ACCIDENT

Aircraft Type and Registration:	Czech Sport Aircraft Sportcruiser, G-CGEO	
No & Type of Engines:	1 Rotax 912 ULS piston engine	
Year of Manufacture:	2009 (Serial no: 09SC303)	
Date & Time (UTC):	7 October 2018 at 1445 hrs	
Location:	Fowlmere Aerodrome, Cambridgeshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Right main landing gear leg damaged	
Commander's Licence:	Light Aircraft Pilot's Licence	
Commander's Age:	75 years	
Commander's Flying Experience:	1,048 hours (of which 350 were on type) Last 90 days - 8 hours Last 28 days - 3 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

Synopsis

The aircraft's right main landing gear (MLG) leg was damaged following a normal landing at Fowlmere Aerodrome. Investigation of the failed MLG leg revealed a manufacturing defect that caused the progressive delamination of the leg during service. The aircraft manufacturer is currently certifying a strengthened MLG leg design and has incorporated improvements to the manufacturing process of the MLG intended to prevent recurrence.

History of the flight

The pilot, accompanied by one passenger, flew the aircraft on a 20-minute flight from Graveley Airstrip, Hertfordshire, to Fowlmere Aerodrome. The pilot stated that the landing at Fowlmere was smooth and that the taxi to the parking area was uneventful. After vacating the aircraft, the pilot noticed that a large crack was present in the rear face of the right MLG leg (Figure 1). The leg retained sufficient residual strength to support the aircraft when parked.

The calculated landing weight for the landing at Fowlmere was 592 kg, below the MTOM of 600 kg. The pilot stated that no cracks were visible in either MLG leg during the pre-flight inspection of the aircraft. A second member of the aircraft's owner group stated that the aircraft, when parked in a hangar, had been sitting 10 cm right wing low during the month preceding the accident with the tyres correctly inflated.

Figure 1
Damage to right MLG leg

Aircraft information

The Sportcruiser is a low-wing monoplane aircraft powered by a Rotax 912S or 912ULS piston engine. It has two seats and a fixed tricycle landing gear. The aircraft was available in the UK as a kit through the LAA Permit to Fly system and remains available as a factory-built aircraft with an EASA Restricted Certificate of Airworthiness (CofA)[1]. A small number of aircraft were factory-built prior to EASA Type Certification, including G-CGEO; these aircraft operate on an EASA Permit to Fly.

MLG leg structure and manufacturing process

The MLG legs are formed from composite materials, predominantly glass fibre fabric layers, impregnated with epoxy resin and cured in a two-part closed mould. As part of the manufacturing process two inflatable rubber tubes are laid longitudinally in the mould before the mould halves are closed. Each rubber tube is covered with a plastic stretch film layer and then glass fibre fabric layers are wrapped around the tube. When the mould halves are closed the rubber tubes are inflated, creating two oval holes within the landing gear leg section and providing a compressive load on the composite material around the tubes to increase fibre compaction within the finished laminate.

The plastic stretch film layer is made from linear low-density polyethylene (LLDPE) and its purpose is to prevent the rubber tubes from bonding to the landing gear leg laminate while the epoxy resin cures in the mould. The rubber tubes and stretch film are removed from the leg once the epoxy resin has cured.

Footnote

[1] These EASA certified aircraft are named PS-28 Cruiser. The Restricted CofA is due to the engine and propeller being approved as part of the aircraft's EASA Type Certificate in accordance with Part-21 (EU 748/2012) 21.A.23 regulations.

The part number of the failed MLG leg installed on G-CGEO was NK-03A-C[2], serial number 68/16 which was produced in May 2016. This landing gear leg had accumulated 332 flight cycles from new, whilst installed on G-CGEO.

Previous MLG events on Sportcruiser/PS-28 aircraft

The aircraft manufacturer provided a list of previous MLG damage to Sportcruiser/PS-28 aircraft (Table 1).

Date of occurrence	Aircraft type	Hours/ Cycles	Details
31/7/2015	PS-28 Cruiser s/n C0479	930/ 3,455	Small crack observed in right MLG. Damage attributed to rough field operation.
19/9/2016	PS-28 Cruiser s/n C0521	1,352/ 2,018	Cracks observed in lower rear side of left MLG. Damage attributed to exceeding torque of wheel attachment bolts.
18/11/2016	PS-28 Cruiser s/n C0507	1,592/ 3,107	Longitudinal cracking of both left and right MLG.
17/10/2017	PS-28 Cruiser s/n C0590	193/ cycles not known	Longitudinal delamination of left MLG at rear face. Aircraft frequently operated from grass runways. Both MLG legs cut open by the manufacturer, no foreign objects identified. Failure considered to be due to overload.
19/10/2017	PS-28 Cruiser s/n C0589	156/ cycles not known	Longitudinal delamination of left MLG. Aircraft frequently operated from grass runways.

Table 1

Previous MLG leg damage to Sportcruiser/PS-28 aircraft

The aircraft manufacturer stated that a possible contributory factor to cases of MLG delamination could be operation of the aircraft beyond its approved maximum takeoff and landing weight limits.

Footnote

[2] Part number NK-03A-C is directly equivalent to p/n SG0030L/P as used on other Sportcruiser and PS-28 Cruiser aircraft.

Aircraft examination

The damaged right MLG leg was examined by the AAIB to determine the cause of the failure. The visible crack in the rear face of the leg was 239 mm long. The leg was cut into three sections (Figure 2).

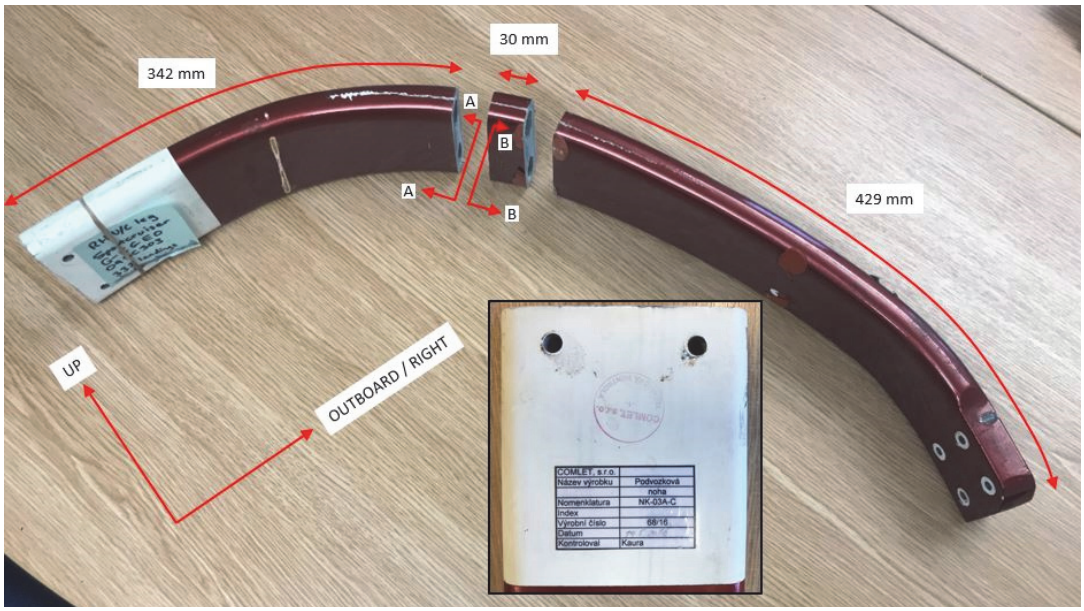

Figure 2

Sectioning of right MLG leg (leg dataplate image inset)

When the leg was cut open, plastic film was visible within the rear hole (Figure 3). Approximately 6 mm of the plastic film was trapped within the laminate between the rear and forward holes at section A-A.

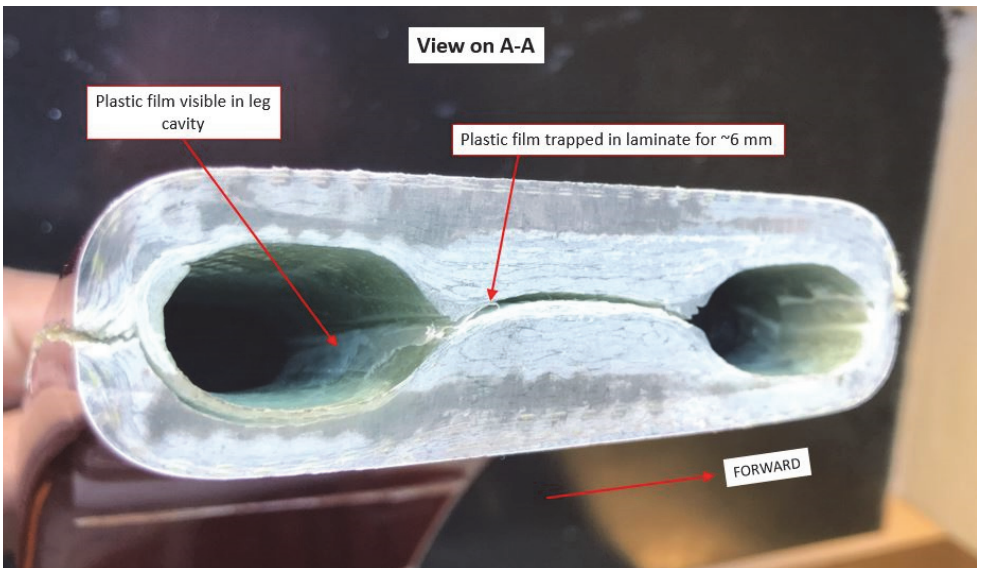

Figure 3

View on section A-A

The leg's composite structure had delaminated between the forward and rear holes (Figure 4). Additional delaminations were observed around the rear half of the rear hole, and between the rear hole and the aft face of the leg section. A small area of fibre pinching was also present at the rear of the leg section.

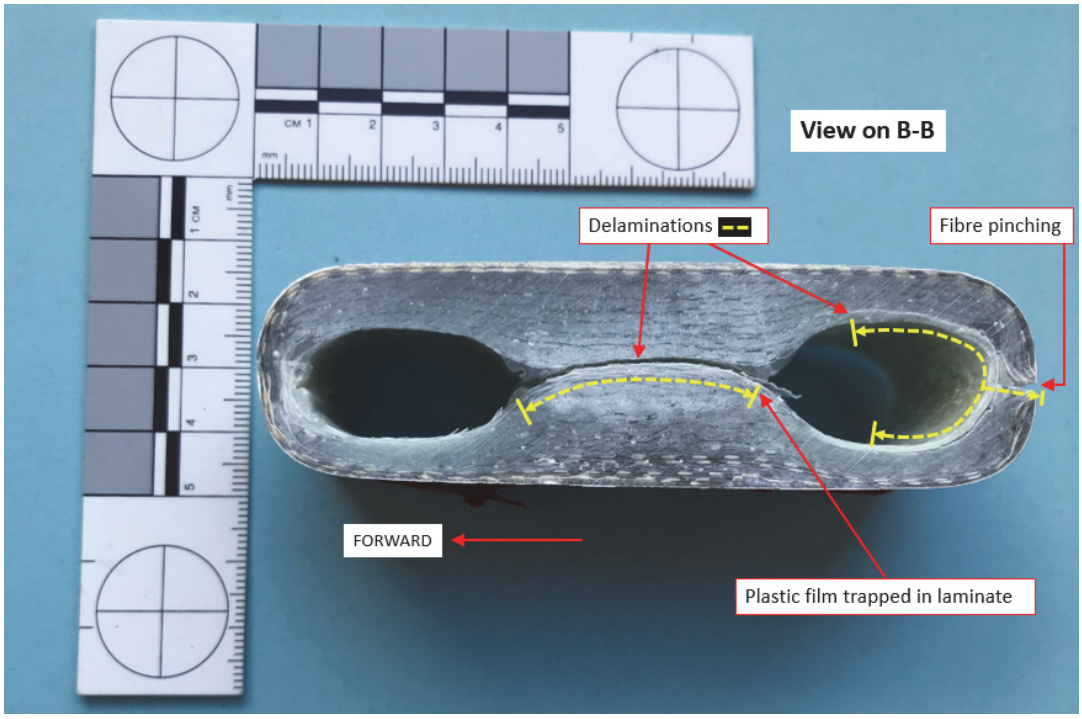

Figure 4

View on section B-B

A sample of the plastic film, measuring approximately 29 mm long by 8 mm wide, was recovered from the leg for laboratory analysis (Figure 5). Additional internal inspection of the leg revealed that the trapped plastic film was present within the rear leg hole over a length of approximately 260 mm, aligned with the external crack in the leg's aft face.

Tests and research

The plastic film sample recovered from the leg, shown in Figures 4 and 5, was analysed using FTIR[3] spectroscopy along with a sample of the stretch film used in the production process of the leg, supplied by the aircraft manufacturer. This analysis showed that the sample was the same material as that used in production of the leg.

Footnote

[3] Fourier Transform Infra-Red (FTIR) spectroscopy involves illuminating a sample with infrared radiation and measuring the spectrum of absorbed radiation in order to characterise the molecular composition of the sample.

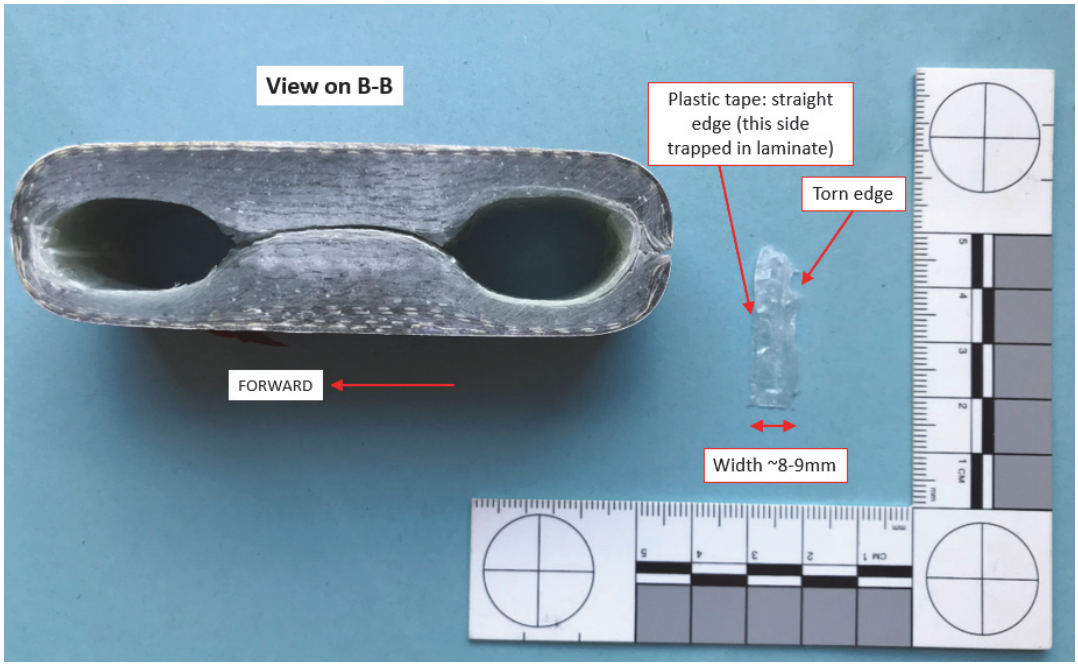

Figure 5

Plastic film sample recovered at section B-B

Analysis

The trapped stretch film within the right MLG laminate created a crack initiation site from which a crack initially propagated forwards, through the central portion of the leg's composite structure. This delamination reduced the stiffness of the leg, commensurate with the observation by the aircraft's owners that the aircraft was sitting 10 cm right wing low in the month preceding the accident flight. A small area of fibre pinching at the rear of the leg section created an additional weak point which eventually failed during the landing at Fowlmere Aerodrome.

The stretch film material was used during the manufacturing process of the leg and it did not form part of the leg's intended structural design. Pressure loads applied to the rear inflatable tube during the lamination process pushed the stretch film into the forward corner void of the rear section hole and the film became permanently trapped once the epoxy resin had cured. The torn edge of the rear length of the trapped stretch film material was created when the bulk of the stretch film was pulled from the rear section hole after the epoxy resin had cured, leaving the trapped portion behind.

Analysis of previously reported PS-28 Cruiser MLG failures showed that at least three of the events exhibited similar longitudinal cracking to that observed on G-CGEO. Investigation by the aircraft manufacturer of the MLG legs from PS-28 Cruiser s/n C0590 concluded that the failure was due to overload and that no foreign objects, including stretch release film, were present within the legs. The damaged MLG legs from s/n C0507 and C0589 were not sectioned to determine the root cause of these failures.

Conclusion

The aircraft's right MLG leg was found to be damaged following a normal landing at Fowlmere Aerodrome. Investigation of the failed MLG leg revealed a small quantity of LLDPE stretch film material within the leg's composite laminate structure that had been unintentionally trapped during the manufacturing process. The trapped stretch film formed a crack initiation site from which a crack initially propagated forward, through the central portion of the leg's composite structure, before the leg eventually cracked externally at the rear face of the leg section.

Safety action

The aircraft manufacturer is currently certifying a reinforced MLG leg, part number SG0160L/P, intended to increase the durability of the legs in service. This new MLG will be available for retrofit to all models of Sportcruiser and PS-28 Cruiser aircraft. In addition to slightly enlarging the MLG leg cross-section, the inflatable tubes and stretch film material used during leg manufacture are now surrounded by a woven glass fibre 'sock', to prevent radial migration of the stretch film into the leg's composite structure.