Accident

Aircraft Type and Registration:	Piper PA-28-181, G-CCAV	
No & Type of Engines:	1 Lycoming O-360-A4M piston engine	
Year of Manufacture:	1980 (Serial no: 28-8090353)	
Date & Time (UTC):	3 May 2023 at 1120 hrs	
Location:	London Biggin Hill Airport	
Type of Flight:	Private	
Persons on Board:	Crew – 1	Passengers – 1
Injuries:	Crew – None	Passengers – None
Nature of Damage:	Damage to nose landing gear and propeller	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	54 years	
Commander's Flying Experience:	355 hours (of which 355 were on type) Last 90 days – 38 hours Last 28 days – 16 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquires by the AAIB.	

Synopsis

The nose landing gear wheel fork fractured during taxiing causing the nosewheel to detach and the propeller to strike the runway. The cause of the fracture was multiple fatigue cracks from corroded bolt holes in the fork assembly. The CAA has taken safety action to issue a Safety Notice to inspect the fork assembly for corrosion and cracking.

History of the flight

While taxiing, following a normal landing, part of the nose landing gear failed (Figure 1) and the propeller struck the runway surface, stopping the engine.

Aircraft information

G-CCAV is a PA-28-181 built in 1980 and until 2003 was operated as a training aircraft. In 2003 the aircraft suffered a landing accident[1] and incurred significant damage, particularly to the nose landing gear and associated structure. The aircraft was rebuilt but no records of the work were kept.

Footnote

[1] AAIB Report G-CCAV 13 June 2003 [accessed September 2023].

Figure 1

G-CCAV after nose landing gear failure

The nose landing gear of the PA-28 consists of a wheel, fork and strut assembly (Figure 2). The aluminium fork is attached to an attachment block by four $^{5}/_{16}$ inch diameter steel bolts and the strut is retained to the attachment block by a single ¼ inch diameter steel bolt.

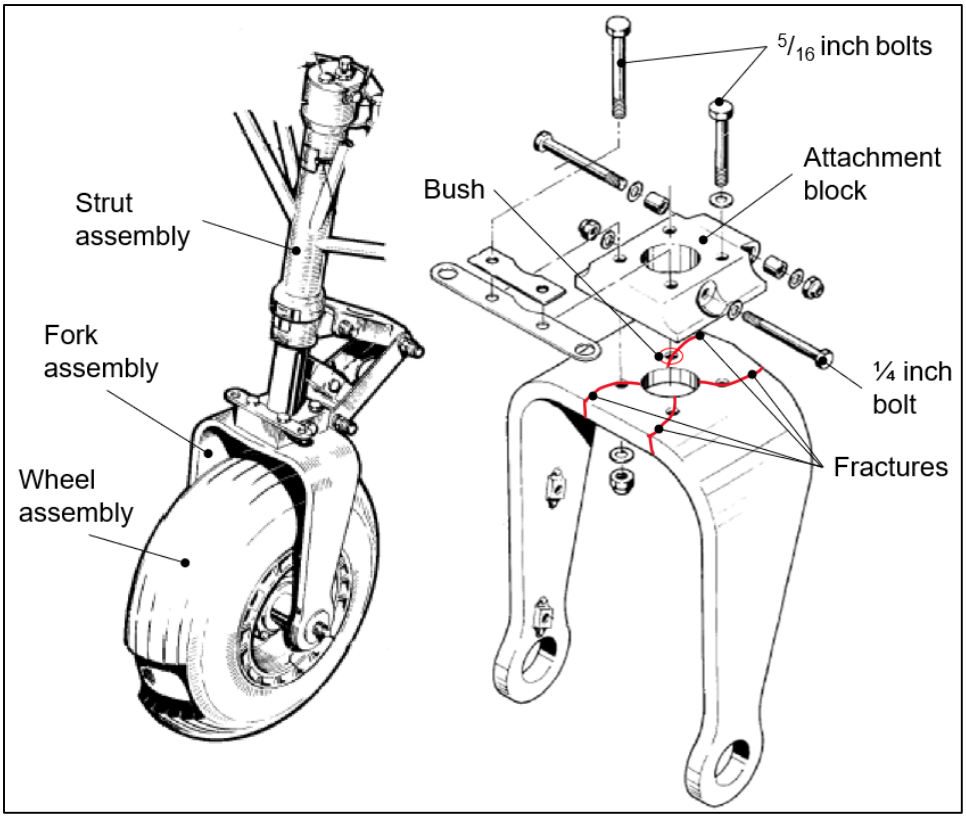

Figure 2

PA-28 Nose landing gear

The aircraft had always been fitted with aerodynamic wheel spats and was predominantly parked on a hard standing, although there was evidence that it had also been parked on grass.

In March 2022 the aircraft underwent its annual inspection and it was recorded on the work sheet: '*Nosewheel Removed Heavy corrosion cleaned and fork re-protected. Nosewheel Hub corrosion rectified and repainted*'. The fork assembly was not removed from the strut assembly to perform these tasks.

Landing gear examination

The fork and strut assembly were inspected and it was determined that the fork assembly had fractured through all four of the attachment block bolt holes (Figure 2). Two pieces of the fork and all the bolts remained attached to the strut assembly and showed evidence of heavy abrasion from the runway surface. There was wear and paint loss on the upper surface of the fork where it was in contact with the attachment block.

The four pieces of the fork were examined using a Scanning Electron Microscope. While most of the surface detail of the fracture faces had been damaged by corrosion, it was possible to observe fatigue striations characteristic of fatigue crack growth. Corrosion pits and additional cracks were observed (Figure 3) in all the bolt holes.

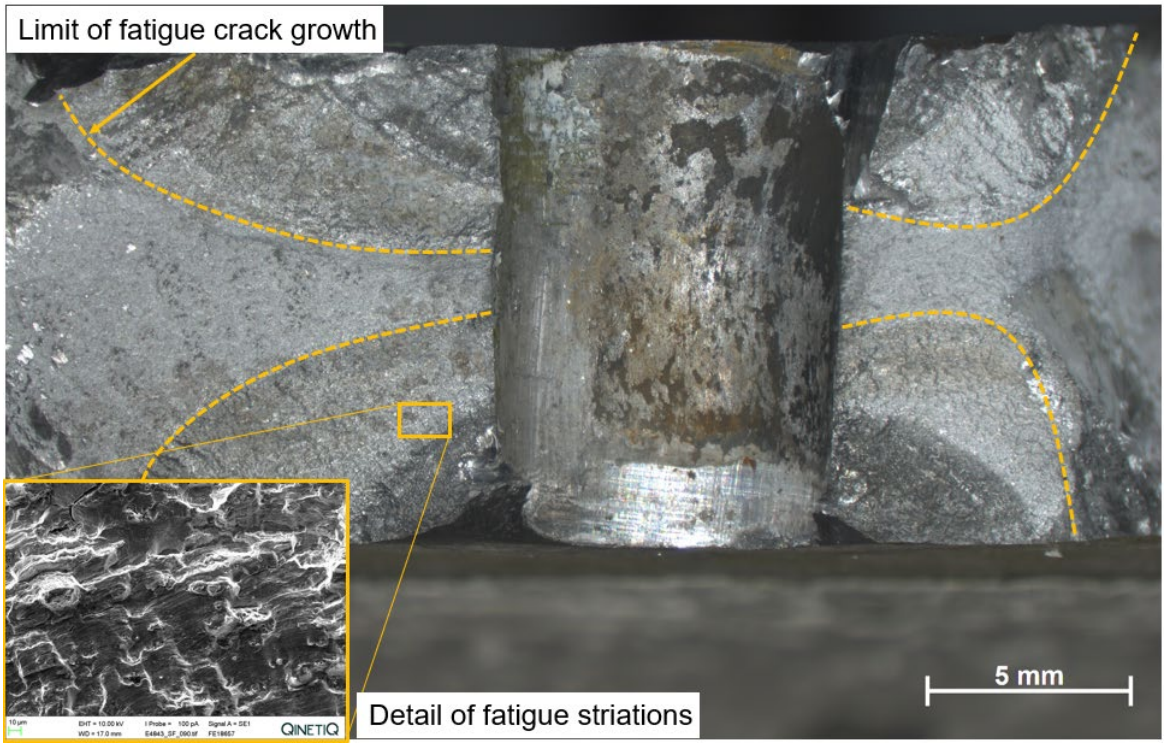

Figure 3

Detail of typical bolt hole showing limits of fatigue crack growth

Right aft bolt hole

In the aft right hole, there was a steel bush which had corroded (Figure 4); there was no visible evidence of a corrosion protective coating on the bush.

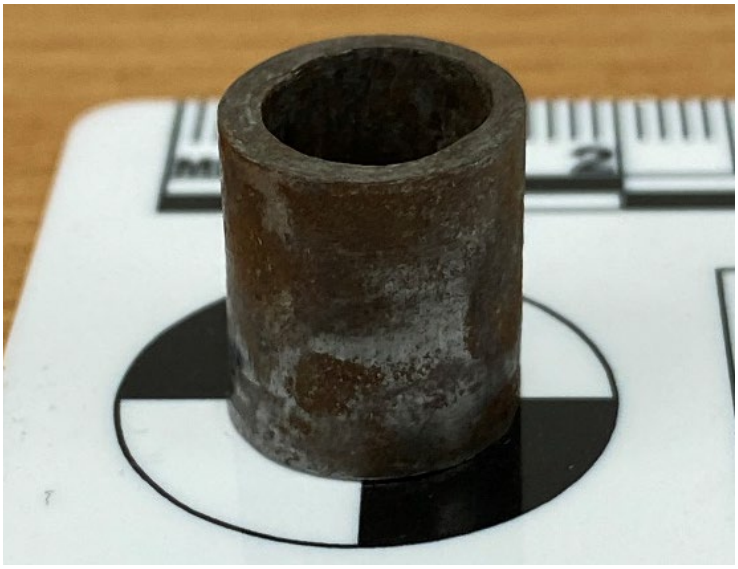

Figure 4

Steel bush

The upper part of this hole exhibited a delaminated structure characteristic of exfoliation corrosion, and it is possible that galvanic corrosion between the aluminium fork and the steel bush may have caused the exfoliation corrosion (Figure 5). The investigation could not find any documentation regarding the installation of this bush.

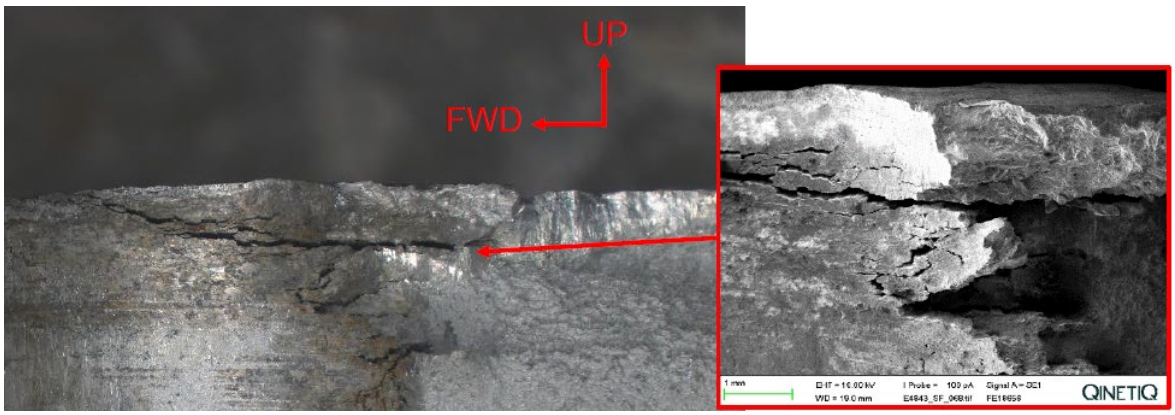

Figure 5

Detail view of right side, aft hole

The hole in the attachment block for the strut assembly was examined and extensive corrosion pitting, cracking around the lower edge and some areas of intergranular corrosive attack were seen.

Airworthiness Bulletin

The Australian Civil Aviation Safety Authority (CASA) published Airworthiness Bulletin 32-019[2] in April 2009 after a series of nose landing failures and recommended operators periodically inspect the interface between the fork and the attachment block. Findings included loose bolts, cracking and corrosion. No similar instructions for continued airworthiness were issued by the FAA, CAA or EASA.

A review of the manufacturer's maintenance manuals for the PA-28-181 aircraft showed that the only corrosion inspection published for the landing gear assembly was a 200-hour interval Special Inspection for aircraft operating in high humidity or salty environments.

Analysis

The failure of the nose landing gear of G-CCAV was caused by fatigue cracks propagating simultaneously from the four attachment bolt holes in the aluminium wheel fork. It was not possible to identify the initiation points for the fatigue cracks due to the level of corrosion on the fracture faces, but there was sufficient evidence to suggest that they would all have started from corrosion damage. The justification for a steel bush could not be determined but it was suspected that it was fitted in 2009 following the heavy landing accident. The lack of protective coating on the bush is likely to have caused galvanic corrosion between the dissimilar metals and exfoliation corrosion of the fork. It was deemed unlikely that this bush would have been a factor in the initiation of fatigue cracks in the other holes.

During maintenance in March 2022 the fork was retreated and corrosion removed from the nosewheel but no disassembly or inspection of the interface with the fork and the attachment block was undertaken. There was a lack of paint and wear was present between the fork and the attachment block, so it is possible that the four attachment bolts were under-torqued. The insufficient clamping might have resulted in relative movement between the two and resulted in rubbing and wear, further reducing the preload. It is known that under-torqued bolts can be the cause of fatigue initiation at the edges of fastener holes.

The aircraft was always fitted with aerodynamic wheel spats which may have contributed to the level of corrosion. Moisture may have become trapped, especially during times when the aircraft was parked on grass and the enclosed space of the spat would have delayed it drying, increasing the risk of corrosion.

A search of the maintenance instructions from the manufacturer revealed that the only specific corrosion inspection of the landing gear is every 200 hours for aircraft operating in salty or high humidity environments. To bring this issue to the attention of operators and maintenance organisations in the UK, the CAA has taken the following Safety Action that will require disassembly of the fork assembly:

Footnote

[2] CASA Airworthiness Bulletin 32-019 [accessed September 2023].

The CAA intend to issue a Safety Notice to advise operators and maintenance organisations on the inspection of the fork assembly at the interface between the fork and attachment block as part of their routine maintenance programme. The visual inspection is to find corrosion or cracking in the fork and report any findings to the CAA.

Conclusion

The nose landing gear fork of G-CCAV failed because of fatigue cracks from the four attachment bolt holes which had initiated from corrosion damage. There are no mandated corrosion inspections of the landing gear other than if the aircraft is operated in salty or high humidity environments.