ACCIDENT

Aircraft Type and Registration:	Extra EA 300, G-SIII
No & Type of Engines:	1 Lycoming AEIO-540-L1B5 piston engine
Year of Manufacture:	1994
Date & Time (UTC):	7 April 2010 at 1825 hrs
Location:	White Waltham Airfield, Berkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right landing gear, propeller blades and right aileron damaged
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	1,983 hours (of which 327 were on type) Last 90 days - 36 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB enquiries

Synopsis

During the landing roll the right mainwheel assembly detached from its axle. Examination revealed that the four fasteners securing the right axle to the landing gear had failed as a result of the nuts having been pulled from the four attachment bolts. The investigation could not determine the cause of the failure.

It was noted that the threads on the attachment bolts can be damaged when the axles are removed from the landing gear. One Safety Recommendation was made to the aircraft manufacturer that new nuts and bolts should be used when the axles are replaced or refitted to the landing gear.

History of the flight

The pilot reported that the wind was light and variable and the approach to Runway 29 at White Waltham was uneventful. The touchdown and landing roll felt normal until just after the brakes had been applied, when the tail started to lift. As the pilot moved the control column rearwards to correct the aircraft attitude, the aircraft dropped to the right and the propeller blades struck the ground several times. The aircraft then veered to the right and came to rest across the runway.

Inspection of the aircraft and runway revealed that the right axle and mainwheel assembly had detached from the landing gear, which created a gouge in the grass runway as the aircraft came to a halt.

The aircraft was operated by a small syndicate and the pilot involved in the accident stated that there had been no reports of the aircraft having had either a heavy landing, or having landed with a large amount of side slip.

Runway condition

There are three grass runways at White Waltham and the Aeronautical Information Publication (AIP) includes a warning:

> *'the aerodrome surface is rough and undulating.'*

The airfield manager advised the AAIB that Runway 29 probably has the worst surface on the airfield and that they are trialling a realigned runway on a smoother piece of ground.

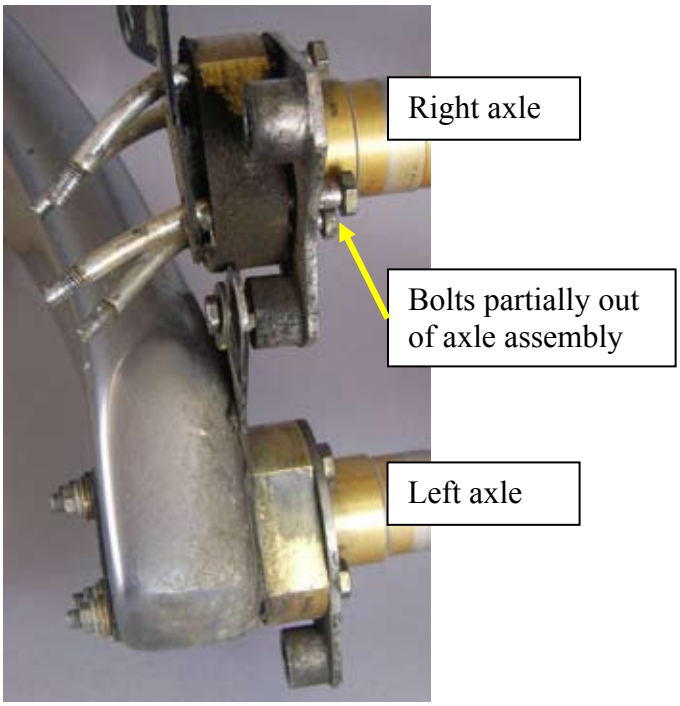

Figure 1
Right and left axles and securing bolts

Aircraft information

The Extra EA 300 is a tandem, two-seat, low-wing aerobatic aircraft equipped with a tailwheel and fixed main landing gear. The axles for the mainwheel assemblies are secured by four bolts to a single U-shaped composite-constructed landing gear, which is attached to the underside of the fuselage. A spat is fitted to each mainwheel and it is not possible to inspect the four bolts, securing each axle to the landing gear, without first removing an access panel.

Damage to the landing gear

Following the accident, the four bolts, which had secured the right axle to the landing gear, were found to be bent and the threads were severely damaged; the nuts were not recovered. The bend in the bolts was consistent with a side load having been applied to the outside of the bottom of the tyre after the bolts had withdrawn out of the axle by around 10 mm to 15 mm. Figure 1 shows the damaged bolts on the right axle next to the left axle, which is still attached to the landing gear.

The landing gear had partially failed at the position where it was attached to the right side of the fuselage. This failure was consistent with the right side of the leg having been dragged along the ground after the wheel assembly had detached from the aircraft.

Previous work on the landing gear

The landing gear leg was last removed in September 2009, 65 flying hours prior to the accident, and the axles were subsequently refitted using the existing nuts and bolts. The maintenance company who carried out the work reported that the nuts had been torqued to approximately 10 nm. The bolts were last inspected when the spats had been removed during the annual inspection, which was carried out on 23 November 2009, 25 flying hours prior to the accident.

Examination of the bolts

The bolts used to secure the right and left axles to the landing gear leg were identified as AN4-28[1] and manufactured from cadmium-plated low-carbon steel. Industry guidelines recommend that the securing nuts should be torque loaded to between 5.6 Nm and 8 Nm. The left axle nuts were assessed as being the correct nuts to be used with the AN4-28 bolts.

Right axle

The threads on all four securing bolts, Figure 2, were extensively damaged and scored as a result of having been pulled through the locating holes in the landing gear leg; this action had destroyed any evidence that might have indicated the nature of any pre-detachment thread failures. However, examination by scanning electron microscopy (SEM) did reveal that the damage to the threads on the bolts was consistent with overload failure in a ductile manner. This damage may have been as a result of the nut having been pulled from the bolt. There was no evidence that any of the nuts had unwound prior to the failure of the threads.

Figure 2

Damaged threads on bolt from right axle

Left axle

The bolts securing the left axle to the landing gear were also inspected by the AAIB and an independent metallurgist.

On each bolt, two washers were fitted between the head of the nut and the backing plate. The torque loading applied to the nuts was assessed as being between 7 Nm and 10 Nm. It was noted that the action of withdrawing the bolts from the axle and landing gear damaged the threads on two of the four bolts. This damage was difficult to detect visually without the use of optical viewing equipment.

One of the bolts was examined by SEM, which revealed cracking and damage to the threads, Figure 3.

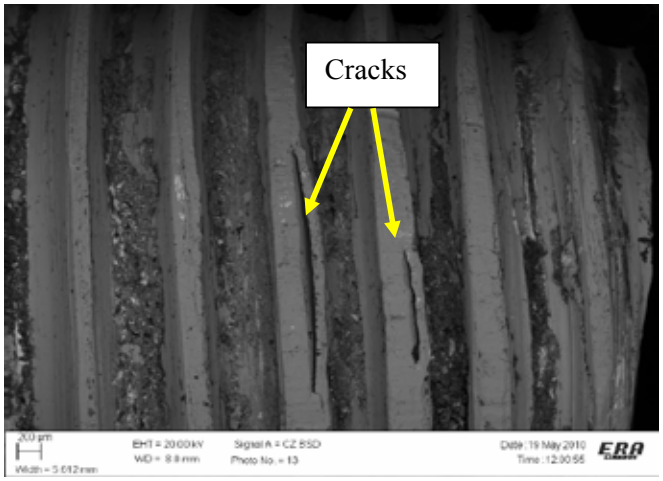

Figure 3

SEM image showing cracks in thread

Manufacturer's comments

The aircraft manufacturer stated that this is the first time they have seen this type of failure on any of the EA 300 series of aircraft, all of which have the same design of landing gear and axles. The policy at the manufacturer's factory is that the nuts and bolts should be replaced with new ones following the removal of the landing gear and

Footnote

[1] ¼ inch diameter, 28 thread per inch, American Unified Fine (UNF) pitch.

axles, although, this advice is not included in the aircraft maintenance manuals. The manufacturer also commented that the nuts should be torqued to 9.5 Nm and that operating from a rough surface can result in a relatively large amount of flexing of the landing gear legs.

Discussion

The four fasteners securing the right axle to the landing gear had failed as a result of the nuts having been pulled off the bolts. However, because of the damage to the threads on the bolts, it was not possible to establish the reason why they failed. There was also no evidence that any of the nuts had unwound prior to the failure of the threads. The bolts on the left axle were identical to those used on the right axle and both sets of bolts were fitted to the aircraft at the same time. The torque on all four bolts on the left axle was found to be close to the industry guidelines, and the manufacturer's recommendation[2]. There is no evidence that the torque on the bolts on the right axle was incorrect.

The damage to the aircraft could not have been due to a heavy landing and, while the bend in the bolts is consistent with a side force having been applied to the outside of the right tyre, there have been no reports of the aircraft having landed with a large amount of sideslip; both mainwheel tyres were undamaged. Runway 29 at White Waltham is considered to be *'rough and undulating'* and the manufacturer has advised that operating on such a surface can cause a relatively large amount of flexing of the landing gear. This flexing, and condition of the runway surface, might result in a large side force on the tyres. However, there have been no failures on other aircraft of similar weight equipped with the same landing gear and axles.

It was noted, from the SEM examination of one of the bolts from the left axle, that there were cracks in a number of threads. It was also noted that the threads can be damaged when the bolts are withdrawn from the landing gear. Had the threads of the attaching bolts on the right axle been cracked, or damaged when the landing gear and existing bolts were refitted 65 flying hours prior to the accident, then it is possible that they might have subsequently failed as a result of normal landing loads. While the manufacturer uses new bolts and nuts each time the axles are fitted to the aircraft, there is no such instruction in the aircraft maintenance manuals. Therefore the following Safety Recommendation is made to the aircraft manufacturer:

Safety Recommendation 2010-046

It is recommended that Extra Aircraft Company advise owners, and include an instruction in the maintenance manual, that new nuts and bolts are to be used when the wheel axles are replaced or refitted.

Footnote

[2] It is not unusual for the torque to relax slightly during normal service.