AAIB Bulletin No: 12/95	**Ref: EW/G95/09/11**	**Category: 1.3**

Aircraft Type and Registration:	Piper PA-34-200T Seneca II, G-BMWP
No & Type of Engines:	2 Continental TSIO-360-E piston engines
Year of Manufacture:	1975
Date & Time (UTC):	14 September 1995 at 0830 hrs
Location:	Stapleford Tawney Airfield, Essex
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to right wingtip and propeller
Commander's Licence:	Commercial Pilot's Licence with Instrument and Instructor Ratings
Commander's Age:	43 years
Commander's Flying Experience:	Approx 3,150 hours (approx 300 were on type) Last 90 days - approx 50 hours Last 28 days - approx 15 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot; metallurgical examination of both main landing gear legs

Following a normal approach and touchdown, the right main landing gear collapsed during the landing roll. Minor damage was caused to the aircraft, but neither crew member was injured.

The right main landing gear leg had broken circumferentially at a point level with the lower end of the fillet. Subsequent examination of the left main gear leg revealed a small crack at the point where the fillet joined the aft side of the leg (see the appended photographs). Both legs were forwarded to the AAIB for metallurgical examination.

The main landing gear trunnions (ie legs) were manufactured from aluminium alloy forgings. Externally, both legs were in generally poor condition, with extensive surface corrosion. Some areas were devoid of paint and were heavily corroded. The paint was intact elsewhere, but blisters were present, some of which had perforated as a result of underlying corrosion.

Examination of the fracture faces of the right trunnion showed that the initiation region was both in and adjacent to the forging flash line at the lower end of the reinforcing web. Much of the fractographic evidence had been destroyed as a result of attempts to re-mate the fracture faces after the accident. However it was possible to determine that fracture initiation and initial progression was due to a combination of corrosion and a tension fatigue mechanism. Subsequent progression was the result of stress corrosion until final overload separation occurred.

Eddy-current tests confirmed the existence of a crack in the left trunnion, and the component was cut so that the suspect region could be subjected to bending loads until failure occurred. Analysis of the fracture faces thus produced indicated that the initiation region had been removed by a grinding or sanding process. However, it was apparent that crack progression, like that on the right-hand trunnion, was due to stress corrosion.

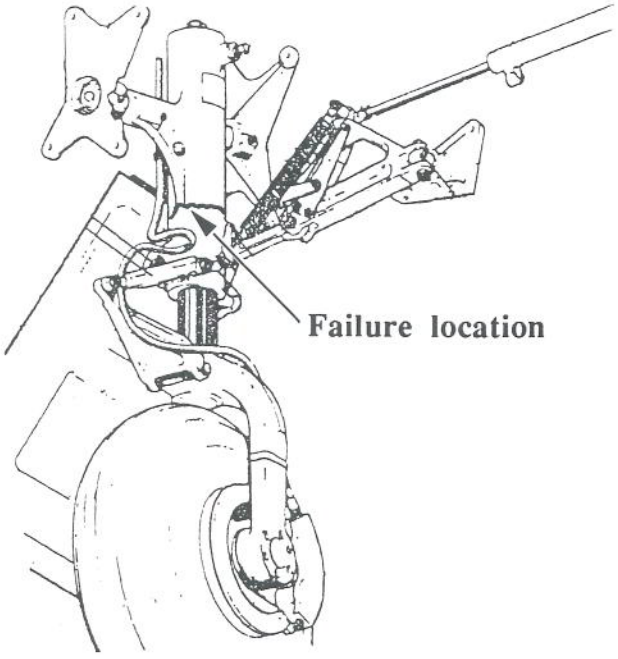
The cracks in both trunnions had originated in the same areas that have featured in other PA-34 and PA-44 trunnion failures. This problem has been the subject of a Piper Service Bulletin, No 787, of which the latest revision, 787B, was issued in August 1993. In June 1988, the UK CAA issued Additional Airworthiness Directive (AAD) No 002-01-88. This effectively reinforced Revision A of SB 787 by imposing a repetitive 100 hour inspection on trunnions with more than 1,000 hours time in service. Cracked trunnions had to be replaced with redesigned components featuring a new part number. However, failures continued to occur following the CAA AAD, leading the AAIB to make a Safety Recommendation, No 93-43, calling for the requirements of AAD 002-01-88 to be reviewed (see accident report on PA-34, G-BORH, published in AAIB Bulletin 8/93). The CAA, whilst accepting this Safety Recommendation, had already submitted comments on a US Federal Aviation Administration (FAA) Notice of Proposed Rulemaking (NPRM), which was intended to address the problem by means of an FAA Airworthiness Directive. In the event, the FAA issued AD No 94-13-11 in August 1994, at which point it formally superseded AAD 002-01-88. AD 94-13-11 used as its basis the provisions of SB 787B, and required all PA-34 and 44 main landing gear trunnions to be inspected after 500 hours time in service, and at 100 hour intervals thereafter, up to a maximum life of 2,000 hours. However, pending arrival of replacement trunnions from the manufacturer, provision was made for extension to 2,500 hours, subject to no cracks being found. Both the SB and the AD made the point that if the trunnion time in service was unknown, then the airframe hours could be substituted. One difference between the AD and the SB is that the latter requires a repetitive 10 hour inspection for trunnions with more than 2000 hours time in service. It states that; *'....it is permissible to permanently remove paint and maintain an alodined surface in the area of inspection to facilitate the ten hour repetitive inspection'*. **Note:** 'alodine' is often referred to as 'alochrom' in the UK. Its use in lieu of paint is questionable in that it forms an extremely thin layer on the surface of the metal which offers little protection against corrosion. Furthermore its presence in, and around, a crack can actually

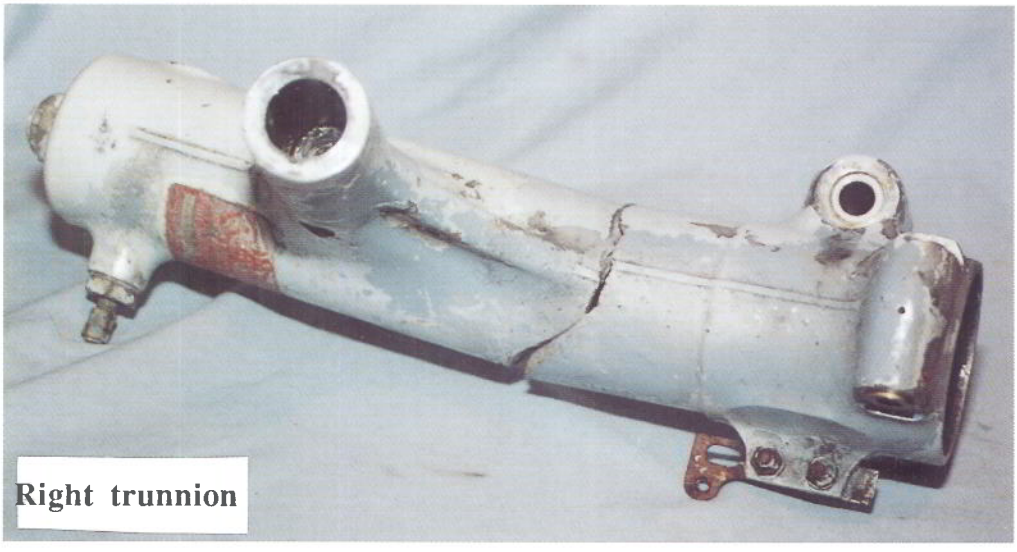
exacerbate the stress corrosion process, which in any event is largely dependant on calendar time, as opposed to flying hours.

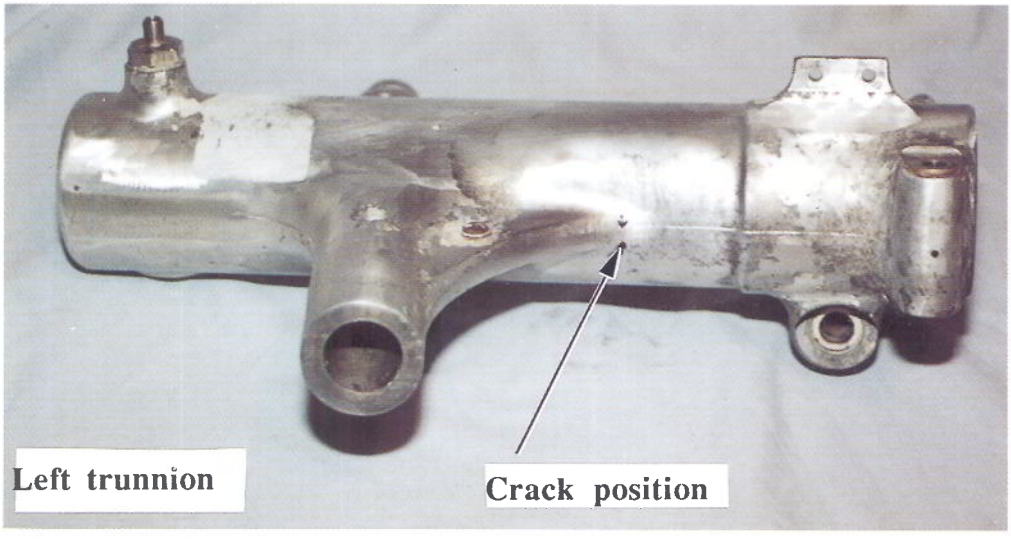
The subject aircraft had achieved in excess of 3,200 flying hours, and there was no record of the trunnions ever having been replaced. However, there was a log book entry to the effect that SB 787B had been complied with in February 1995, despite the trunnions having exceeded their allowable life.

Whilst the AD appears to address the trunnion failure problem by requiring repetitive inspections and component replacement if time in service exceeds 2,000 hours, it may not provide totally adequate protection for older aircraft with low annual utilisation. The following Recommendation has therefore been made to the CAA:

> **95-42:** In order to reduce the incidence of main landing gear leg failures, the FAA should issue an Additional Airworthiness Directive which mandates Piper PA-34 and PA-44 main landing gear trunnion inspections on the basis of calendar time as well as flying hours, in view of the fact that FAA AD 94-13-11 does not appear to acknowledge the calendar time - dependent nature of associated stress corrosion cracking.







Main landing gear trunnions from G-BMWP