo strut 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. 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 (see 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 collapsing when the landing gear is under load.

The geometry of the NLG is such that the aircraft’s weight on the nose-wheel applies a compressive load to the drag link assembly which tends to drive it more

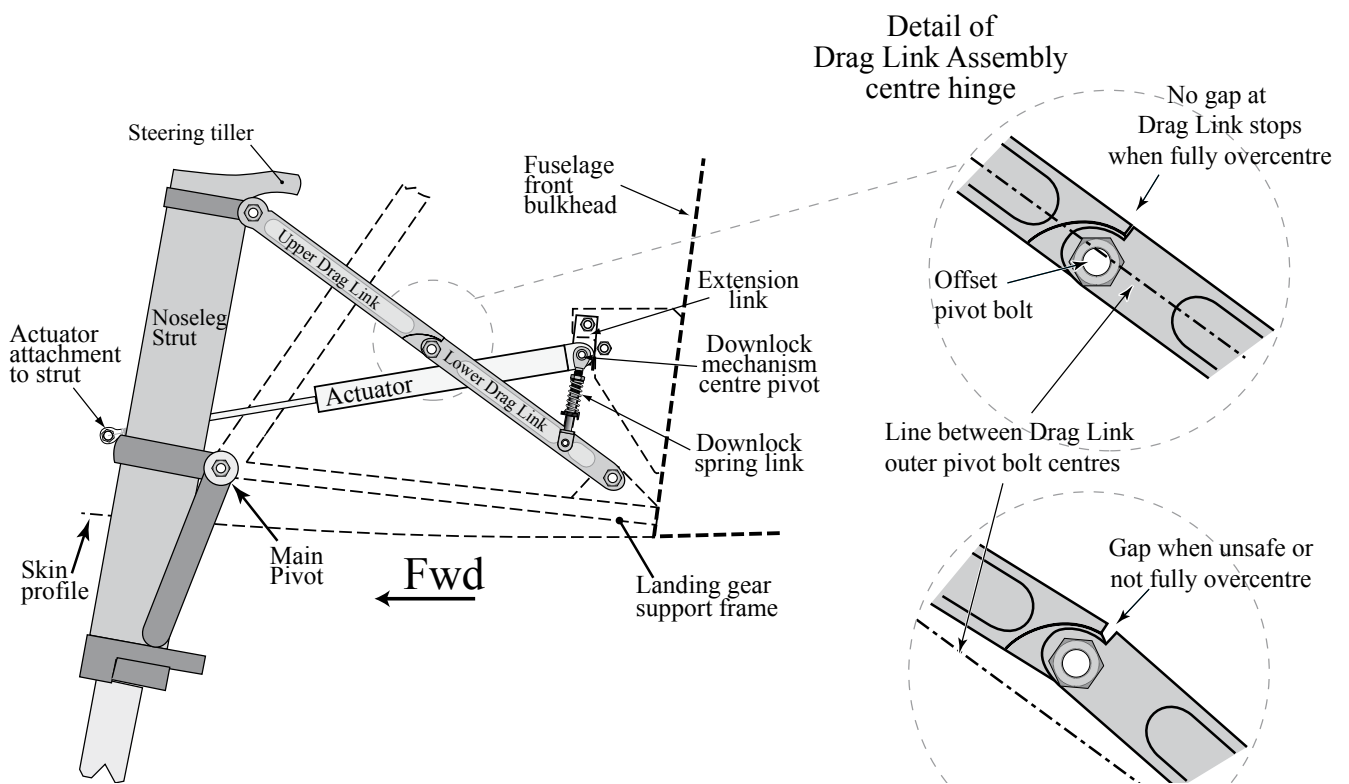


Figure 1

PA-34 nose landing gear side view showing main components in extended position
(Steering mechanism & downlock spring omitted for clarity)

firmly into the safe over centre condition when the gear is properly extended. Conversely, it will tend to cause the drag link to fold, and the gear to retract, if the load is applied when the drag link assembly is in an under centre condition.

The downlock spring link maintains the drag links in the over centre downlock position by applying a force on the lower drag link. However, small dimensional changes in this spring link can allow the drag link assembly to remain unlocked, or to have sufficient unrestrained movement to become unlocked, whilst the cockpit indicator shows the NLG to be locked down. The AAIB is aware of around nine incidents to UK registered Piper Seneca aircraft which involved uncommanded nose landing gear retraction, and the sensitivity of the NLG downlock mechanism to dimensional changes has been analysed in previous Bulletins, most recently in AAIB Bulletin 11/2005.

Nose gear examination

The aircraft was examined at Humberside Airport with the NLG secured in the down position by strops. Facilities were not available to carry out a functional test of the landing gear. The NLG extension link (see Figure 2) was found in a position corresponding to the down and locked position and the NLG micro switch had been activated, producing a 'down and locked' indication in the cockpit. The drag link assembly however was in an unlocked, under centre, condition. The downlock spring link showed some ovality in the pin slot, it was not possible to determine if this was the result of in service wear or as a result of an overload event. The central pivot pin, which secures the spring lock to the extension link and acts as the retraction jack input point, was severely distorted (see Figure 3). The retraction jack appeared to be in good condition with no evidence of external leaks or damage.

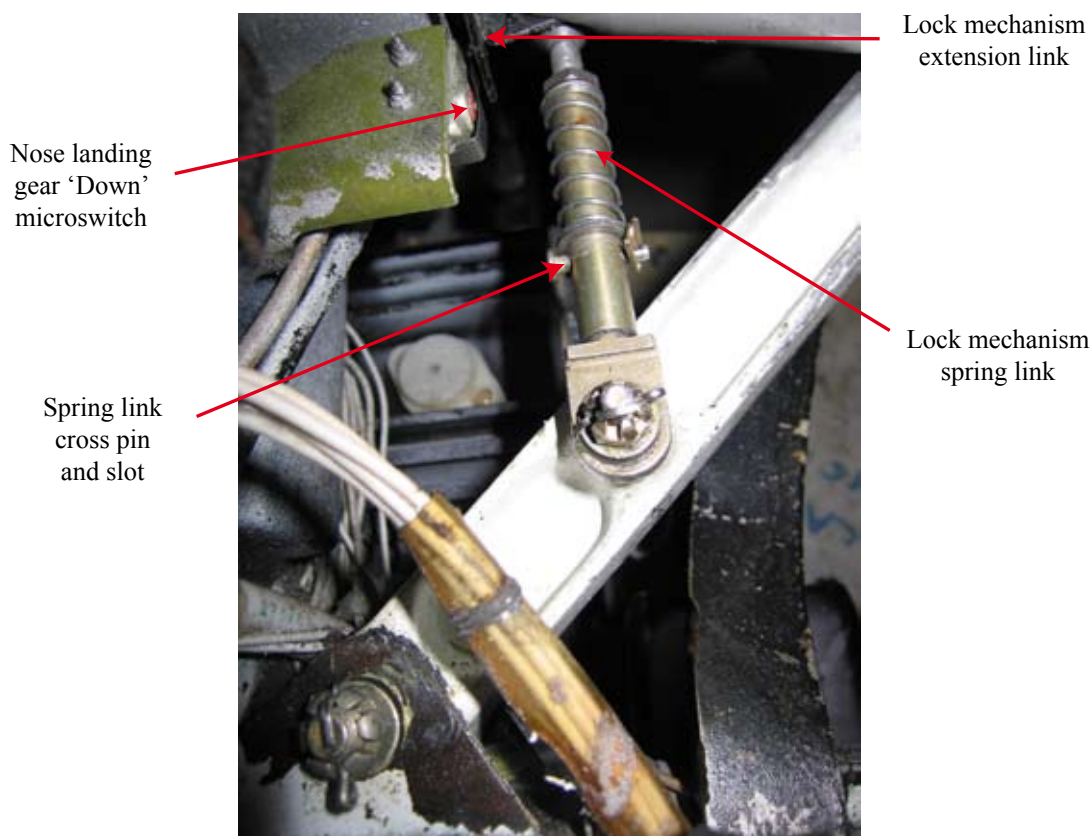


Figure 2

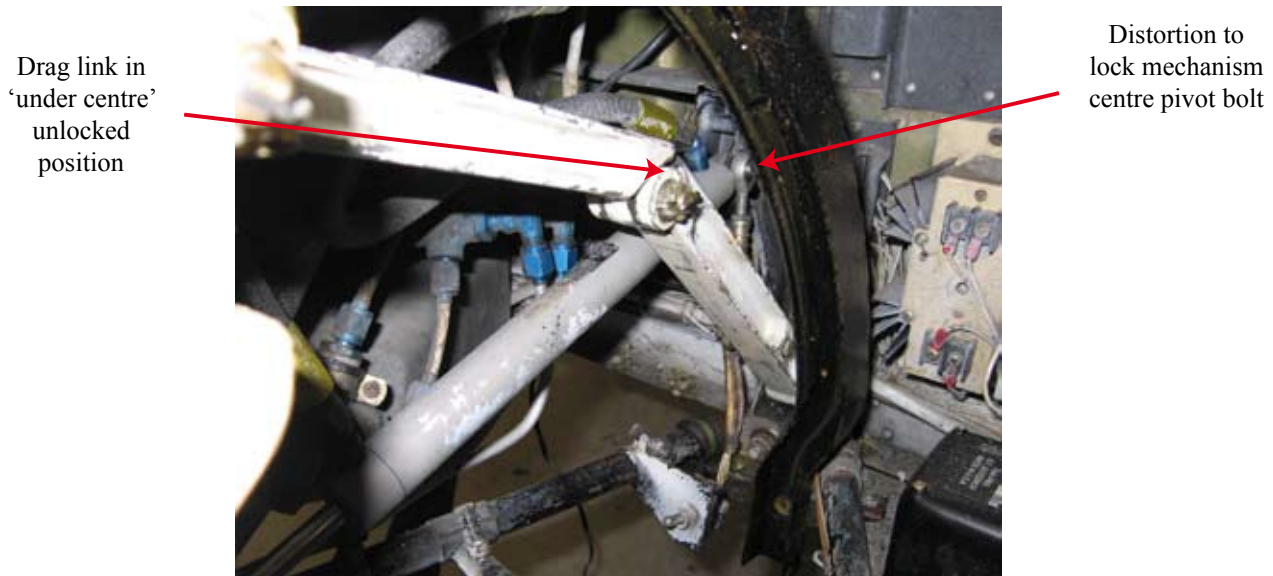


Figure 3

Analysis

Given the reportedly smooth collapse of the NLG, it appears probable that the NLG, although indicating 'down and locked' had not achieved a locked condition, leading to the 'retraction' of the NLG as weight was applied to it. In order for the NLG to remain unlocked, the ability of the downlock spring link to force the drag link into a locked position must have been compromised. The sensitivity of the Seneca NLG to small changes to the compressed length of the downlock spring link has been covered in some detail in previous Seneca landing gear collapse reports. (See AAIB Bulletin 11/2005).

Based on the results of previous investigations and the ductility of the material involved, it is probable that the distortion of the downlock mechanism centre pivot pin was produced as a result of an overload event such as a nose wheel landing, or rough surface takeoff. A review of the aircraft records and discussions with the aircraft's owner and maintenance organisation did not reveal any events which might have resulted in an overload of the link mounting pin.

During NLG extension, as the actuator extends, the extension link (see Figures 1 & 2) is rotated to make contact with the microswitch, providing an indication that the actuator has reached the limit of its extension and that the NLG is 'down and locked'. If the compressed downlock spring link remains of sufficient length, the NLG drag link assembly will be forced into the over centre position, locking the NLG in position. In a situation where the compressed downlock spring link is shorter than required, the NLG microswitch will still be activated by the extension of the NLG actuator; but the downlock spring link will not be of sufficient length to drive the drag link assembly into the 'safe' over centre position. It is probable that the combination of the distortion to the downlock mechanism centre pivot pin and the ovality of the pin slot, which introduced increased play in the downlock spring link, allowed the drag link assembly to remain in, or move to, an under centre and 'unlocked' position whilst indications showed that it was 'down and locked'.

Conclusions

The NLG failed to maintain a locked condition despite indicating to the pilot that it was ‘down and locked’.

A change in geometry of the drag link spring lock, probably as a result of a combination of a high load event and in service wear prevented the drag link assembly achieving or sustaining a ‘safe’ condition; allowing the NLG to collapse as weight was applied to it.

The problems associated with the Piper PA-34 NLG have been thoroughly investigated in previous AAIB investigations. As a result a number of safety recommendations have been made which adequately address the causes of PA-34 NLG collapses; therefore no additional safety recommendations have been made as a result of this investigation.

Previous Safety Recommendations

As a consequence of the investigations into previous nose landing gear collapses on PA-34s, the AAIB has made five Safety Recommendations which are reproduced below. The earliest three of these have been accepted and acted on in some measure and a response on the latest two is understood to be imminent. The five Safety Recommendations were:

Safety Recommendation 2000-45 (FAA 00.327):

It is therefore recommended that the New Piper Aircraft Company should review and amplify the instructions for rigging the nose landing gear downlock mechanism contained in the Piper PA-34 Maintenance Manual.

Safety Recommendation 2000-46 (FAA 00.328):

The FAA and the CAA, in conjunction with the New Piper Aircraft Company, should investigate the causes of reported cases of Piper Seneca nose

landing gear collapse. Consideration should be given to design modification which should minimise movement of the drag brace resulting from loads applied to the nose landing gear, and to ensure sufficient force is applied to the drag brace to retain it in the locked condition.

Safety Recommendation 2004-07 (FAA 04.019):

It is recommended that the Federal Aviation Administration, as the primary certificating authority for the Piper PA-34 Seneca aircraft series, should require the aircraft manufacturer to provide a clear and unambiguous description of the operation of the nose gear downlock spring link, its installation and its correct rigging by both narrative and pictorial means.

Safety Recommendation 2005-106 (FAA 05.303):

The Federal Aviation Administration of the USA should ensure that the New Piper Aircraft Company includes, in the appropriate Maintenance Manuals, clear advice on the factors affecting ‘free fall’ extension of this landing gear and a more precise definition of an ‘acceptable’ nose landing gear ‘Retraction Link Retention Spring’.

Safety Recommendation 2005-107 (FAA 05.304):

The Federal Aviation Administration of the USA should ensure that the New Piper Aircraft Company reviews the content of Service Bulletin 1123A and expedites embodiment of the resulting instructions into the Maintenance Manual.