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):	12 September 2008 at 1825 hrs
Location:	On the runway at White Waltham Airfield
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to the propeller, left hand landing gear strut, left wing and the fuselage
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	9,500 hours (of which 25 were on type) Last 90 days - 130 hours Last 28 days - 28 hours
Information Source:	AAIB Field Investigation

Synopsis

During the landing roll the left landing gear leg fractured, which caused the wheel assembly to detach from the leg. Examination of the failure revealed that the lower area of the composite leg had weakened over a period of time, due to the brake calliper abrading the paint and outer layer of the glass fabric reinforced composite material. This caused cracks to develop and propagate in the cotton flock-filled composite material in the area of the metal flange plate, as a result of lateral flexing of the leg. This abrading and cracking of the composite material allowed contaminants into the plywood core and, over time, caused the plywood to swell. This swelling caused further cracking of the composite material, weakening the lower leg in the area of the wheel attachment, which resulted in a lateral failure.

History of the flight

Following a normal approach, touchdown and landing roll the aircraft veered uncontrollably to the left, pitched nose down and swung through approximately 180° before coming to rest. The pilot switched off all the aircraft services and quickly exited the aircraft with his passenger; neither suffered injuries.

Description of the main landing gear

The Extra 300 is designed as a conventional tailwheel aircraft with a fixed main landing gear. The main landing gear wheels are attached to a single U-shaped composite-constructed carrier, which tapers towards the wheel axle attachment points and is attached to the underside of the fuselage. This composite carrier incorporates the spring and damping for the wheels.

The carrier is constructed from a mixture of glass fibre rovings, glass fabric and cotton flock infused with a epoxy resin. At either end of the composite carrier, where the wheel axles are attached, the composite has a construction consisting of a plywood core overlaid with glass fibre composite. Further up the landing gear legs the construction changes to a sandwich structure, with glass fibre rovings and glass fabric over-wrapping of a foam core. The composite beam is constructed in two sections with the join running longitudinally down the centre line. Following construction, the U-shaped carrier has a number of coats of paint applied.

The aircraft manufacturer redesigned the main landing gear composite U-shaped carrier, which included reinforcing and reshaping the wheel attachment area and strengthening the upper area of the main carrier by wrapping glass fibre fabric round the two sections of the composite beam. This redesigned carrier replaced the original design, which was fitted to G-SIII at the time of the accident, on new-build aircraft and on an attrition basis for existing aircraft.

Engineering examination

On G-SIII the lower part of the composite left landing gear, with the wheel, brake disc, calliper and the wheel spat, had broken away from the leg. The complete main landing gear was taken to QinetiQ for a detailed examination.

Examination of the left landing gear leg showed that the failure appeared to have occurred due to two separate events. One was the abrading of the paint and the outer layer of the glass fabric reinforced composite material at the lower rear area of the leg, which exposed the glass fibre fabric and resulted in local cracking. The other was cracking of the paint and the epoxy-infused cotton composite material around the metal flange plate mounted on the lower inboard surface of the leg. These breaches of the composite material allowed the ingress of contaminants, both solids and liquids. Over time the liquid contaminants penetrated to the plywood core and, when absorbed, increased the volume of the plywood. This increase in volume caused cracks to develop in undamaged areas of the outer layer of the cotton-flock filled composite material which, in turn, allowed an increased ingress of contaminants. Over time this weakened the structure of the lower leg in the area of the wheel attachment, leading to failure. One of the contaminants was identified by smell as being oil-based, most likely hydraulic fluid, which may have a detrimental weakening effect on the resin that binds together the glass fibre fabric.

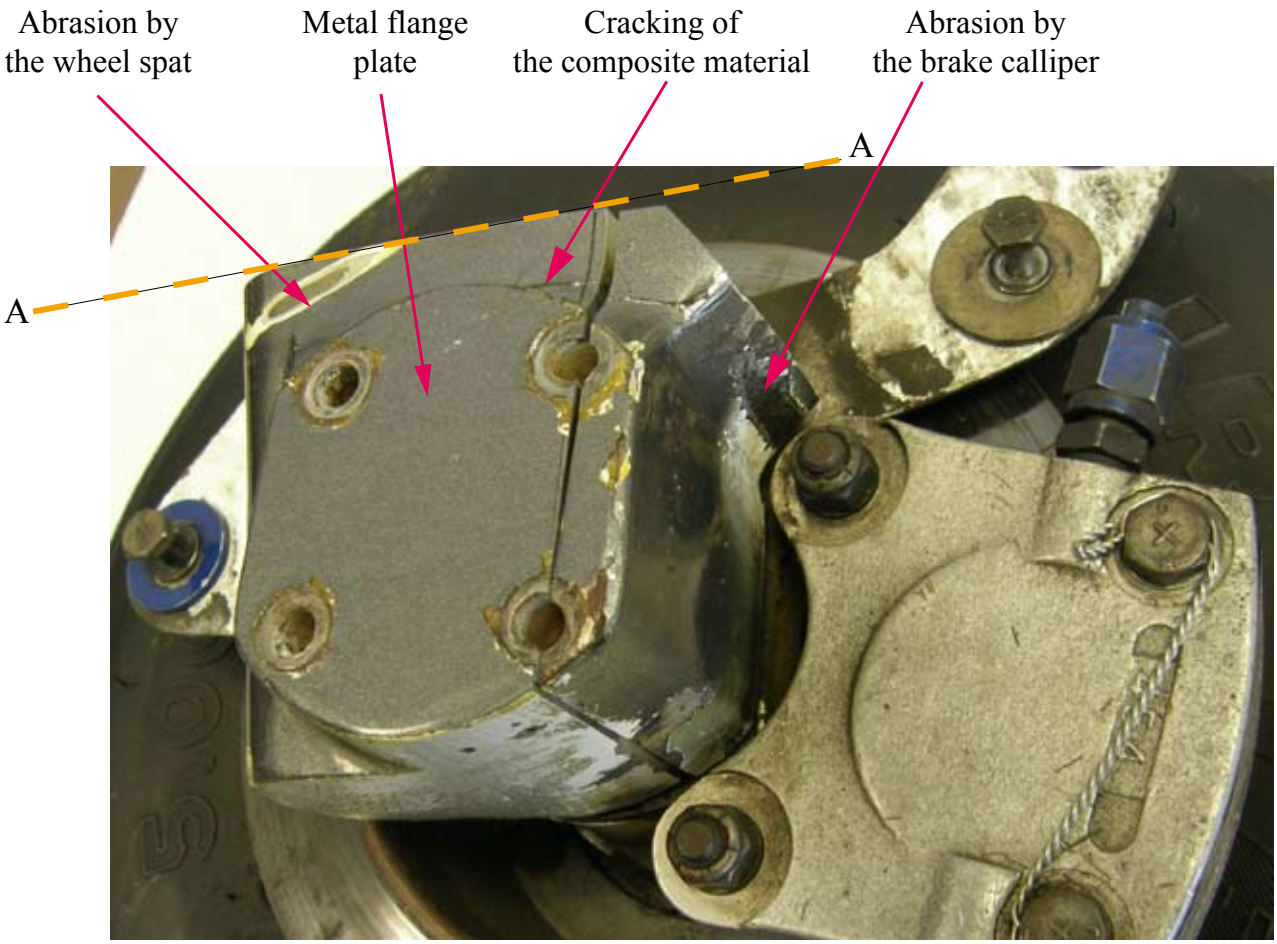
The cracking of the composite material in the area of the metal flange plate was as a result of lateral flexing of the composite U-shaped carrier during taxiing, takeoff and landing. The final failure of the leg was in a lateral loading direction.

A study of the right landing gear leg in the area of the wheel attachment, which had not failed, revealed the presence of composite material abrasion and cracking in similar locations to those identified on the left side. In common with the left side fractures, the cracks on the right side also showed signs of staining, indicating a progressive accumulation of damage, although in both cases the time period could not be determined. The similarity between the damage in the right and left landing gears suggests that both were subject to the same failure mechanisms, with the left failing first due to a single high load. The damage accumulating on the inboard and aft surfaces would have significantly weakened the composite material around the wheel attachment, leading to failure.

As a result of the findings of the QinetiQ examination the right wheel, wheel spat and wheel brake assembly were refitted to the composite landing gear (Figure 1) and it was found that the inner upper corner of the brake calliper had abraded the composite material to the extent that it exposed the glass fibre fabric. This allowed contaminants such as moisture, brake dust and hydraulic fluid to penetrate the inner structure of the composite leg. The abrading of the outer layer of the cotton-flock filled composite material was deeper on the failed left landing gear leg than the right.

Manufacturers' maintenance requirements

The manufacturers' Service Manual calls for a visual inspection at 1,000 hrs of the main landing gear spring for dents, cracks and delaminations, especially at the wheel axle attachment and the centre bushing, for wear and looseness. There are no specific requirements to inspect for abrasion of the outer layer of the glass fabric reinforced composite material. The aircraft had achieved 1,201 hrs since manufacture.



Courtesy of QinetiQ

Figure 1

The reassembled 'original design' right landing gear from G-SIII
(wheel and brake mounting cut from main U-shaped carrier along line A - A)

Other information

A number of other Extra 300 model aircraft were examined, some with and some without the redesigned composite U-shaped carrier. All of them showed varying degrees of abrasion of the composite material by the brake calliper and, to a lesser degree, the wheel spat. Cracking of the composite material in the area of the metal flange plate was only seen on the 'original design' composite U-shaped carrier.

Safety action

There is continuing discussion on the mode and cause of the technical failure and the aircraft manufacturer has introduced an additional inspection requirement:

> *'Visually inspect complete main landing gear spring for dents, cracks and deformations, especially in the area of the mounting clamps and the axle attachments, when wheels and brake callipers are removed.'*

In addition, as airworthiness oversight of this category of aircraft remains the responsibility of the National Aviation Authority of the State of Design:

Safety Recommendation 2009-108

It is recommended that the Luftfahrt-Bundesamt (LBA) review the continued airworthiness of the main landing gear fitted to Extra EA 300 aircraft to ensure the integrity of the outer layer of the cotton flock filled composite material.

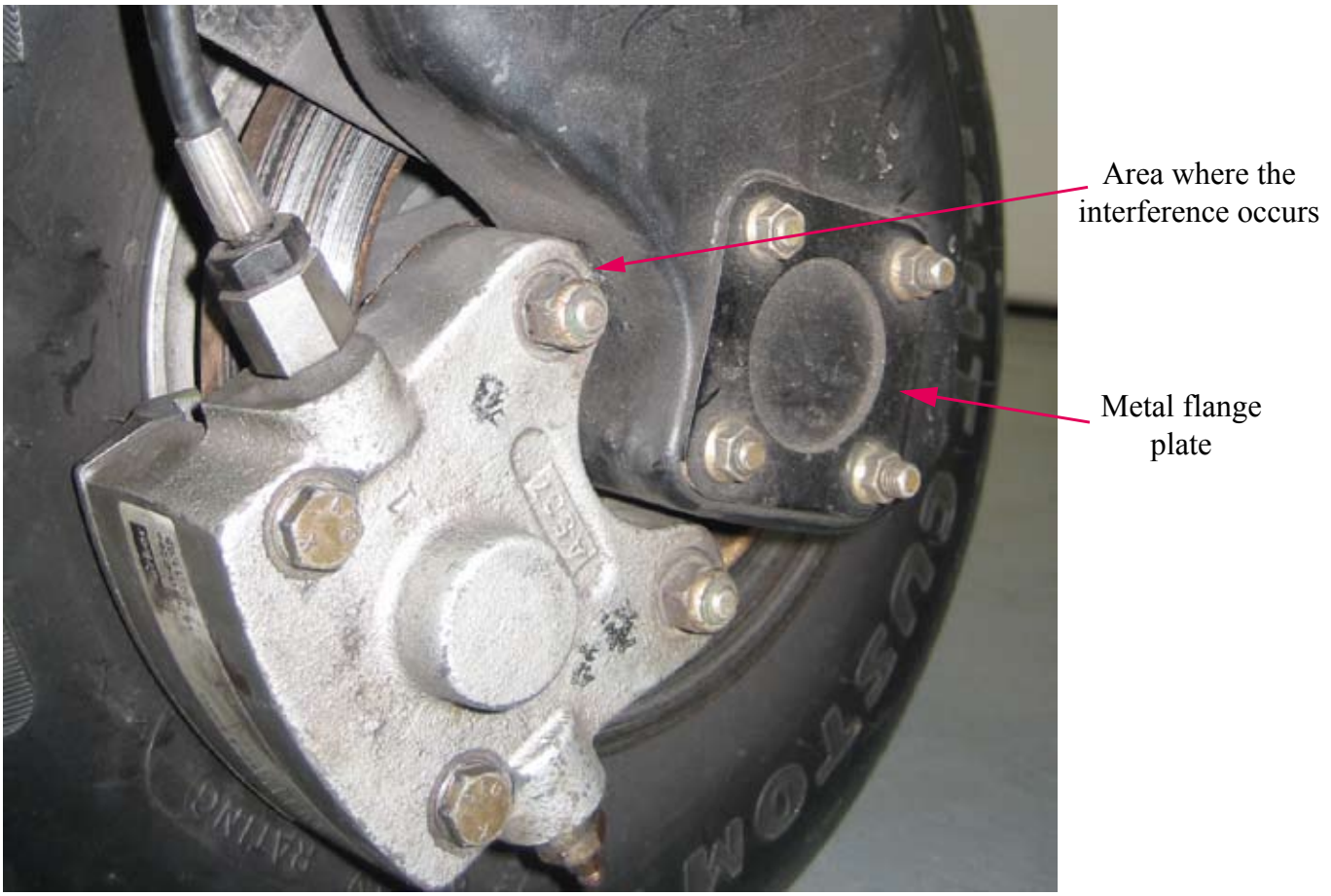


Figure 2

Interference between the brake calliper and the 'redesigned' landing gear leg