

Piper PA-34-200 Seneca, G-TEST

AAIB Bulletin No: 8/2004	Ref: EW/G2004/01/07	Category: 1.3
Aircraft Type and Registration:	Piper PA-34-200 Seneca, G-TEST	
No & Type of Engines:	2 Lycoming IO-360-C1E6 piston engines	
Year of Manufacture:	1974	
Date & Time (UTC):	21 January 2004 at 1533 hrs	
Location:	Stapleford Aerodrome, Essex	
Type of Flight:	Training	
Persons on Board:	Crew - 3	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Right wing, landing gear and propeller damaged	
Commander's Licence:	United Kingdom Basic Commercial Pilot's Licence	
Commander's Age:	52 years	
Commander's Flying Experience:	3,200 hours (of which 990 were on type)	
	Last 90 days - 60 hours	
	Last 28 days - 20 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional AAIB investigation	

Circumstances

After completing an instrument training detail the aircraft made a visual landing on the asphalt element of Runway 22, utilising full flap. The commander stated that following a normal touchdown "slight to moderate braking was applied" after rolling approximately 70% of the runway distance. Without warning the right main landing gear collapsed and the aircraft veered through 90° to the right before coming to rest close to the edge of the runway. There were no injuries to the occupants.

Examination of the right main landing gear oleo strut

It was found that the right main landing gear oleo strut, which consisted of a cylindrical tube, had fractured close to its lower end, within the 'half fork' assembly that mounted the wheel axle (see Figure 1). This had allowed the wheel and half fork assembly to break away, with the remaining portion of the oleo tube contacting the runway.

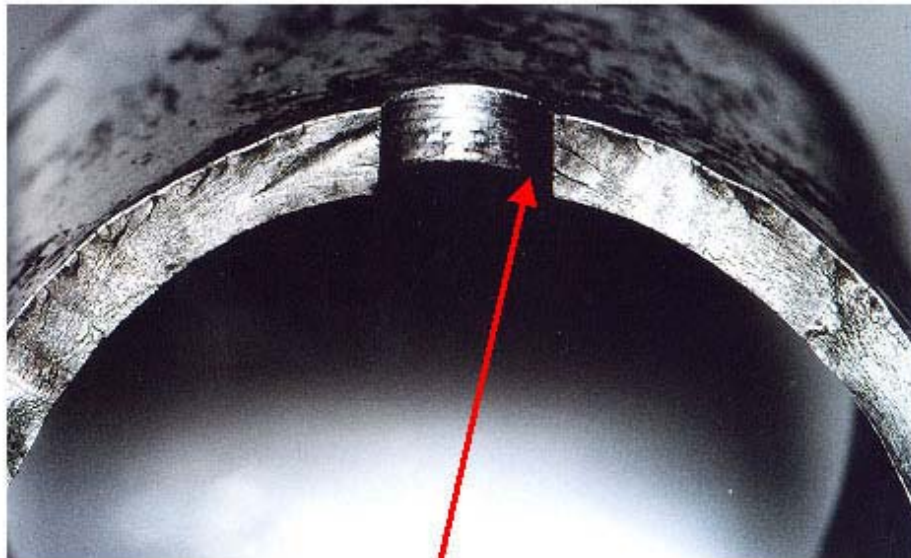
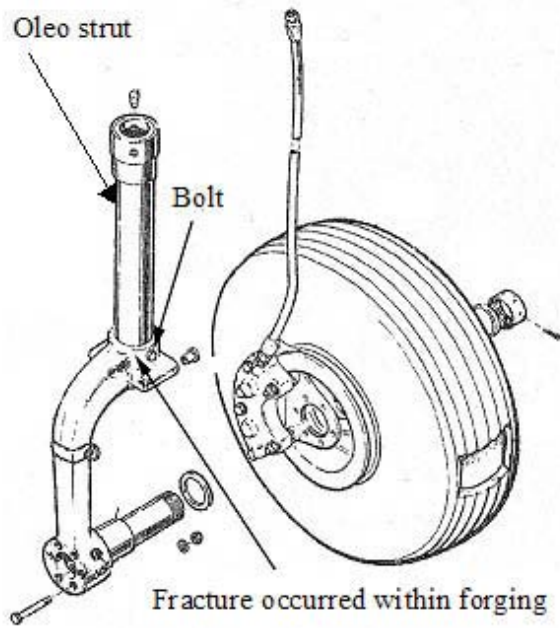
The tube, which was an interference fit within the wheel fork forging, was attached to it by means of a bolt located in a fore-aft direction across the diameter. The lower portion of the tube had been

retained within the forging, and it was apparent that the plane of the fracture passed through the forward bolt hole and just above the aft hole. The mating fracture surface on the upper portion of the strut had been heavily abraded by the runway surface.

The components were subjected to a metallurgical examination, although most of the evidence had been removed from the upper fracture face due to abrasion damage. The separated lower portion was removed from the half fork, which had protected it from damage. It was found that the failure had resulted from a fatigue mechanism originating at the forward bolt hole. This had propagated around 25% of the circumference of the strut before separation occurred as a result of a rearwards bending overload. The fatigue cracking had initiated in the bore of the hole from multiple sites, with progression initially being slow. It was considered that the process could have started shortly after the component entered service.

Examination of the bore revealed that the surface finish was very poor as a result of 'abusive machining' that had occurred during the drilling of the hole (see photograph in Figure 1). Such abuse could have taken the form of a blunt drill, lack of machining lubricant, or too fast a feed speed. The effect of this would have been to considerably reduce the fatigue resistance of the component. The surface finish of the aft bolt hole was similarly poor, although no fatigue cracks were evident.

Figure 1: Details of G-TEST oleo strut failure



Details of fatigue failure (above) and poor surface finish of hole bore (left), due to machining abuse

Figure 1. Details of G-TEST oleo strut failure

(Photos: H T Consultants)

The normal in-service loads on the oleo tube would arise from landing, braking and taxiing, and would impart bending stresses in the tube. The rearward bending loads would be greater than the

forward ones, primarily due to the landing and breaking elements. In the absence of any evidence of abnormal loading, it was concluded that the failure of the tube resulted from long-term service loads acting on a component with considerably reduced fatigue resistance due to machining abuse.

Aircraft history

As noted above, the aircraft was built in 1974, but did not come onto the UK register until July 1989. An incident occurred in August 1991 in which the right landing gear collapsed as a result of a failure of the trunnion housing. The lower section of the landing gear, including the oleo tube and wheel fork, were not changed during the subsequent repair; it is thus conceivable that they were the original items fitted at aircraft build. There was no evidence of a repair ever being conducted on the oleo tube; in any case it is unlikely that the lower portion would ever be touched, as the tube, half fork and wheel axle are delivered from the manufacturers as a complete unit. Furthermore, as the tube is an interference fit in the half fork forging, the area around the bolt holes cannot readily be accessed or inspected. It is thus probable that the machining abuse occurred at manufacture.

Although the United Kingdom Civil Aviation Authority has numerous records of landing gear failures occurring to PA-34 series aircraft, none was similar to this particular case.