Air Accident Investigation Unit Ireland

SYNOPTIC REPORT

ACCIDENT

Piper PA-34 Seneca, EI-CMT
Cork Airport, Co. Cork
29 May 2013

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

Foreword

This safety investigation is exclusively of a technical nature and the Final Report reflects the determination of the AAIU regarding the circumstances of this occurrence and its probable causes.

In accordance with the provisions of Annex 13[1] to the Convention on International Civil Aviation, Regulation (EU) No 996/2010[2] and Statutory Instrument No. 460 of 2009[3], safety investigations are in no case concerned with apportioning blame or liability. They are independent of, separate from and without prejudice to any judicial or administrative proceedings to apportion blame or liability. The sole objective of this safety investigation and Final Report is the prevention of accidents and incidents.

Accordingly, it is inappropriate that AAIU Reports should be used to assign fault or blame or determine liability, since neither the safety investigation nor the reporting process has been undertaken for that purpose.

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[1] **Annex 13**: International Civil Aviation Organization (ICAO), Annex 13, Aircraft Accident and Incident Investigation.
[2] **Regulation (EU) No 996/2010** of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation.
[3] **Statutory Instrument (SI) No. 460 of 2009**: Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009.

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In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010 and the provisions of SI 460 of 2009, the Chief Inspector of Air Accidents on 29 May 2013, appointed Mr Paul Farrell as the Investigator-in-Charge to carry out an Investigation into this Accident and prepare a Report.

Aircraft Type and Registration:	Piper PA-34 Seneca, EI-CMT	
No. and Type of Engines:	2 x Continental TSIO-360 EB(L)	
Aircraft Serial Number:	34-7870088	
Year of Manufacture:	1978	
Date and Time (UTC[4]):	29 May 2013 @ 14.20 hrs	
Location:	Cork Airport (EICK), RWY 35	
Type of Operation:	General Aviation - Flight Training/Instructional – Dual	
Persons on Board:	Crew - 2	Passengers - 0
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Substantial	
Commander's Licence:	Commercial Pilot Licence (CPL) issued by the Irish Aviation Authority (IAA)	
Commander's Details:	Male, aged 24 years	
Commander's Flying Experience:	2,108 hours, of which 323 were on type	
Notification Source:	Duty Manager, ATC Cork	
Information Source:	AAIU Report Form submitted by the Instructor, AAIU Field Investigation	

[4] **UTC**: Co-ordinated Universal Time. All times in this report are in UTC (local time minus one hour on the date of the accident).

SYNOPSIS

During the landing roll the aircraft nose landing gear (NLG) retracted. The aircraft nose and both propellers contacted the runway surface. Damage to the aircraft was substantial. There were no injuries.

1. FACTUAL INFORMATION

1.1 History of the Flight

The aircraft, with an Instructor and Student on board, departed from EICK on a training flight which was part of a CPL training programme. The aircraft routed to Shannon Airport (EINN) where it conducted a planned low approach and go-around for training purposes. It then proceeded towards Charleville from where it routed towards Fethard to conduct a series of upper air work exercises in that area. The Instructor estimated that the total flight time was two hours.

The Student then set course back towards EICK where he carried out a touch-and-go on RWY 35. Following the go-around the landing gear was retracted and all gear indications were normal. The aircraft completed a right hand circuit to RWY 35 for a full-stop landing. The landing gear was lowered and the Instructor reported that all gear indications were normal "*three greens and the gear unsafe light wasn't on*". The Instructor described this as a normal approach. Just before landing the aircraft experienced a slight "*balloon*", however the Instructor said that this was well controlled by the Student and the aircraft did not touch the runway during the balloon. The Instructor recalled that the initial phase of the landing roll was normal but then the aircraft nose landing gear retracted into its wheel well. The aircraft nose and both propellers contacted the runway surface. Damage to the aircraft was substantial. There were no injuries.

Interviews with the Instructor and Student indicated a professional and thorough approach to all aspects of the flight from initial briefing up to and including the occurrence and its aftermath.

1.2 Aircraft Examination

The AAIU was advised about the event shortly after it occurred. To facilitate operations at EICK it was agreed that the scene would be thoroughly photographed and that the aircraft could be recovered to the Owner's hangar. To aid the recovery operation, the nose of the aircraft was lifted and the nosewheel was pulled downwards. Full downlock was not achieved so a strap was applied to the linkage arms to secure the NLG in the down position whilst the aircraft was manoeuvred. An AAIU team visited EICK on the following day to inspect the aircraft.

Figure No. 1 shows a schematic diagram of the NLG actuating linkages with the over-centre, geometric lock indicated in red and the down lock link indicated in purple.

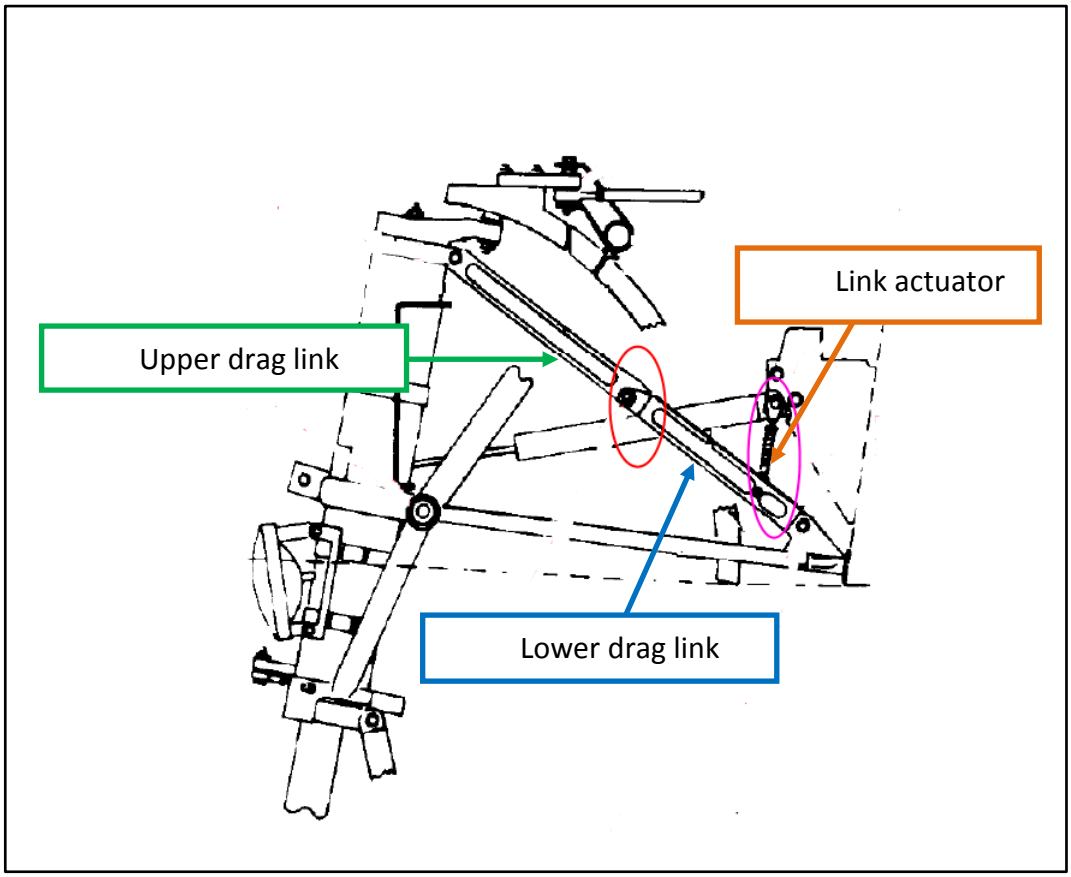

Figure No. 1: NLG actuation schematic showing the geometric lock (red) and down lock link (purple)

The actuating linkages for the NLG on the subject aircraft were examined. Locking of the NLG in the down position relies on an over-centre, geometric lock being formed and maintained between the upper and lower drag links. In normal operation, the aircraft's weight on the nosewheel applies a load to the NLG's drag link assembly which will maintain the over-centre geometric lock condition. However, if for any reason the geometric lock over-centre condition has not been achieved when weight is put on the nosewheel, then the load will actually cause the NLG drag linkage to fold and the gear will retract into the wheel well. The Investigation noted that, with the gear in the down position, the geometric lock over-centre condition was not in evidence on the subject aircraft (**Photo No. 1**). The link actuator was examined and found to be damaged in such a way that the over-centre geometric lock could not be achieved.

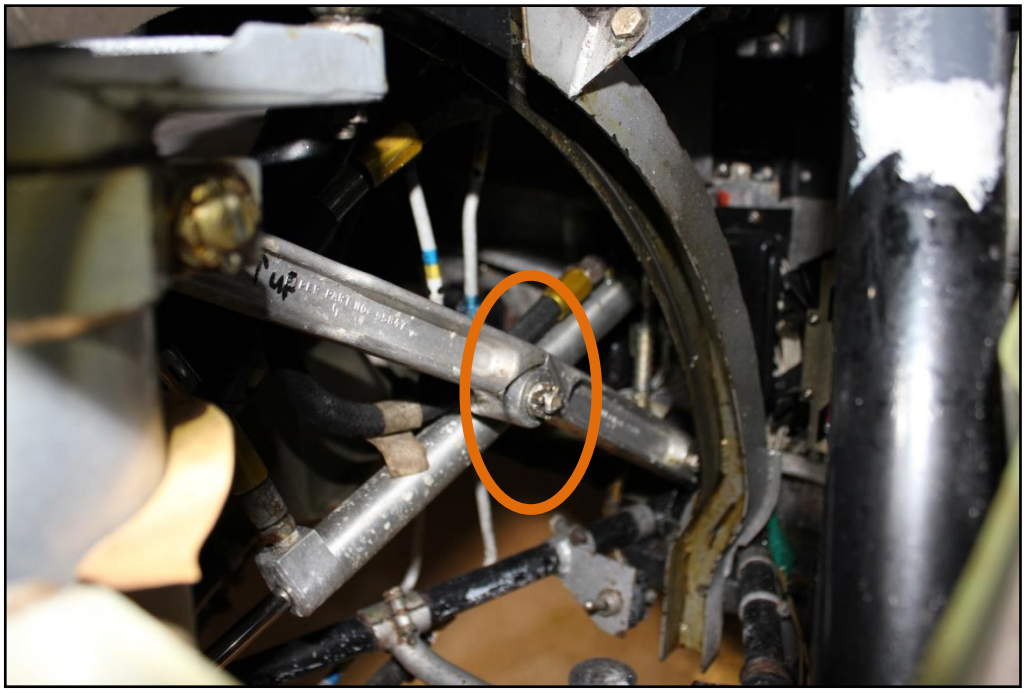

Photo No. 1: Linkages as found with no geometric lock in evidence.

The down lock link was closely examined. This link is a spring-loaded device which is set to a specific length so as to ensure that during extension it applies a load to the lower drag link, thereby forcing it into an over-centre, geometric lock with the upper drag link. Effective spring action is critical to maintaining the correct length of the down lock link. It was noted that this link had suffered crush damage and permanent distortion of the pin holes (**Photo No. 2**) and as a consequence the down lock link was not properly spring loaded to the correct length.

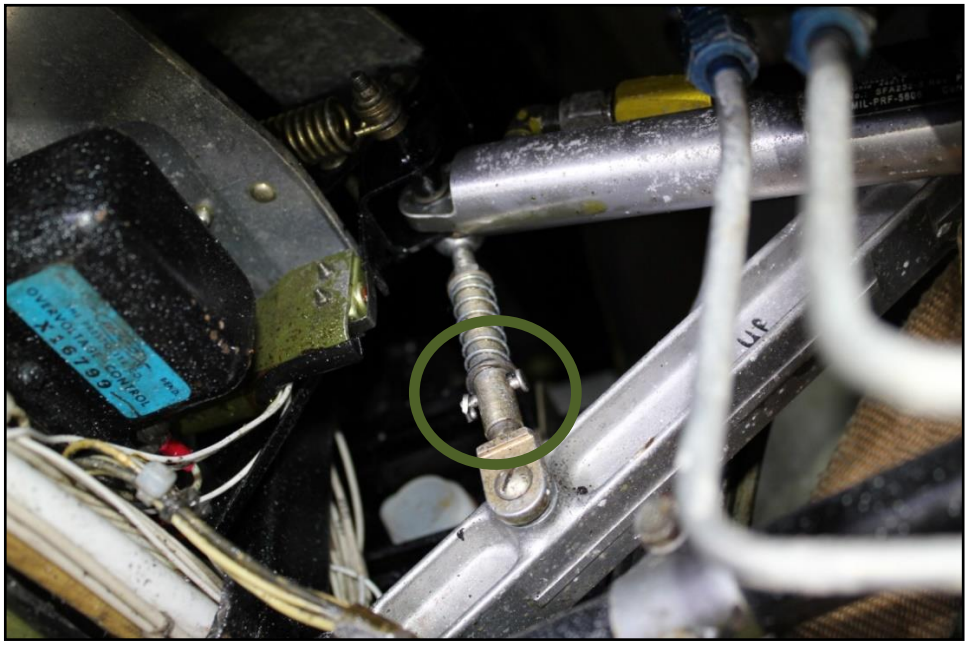

Photo No. 2: Down lock link crush damage at the pinholes.

On removal of the down lock link it was further noted that the centre pivot bolt which passes through the upper eye-end of the down lock link, securing it to the aircraft structure, had failed in bending (**Photo No. 3**).

Photo No. 3: Failure in bending of the down lock link bolt.

Closer examination revealed the extent of the pin hole elongation and confirmed the failure of the spring loading which is necessary to ensure correct link length (**Photo No. 4**).

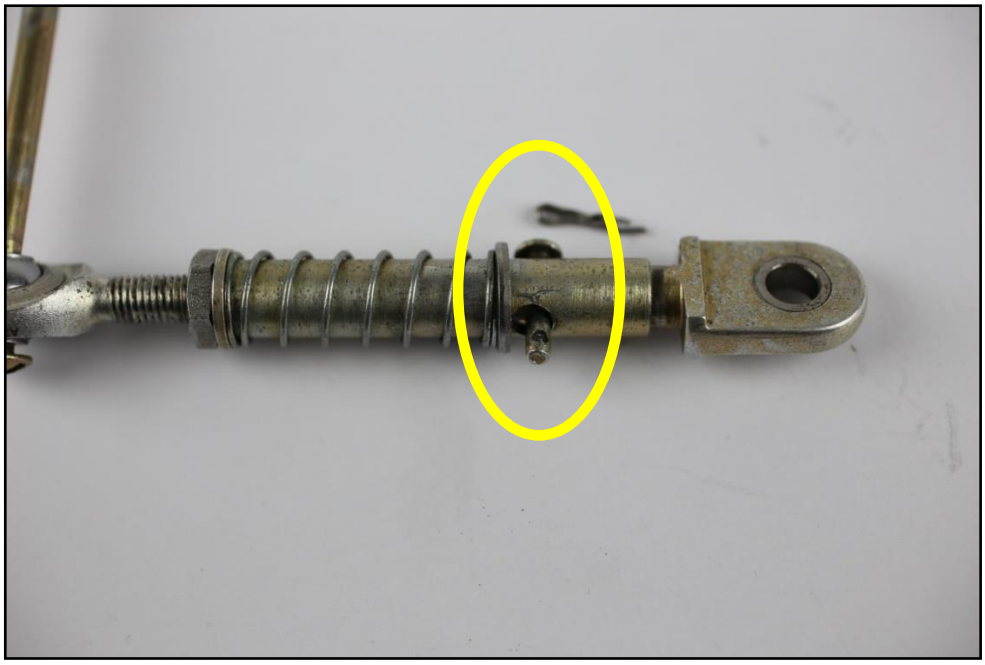

Photo No. 4: Down lock link elongated pin holes and improper spring loading.

1.3 History of such events

There have been many reports by Safety Investigation Authorities (e.g. The UK Air Accidents Investigation Branch (AAIB)) into similar NLG collapses (c.f. AAIB Bulletin: 3/2002, Ref: EW/C1999/10/5 and AAIB Bulletin: 7/2011, Ref: EW/G2011/03/08). The AAIB made a number of Safety Recommendations and the US Federal Aviation Administration (FAA) conducted a review of similar occurrences. The manufacturer made a number of amendments to the Aircraft 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 SB was amended to Revision 'A' in November 2004 and to Revision 'B' in April 2006.

On 8 August 2005, the FAA issued Airworthiness Directive (AD) No 2005-13-16, which mandated compliance with Manufacturer's SB 1123A.This AD states, "*There are 71 SDRs [Service Difficulty Reports] that describe the collapse or involuntary retraction of the NLG [Nose Landing Gear] …The exact cause of the collapse or involuntary retraction of the NLG cannot be determined*". And elsewhere in the AD it stated "*The FAA in collaboration with Piper has examined this issue for the past 5 years. Piper conducted several ground and flight tests in an effort to determine the source of the problem. Unfortunately, due to the complicated design of the NLG, Piper could not isolate one specific problem*."

1.4 Aircraft Records

The aircraft maintenance records and log books were reviewed by the Investigation with particular emphasis on the NLG. No anomalies were noted.

All prescribed maintenance had been accomplished and certified on time. Maintenance personnel who were interviewed were fully conversant with the maintenance procedures for NLG linkage adjustment and were aware of the tolerance sensitivity of the linkage parts and adjustment.

The incoming stores certification for the NLG down lock link (FAA Form 8130-3) and for the eye-end bolt (Certificate of Conformance) were examined and found to be in order.

The aircraft records contained no recent reports of heavy landings or defects with the landing gear.

2. ANALYSIS

This aircraft type has a history of NLG collapse events. A five year study by the Manufacturer and the FAA did not isolate a root cause for this type of event.

In the case of this particular aircraft, examination of the aircraft maintenance and operational records did not reveal any issues relating to maintenance or operational history which could explain why the NLG collapsed. There was a failure in bending of the down lock link bolt. There was also an elongation of the pin holes in the down lock link barrel which resulted in a loss of effective spring loading and hence loss of length in the down lock link.

It is probable that the bending failure of the down lock link bolt and/or the elongation of the down lock link pin holes (and associated loss of effective spring loading) resulted in a situation where the length of the down lock link was insufficient to maintain the over-centre geometric locking between the upper and lower drag links. It was not possible to determine when, why or in what sequence the bending failure and hole elongation occurred. Once geometric locking between the upper and lower drag links was lost, the NLG retracted under the applied loads during the landing roll.

3. CONCLUSIONS

(a) Findings

1. The aircraft carried out a normal approach and landing on RWY 25 at EICK.
2. During the landing roll the NLG retracted.
3. The aircraft nose cone and propellers contacted the runway, sustaining substantial damage.
4. Examination of the aircraft maintenance and operational records did not reveal any issues relating to maintenance or operational history which could explain why the NLG collapsed.
5. The Piper PA-34 aircraft type has a history of NLG collapse events.
6. A five year study by the Manufacturer and the FAA did not isolate one specific problem which was the root cause for this type of event.
7. There was a failure in bending of the down lock link bolt.
8. There was also an elongation of the pin holes in the down lock link barrel which resulted in a loss of effective spring loading and hence loss of length in the down lock link.
9. There is a known propensity of the complicated landing gear design on this aircraft type to suffer from NLG retraction for reasons that the FAA and the Manufacturer have not been able to determine.

(b) Probable Cause

The bending failure of the down lock link bolt and/or the elongation of the down lock link pin holes (and associated loss of effective spring loading) resulted in a situation where the length of the down lock link was insufficient to maintain the over-centre geometric lock between the upper and lower drag links.

4. SAFETY RECOMMENDATIONS

This Investigation does not sustain any Safety Recommendations.

- END -

In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No. 996/2010, and Statutory Instrument No. 460 of 2009, Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulation, 2009, the sole purpose of this investigation is to prevent aviation accidents and serious incidents. It is not the purpose of any such investigation and the associated investigation report to apportion blame or liability.

A safety recommendation shall in no case create a presumption of blame or liability for an occurrence.

Produced by the Air Accident Investigation Unit

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