

Avid Speedwing (Modified), G-BUZM

AAIB Bulletin No: 10/2004	Ref: EW/C2004/03/06	Category: 1.3
Aircraft Type and Registration:	Avid Speedwing (Modified), G-BUZM	
No & Type of Engines:	1 Jabiru 2200A piston engine	
Year of Manufacture:	1994	
Date & Time (UTC):	28 March 2004 at 1245 hrs	
Location:	Caernarfon, Wales	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damage to propeller and nose landing gear	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	67 years	
Commander's Flying Experience:	301 hours (of which 172 were on type)	
	Last 90 days - 22 hours	
	Last 28 days - 19 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot with subsequent telephone and written enquires.	

Synopsis

Whilst taxiing, following an uneventful landing, the nose landing gear collapsed. Subsequent investigation revealed that circumferential cracking had developed from a through bolt hole used to retain a stop bushing (or lower bearing sleeve) on the nose gear strut. These holes had been drilled aligned with the fore and aft axis of the aircraft and were in the area of highest stress whenever the gear flexed, for example, during touchdown. It was recommended by the manufacturer and the PFA that the axis of this hole should be aligned perpendicular to the line of flight, in the axis of minimum stress loading, which is left to right and parallel to the nose wheel axle.

History of Flight

Following an uneventful flight from Llanbedr, the pilot landed the aircraft on Runway 26 at Caernarfon. The landing was described as normal, with the pilot holding the nose wheel off the runway until the speed of the aircraft had slowed to about 30-36 mph. At the end of the runway, the pilot then steered the aircraft onto the taxiway but whilst completing a normal left turn, and at a ground speed of about 4 mph, the nose gear collapsed.

Engineering Examination

Subsequent engineering examination of the nose gear strut revealed that it had fractured at the position of a hole drilled through the strut, a hole through which the retention bolt for a stop bushing was located. The axis of this hole was aligned with the longitudinal axis of the aircraft and, consequently, the two holes were located in the higher stress region of the strut when fore and aft deflection of the strut occurred, for example, during touchdown. Over time, the two holes in the strut walls had elongated and circumferential cracks had developed, originating at these holes, Figure 1. The crack surfaces close to the holes exhibited the characteristics of a fatigue mechanism, but the majority of the fracture showed evidence of overload failure, most likely occasioned at the time the nose gear collapsed.

Figure 1 Lower section of failed nose gear. Note the bolt hole orientation



Figure 1. Lower section of failed nose gear. Note the bolt hole orientation

Information supplied by the pilot owner of the aircraft, revealed that the failed nose gear had been purchased as a second-hand item and had been fitted to G-BUZM for about six months. The reason for the need to obtain and fit a replacement nose gear was as a result of the original nose gear suffering a similar fracture of the strut. Since this second-hand replacement gear had been fitted, the pilot had felt a degree of nose wheel shimmy most times when operating the aircraft.

Nose gear failure history.

The failure on G-BUZM is not the first instance of a failure of an Avid Speedwing nose gear strut resulting from the orientation of the stop bushing retention bolt holes. The AAIB reported on a similar accident to G-BTKG (EW/G2003/09/19 Bulletin 11/2003), in which that gear had also previously been fitted to another aircraft. Although the stop bushing had been fitted with its bolt in the left to right axis, it also had (redundant) holes drilled along the fore and aft axis. This strut had then also failed as a result of circumferential cracking originating from the redundant holes.

The Avid Speedwing is usually constructed from a kit. The bolt holes in the nose gear strut are drilled, by the constructor, using the pre-drilled holes in the stop bushing as a guide. The original construction manual, issued in 1988, detailed the drilling of these holes and states:

'Align the drilled holes in the sleeve to be parallel to the nose wheel forks...'

In 1993, the kit manual was updated and the steps for the drilling of the nose gear had been revised, to read:

'Slide the LG22 stop bushing up from the bottom and hold it against the bottom of the fuselage nose fork tubing, with the LG22 pushed firmly against the frame so as to allow no up or down movement, mark the nose gear through the pre-drilled holes in the LG22, and drill...'

Clearly, there is no mention of the orientation of the bolt holes in the revised manual. Due to this omission the following was published in the September 1993 issue of UKAvid, the manufacturer's newsletter to owner/constructors:

'The constructor's manual has a few typos and errors as well as a number of rather misleading bits of information. Referred to page or drawing number the following updates the goofs or offers an improvement. Page 10 Chapter 2 Section II-D Step 1. Drill hole for stop bushing across the nose leg i.e. at 90 degrees to the flight line not inline as this may weaken the leg.'

However, this may not have been read by all of the Avid Speedwing constructors or owners. No changes were made to the manual or any checks required to be made of aircraft in service or under construction. Figure 2a shows a representation of the nose gear with the stop bushing and bolt installed in the fore and aft direction as found on G-BUZM. Figure 2(b) shows the same nose gear representation but with the bolt now installed as detailed in the 1988 manual, parallel to the nose gear forks.

Figure 2 Gear Installation representation showing the stop bushing and bolt orientation

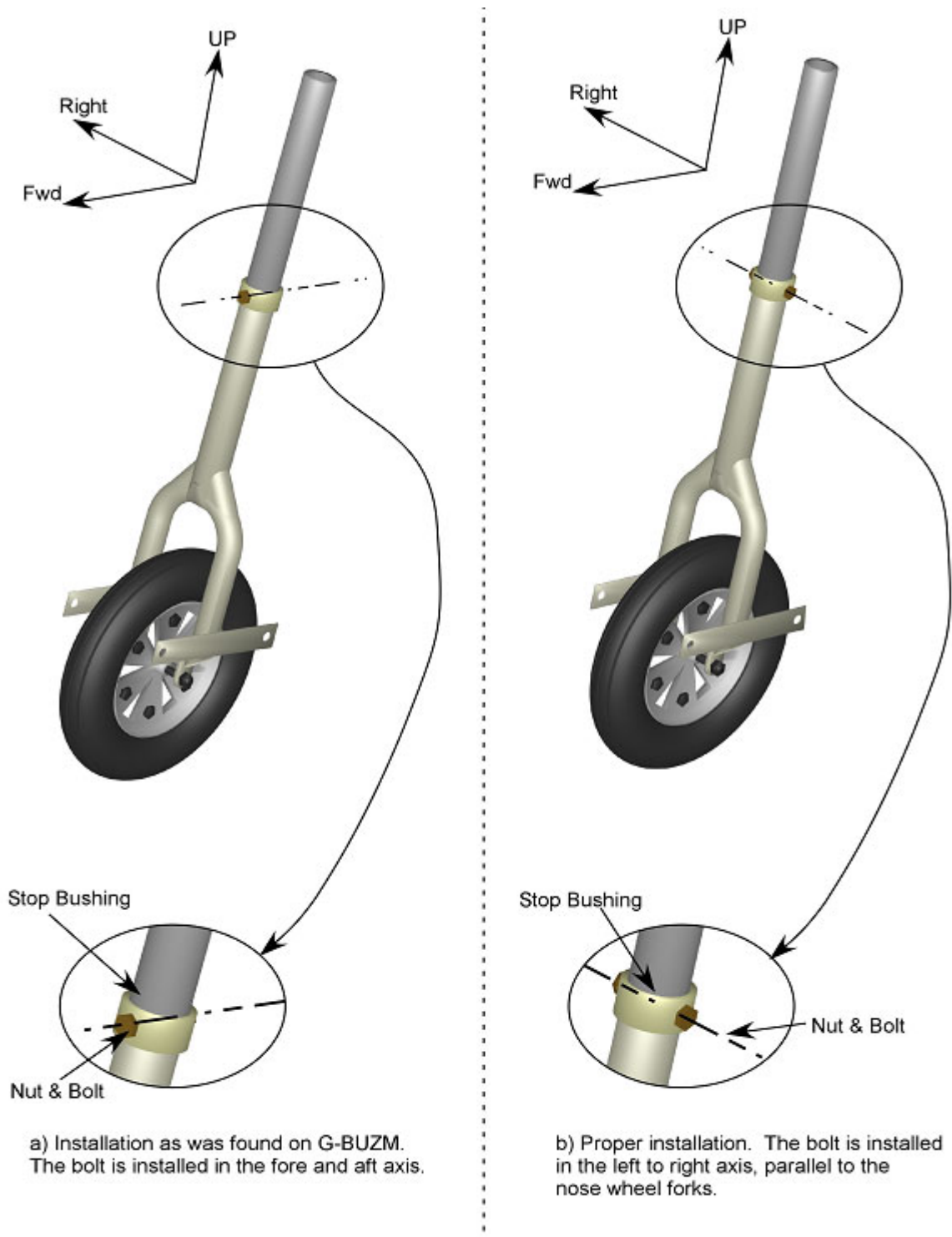


Figure 2. Gear Installation representation showing the stop bushing and bolt orientation.

In December 1993, the PFA issued a modification MOD/189/001 for the Avid Speedwing. This was due to several cases of failed nose legs, but which had been attributed to the lack of strength in the sidewall of the nose leg strut. The modification offered several options, one of which was to replace the nose leg with a new leg that incorporated a thicker, and thereby stronger, sidewall. The failed nose leg from G-BUZM, although second-hand, was of the thicker sidewall material. More

importantly, the modification made a special mention about the drilling of the subject bolt holes in the nose leg strut and states:

'In addition, for either option 1 or 2 above it is recommended that the bolt hole for the bolt attaching the lower bearing sleeve to the leg is aligned perpendicular to the line of flight rather than fore and aft as shown in the build manual'

The stresses experienced by the nose gear strut are usually bending and compressive due to the friction of the nose wheel on the ground and the weight of the aircraft. This would result in the maximum bending induced stresses being concentrated on the fore and aft faces of the nose leg. The placing of a bolt hole in the fore and aft axis puts them in the area of highest stress and results in regions of stress concentration, which then leads to cracking. To reduce this likelihood of cracking the bolt holes should be placed in an area of the lowest stress, which in this case would be parallel to the nose gear forks as shown in Figure 2b and this was as detailed in the original kit construction manual.

Safety Action

Notwithstanding the fact that advice from the manufacturer and the PFA has been published identifying the preferred orientation of the stop bushing retention bolt through the nose gear strut, the failure which occurred to G-BUZM indicates that some aircraft are probably in service with the bolt installed in the incorrect orientation. The following safety recommendation is therefore made.

Safety Recommendation 2004-71

It is recommended that the PFA ensure all Avid Speedwing aircraft under construction or in service in the UK, that are fitted with a nose landing gear, have the nose gear strut installed with the axis of the bolt hole for the stop bushing aligned parallel to the nose wheel axle, and that none have been modified to leave redundant holes aligned with the aircraft longitudinal axis.