

ACCIDENT

Aircraft Type and Registration:	Piper PA-34-200T Seneca II, G-ROUS	
No & Type of Engines:	2 Continental Motors Corp TSIO-360-EB piston engines	
Year of Manufacture:	1978	
Date & Time (UTC):	12 November 2008 at 1525 hrs	
Location:	Oxford Kidlington Airport	
Type of Flight:	Training	
Persons on Board:	Crew - 3	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damage to left landing gear retraction mechanism, left wing tip, left aileron hinge bracket, left aileron and flap	
Commander's Licence:	Commercial Pilot's Licence	
Commander's Age:	47 years	
Commander's Flying Experience:	2,684 hours (of which 965 were on type) Last 90 days - 87 hours Last 28 days - 39 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further investigation by AAIB	

Synopsis

Whilst flying a routine training circuit, the occupants heard a loud bang as the landing gear extended and the 'gear unsafe' warning light remained illuminated. When the aircraft landed, the left main gear leg collapsed and the aircraft departed the runway. It was later identified that the retraction fitting had failed.

History of the flight

The aircraft departed from Oxford Kidlington Airport for a 30-minute training flight with the instructor in the right-hand seat and student pilots in the left and rear seats. The departure and initial climb into the Runway 19 circuit were flown by the student and apparently passed

without incident. After the aircraft had turned downwind the student attempted to lower the landing gear. As the main gear deployed there was a loud bang. The green 'gear down and locked' indication lights illuminated for the right main and nose gear but not the left main gear. The red 'gear unsafe' warning light also remained on. The instructor told the student pilot to continue flying the circuit as normal. Once the aircraft had turned onto the base leg the instructor recycled the gear up and down, but the gear indication lights returned to the same state. The aircraft continued onto final approach and the instructor informed the tower controller of his problem, requesting a visual check of the gear as the aircraft

passed over. Both the tower controller and the pilot of an aircraft located at the runway holding point advised that the gear appeared to be down.

The instructor initiated a go-around and selected the gear UP, but the 'gear unsafe' warning light remained illuminated. Again, the instructor told the student pilot to continue to fly a normal circuit and on the downwind leg he advised ATC of his intention to land this time. During the downwind leg, the instructor confirmed that the indication was correct by interchanging the bulbs from the left and right main gear green lights. At the end of the downwind leg, the instructor used the emergency gear lowering switch to extend the gear, but this made no difference to the cockpit indication. The instructor then became the handling pilot to fly the final approach and landed on the right main gear, attempting to hold off the left main gear for as long as possible. When he felt the left wing drop below its usual orientation, he feathered both props and retarded both the mixture levers. The left wing then contacted the runway and the aircraft veered round to the left, departing onto the grass at relatively low speed, before coming to rest with the tail still over the tarmac. The aircraft was rapidly shut down and all three occupants departed through the rear door.

Landing gear system (Figures 1 and 2)

The aircraft is equipped with a retractable tricycle landing gear, hydraulically extended and retracted by an electrically powered reversible pump. When the gear is 'down and locked' this is indicated by three green lights, located above the gear selector switch. Activation of all three gear down limit microswitches will shut the hydraulic pump off and energise the green lights. A red light at the top of the instrument panel illuminates when the gear is 'unsafe' (neither limit switch has contacted). As engine manifold pressure drops below approximately 14 inches of mercury, and

if the landing gear has not been extended, a throttle switch located in the quadrant will actuate a warning horn indicating to the pilot the landing gear is still up. The warning horn will continue to operate until the landing gear is down and locked.

The landing gear is normally extended and retracted by means of the gear selector switch. In the event of hydraulic or electrical system failure the gear can be extended by pulling the free-fall valve, thus bypassing the hydraulic fluid and permitting the gear to fall under gravity. Once the gear is down, a spring maintains the side-brace truss assembly in the locked position until released by hydraulic pressure. There is also a downlock hook which prevents the truss assembly from moving until the gear is hydraulically retracted.

The hydraulic actuator ram for the main gear leg is attached to a retraction fitting. The fitting is located at the top of the truss assembly and is a key component in the extension and retraction system. The spring assembly and downlock hook mechanism are also attached to this fitting. As the hydraulic actuator ram extends, the fitting rotates forward, pushing the truss assembly against the spring pressure until the gear leg is down and the over-centre position of the truss assembly is reached. The downlock hook is also pushed forward by this action until it latches onto the lower truss link. Retraction of the gear works in the opposite sense, with the downlock hook being pulled off the lower truss link, as the retraction fitting and upper truss link rotate back with the retracting hydraulic actuator ram.

Engineering inspection

Inspection of the left landing gear identified that the retraction fitting had failed along three fracture lines (Figure 3). This had resulted in the top sections of the lugs, where the hydraulic actuator eye end and

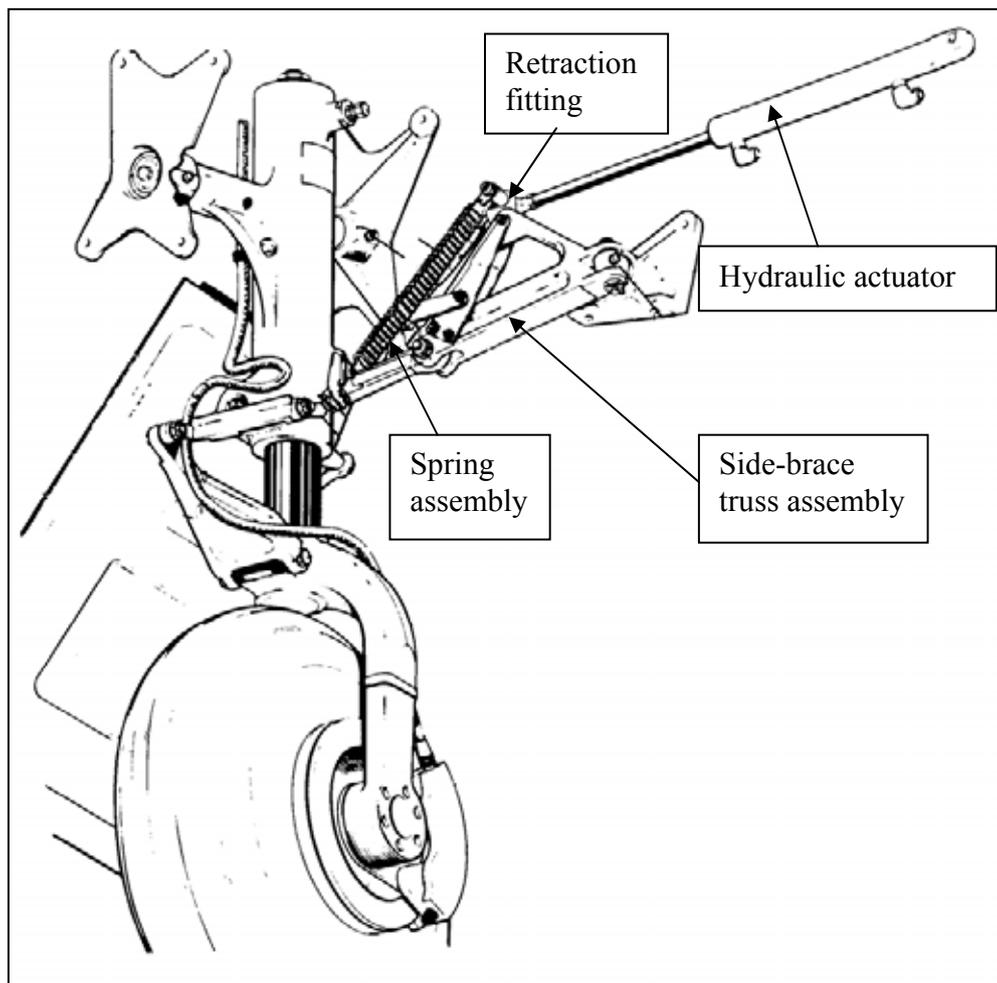


Figure 1

Main landing gear

the spring are attached, separating from the lower half of the fitting, which remained bolted to the truss assembly. A section of the retraction fitting, forward of the attachment point for the downlock hook assembly, was missing completely. The downlock hook assembly had detached from the retraction fitting and was lodged between the down limit microswitch plate and the lower truss link assembly.

Detailed inspection of the retraction fitting identified various impact and wear marks, specifically around each of the bolt holes and on the body of the fitting. A wear mark on the rear under-surface of the fitting also

correlated with a witness mark on the truss assembly. The retraction fitting had been installed on the aircraft, as new, three years (1,508 flight hours) previously. The fitting is an aluminium silicon casting and the fracture surfaces had a characteristic granular appearance. The fracture surfaces for failures B and C were significantly darker in colour than for failure A and showed evidence of polishing of the raised sections of the surface.

Analysis

The discolouration and polishing exhibited on the fracture surfaces of failures B and C suggest that these failures occurred prior to failure A. All the fracture

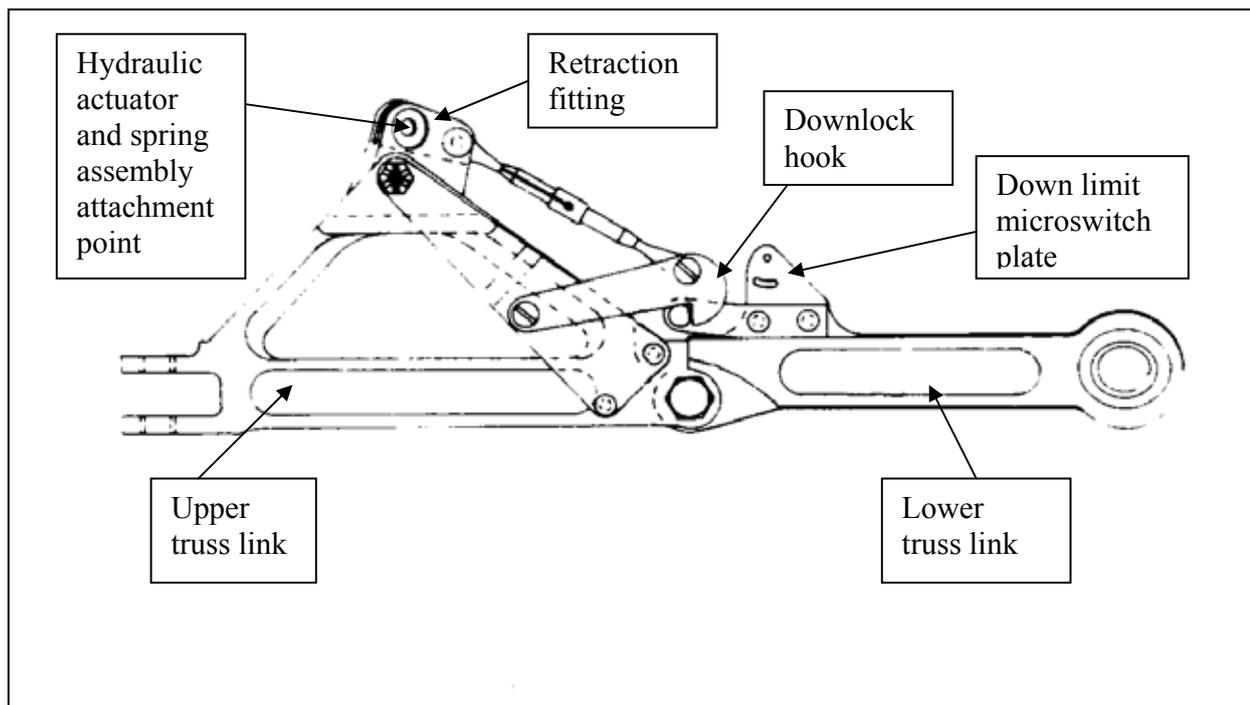


Figure 2
Side-brace truss assembly

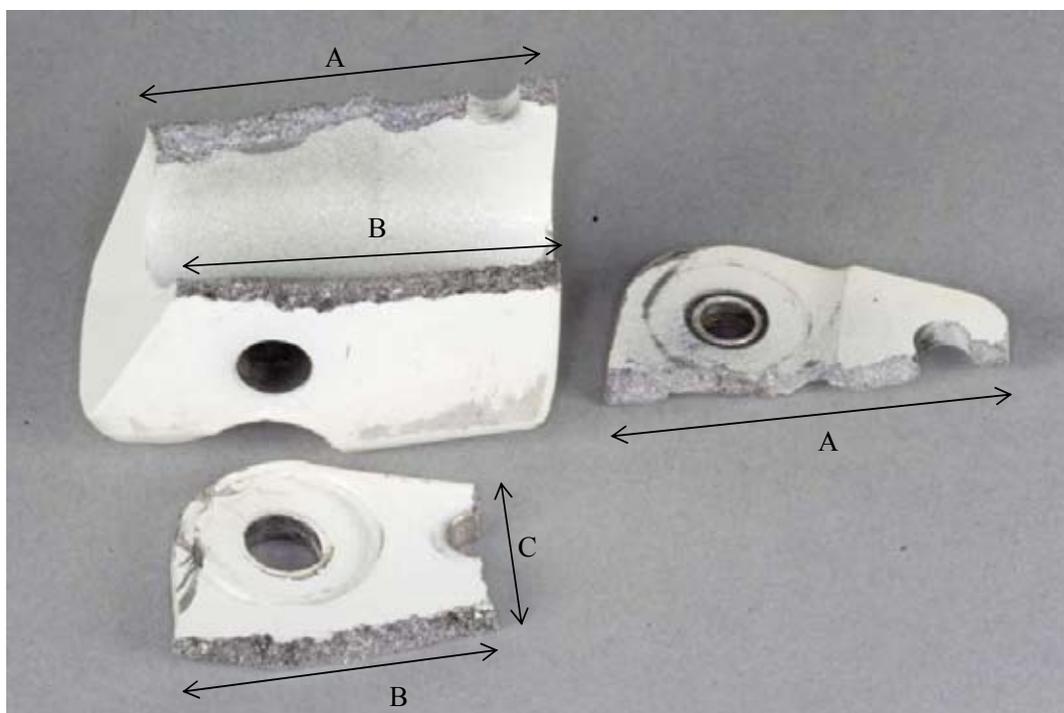


Figure 3
Failed retraction fitting

surfaces were consistent with ductile overload. Cast aluminium has low fracture toughness and is susceptible to shock overload type failures.

Failures B and C probably occurred during a retraction cycle in a previous flight, when the load generated by the downlock hook release was applied to the fitting through the downlock hook assembly for reasons that are not evident. Continued operation of the gear meant that the fitting and downlock assembly would not be working symmetrically, causing the bolt holes in the fitting to wear. This may eventually have resulted in the downlock hook dropping to a lower position than normal during the first extension cycle of the accident flight and, rather than hooking around the 'stop' on the lower truss link, it butted against it. As the hydraulic ram tried to extend the gear fully, the load would be transferred up the downlock assembly and into the remaining intact side of the retraction fitting, causing it to fail in overload and the downlock assembly to drop down.

The gear would therefore have been 'down' as observed by the tower controller and holding pilot. However, the lack of hydraulic actuator connection or downlock hook securing the side-brace truss meant that it was not over-centre and not locked, leading to the cockpit indication observed by the instructor. When the aircraft landed, the unsupported gear leg then collapsed under the weight of the aircraft, trapping the downlock hook assembly as found during the aircraft recovery.

Conclusion

The operator has commenced a fleet-wide inspection programme of the retraction fitting and truss assembly at the next 100 hour maintenance check, with a repeat inspection each annual maintenance check. At the time of writing, six aircraft have been inspected with no adverse findings. The operator also comments that this is the first failure of a retraction fitting in their extensive experience of operating this aircraft type.