Gill SA Pulsar, G-BSFA

AAIB Bulletin No: 5/2003	**Ref: EW/G2002/08/13**	**Category: 1.3**
Aircraft Type and Registration:	Gill SA Pulsar, G-BSFA	
No & Type of Engines:	1 Rotax 582 piston engine	
Year of Manufacture:	1992	
Date & Time (UTC):	14 August 2002 at 1845 hrs	
Location:	Gloucestershire Aerodrome, Staverton	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Damage to nose leg and floor aft of firewall	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	40 years	
Commander's Flying Experience:	526 hours (of which 34 were on type)	
	Last 90 days - 26 hours	
	Last 28 days - 11 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and metallurgical examination of failed pin from the nose landing gear	

History of Flight

Whilst taking off from Staverton for a local flight, the nose wheel became detached as the aircraft rotated. The event was not apparent to the aircraft occupants, who were subsequently informed by a radio message from an aircraft preparing to take off behind them. They decided to circle the airfield for 20 minutes while the emergency services were assembled, following which a low approach and go-around was made. This allowed observers on the ground to confirm that the nosewheel and fairing were missing from the aircraft. Another long approach was made, and when it was certain that a go-around was not required, the magnetos were switched off and the propeller rotated to the horizontal position before turning off the fuel and battery master switch. The latter actions were discussed whilst orbiting the airfield and were carried out by the passenger, who also held a current PPL.

After touch down, the nose was held off for as long as possible, with no wheel braking, before the nose leg settled onto the runway. It slid along for about 30 metres before digging in, bringing the aircraft to an abrupt halt. The aircraft occupants were uninjured and exited by the normal means.

Description of the nose landing gear

The nose landing gear strut on this type of aircraft consists of a thick-walled tube, with a castoring nosewheel assembly attached to the lower end. The upper end is welded to a cross tube running beneath the lower edge of the firewall. Lateral bracing is provided by additional tubes welded

between the ends of the cross tube and a point on the strut approximately one third of its length from the top. A drag brace runs from the same point on the strut to the centre member of the engine mount. Some aircraft, including G-BSFA, have a damper incorporated with the strut. The salient features of the nose landing gear are shown in the attached Figure 1.

The detached nosewheel assembly was subsequently recovered from the runway and, together with the strut, sent to the AAIB for examination. An additional strut, which had been removed from the same aircraft soon after its construction, following discovery by the previous owner that the nosewheel attachment pin was bent, was also submitted for examination. The aircraft log book did not record when the nose landing gear was replaced, although it is understood that approximately 20 flying hours had been achieved at that time. It is also understood that the drag brace was changed to one with an integral damper at the same time.

Examination of the nose leg

The nose leg components were subjected to a metallurgical examination. The lower end of the strut had a collar welded to it, apparently made from the same tubular steel. The nosewheel pivot pin passed through the collar and an additional weld bead joined the strut to the portion of the pin protruding above the collar. The pin was found to have suffered a fatigue fracture approximately in line with the upper face of the collar (see Figure 3). The failure occurred as a result of a reverse bending mechanism in the fore and aft direction (see Figure 2), with multiple initiation sites at the surface of the pin on the front and rear sections of the circumference. In addition, multiple secondary fatigue initiation sites were present either side of the fore-aft direction, just below the main plane of separation. This indicated the application of reverse bending loads had occurred either side of the longitudinal axis, ie when the nosewheel was pointing away from the straight-ahead position.

The intact strut with the bent pin was sectioned along the length of the pin, and three discontinuities were apparent, as shown in Figure 4. Additional metallurgical examination revealed that crack 'A' had occurred as a result of a tension fatigue mechanism, with initiation being in the root of the weld. This was approximately in line with the top surface of the collar and so was in a position very similar to the plane of separation in the pin from G-BSFA.

Crack 'B' had initially occurred by a forward bending fatigue mechanism, although this had been followed by a short overload tear with associated plastic deformation. Additional crack growth had then occurred as a result of fatigue.

The discontinuity at 'C' was found be the result of a complete lack of fusion in one side of the weld at this position. It probably had little influence on the development of cracks 'A' and 'B'.

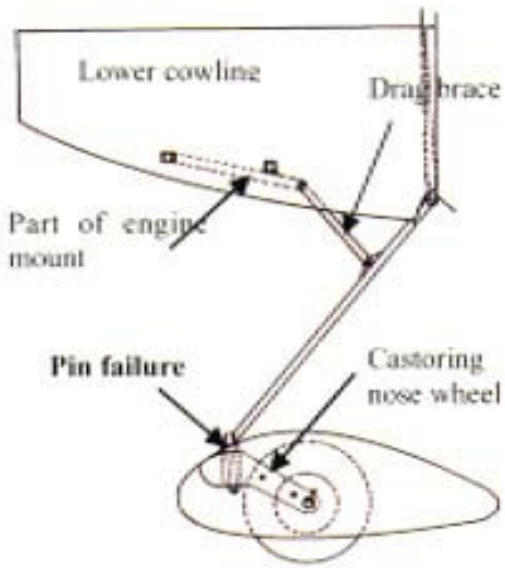

Fig 1. Nose landing gear layout

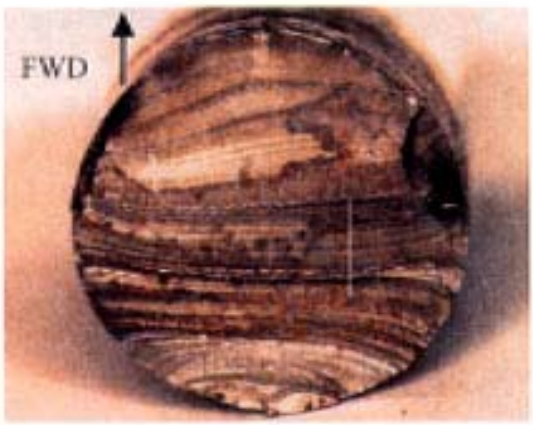

Fig 2. View of fracture face

(Photo: H T Consultants)

Fig 3. Pivot pin and bottom of strut: separation plane within collar is arrowed. (Photo: H T Consultants)

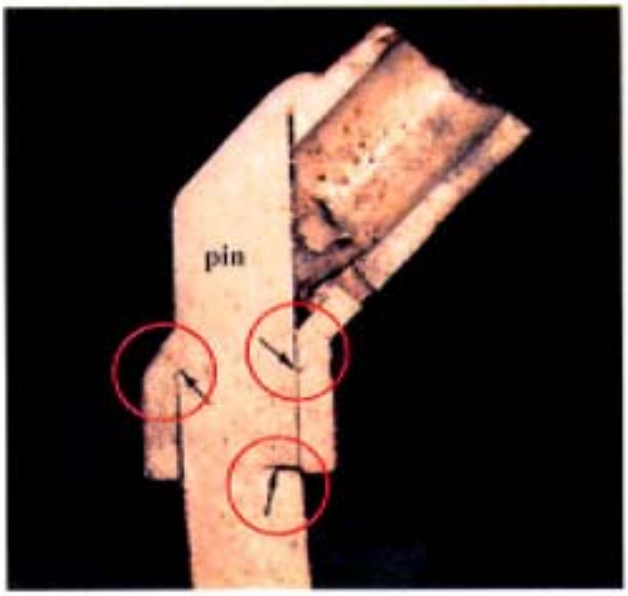

Fig 4. Section through intact strut, showing cracks in pin (A&B) and lack of fusion between collar and tube (C). (Photo: H T Consultants)

Additional metallurgical examination revealed that the strut had been manufactured from steel with a tensile strength of around 55 ton/sq in. It was not considered that the quality of the strut material or the welding contributed to the initiation and progression of the fatigue damage.

Other information

The airworthiness aspects of this aircraft are looked after by the Popular Flying Association (PFA), who have advised that the subject aircraft had achieved more than 300 flying hours, which is high relative to the other 20 or so aircraft on the UK register (even taking into account that the failed leg had actually achieved approximately 20 hours less than this figure). The PFA were not aware of any similar failures having occurred in the UK. Although the aircraft is currently based at Staverton, which has paved runways and taxiways, it was previously operated as a demonstration machine from a grass airfield.

Discussion

The pilot of G-BSFA was grateful for the fact that the detachment of the nosewheel was observed and reported by the pilot of another aircraft. He otherwise would have been unaware of the problem and therefore not taken any precautions prior to the subsequent landing, the consequences of which could have been more severe.

Examination of the failed pin indicated that the failure was the result of a fatigue process, with multiple initiation sites. There was thus no evidence to suggest that a single event, such as a heavy landing had been responsible for the initiation. The examination of the intact strut and pin provided corroborative evidence, for despite the fact that the pin had been subjected to an overload sufficient to produce plastic deformation, fatigue damage was already present.

In the absence of any evidence indicating that this aircraft had been operated in a radically different way to others in the UK, it was concluded that the failure resulted from typical in-service loads. This posed the question of whether the design was suitable for operation from all but the smoothest of surfaces and, as a consequence, whether a "safe life" should be imposed on the nose landing gear. It should be noted that the nature of the installation is not conducive to a reliable inspection method for discovering cracks in the pin.

The owner of G-BSFA has fitted a new nose landing gear, supplied by the aircraft kit manufacturer, which is of a different design to the failed component. The design has been available in the United States for several years but this appears to be the first one imported into the UK. It is currently being evaluated by the PFA.

Safety Recommendation

The findings from the investigation into the accident to G-BSFA have indicated that the failure of the nosewheel castoring pin probably occurred as a result of normal operating loads.

Safety Recommendation 2003-06

It is recommended that the Popular Flying Association conduct a design review of the nose landing gear as fitted to Pulsar aircraft on the UK register and liase with the Experimental Aircraft Association (EAA) in the USA on this matter.