ACCIDENT

Aircraft Type and Registration:	Cessna T303 Crusader, G-CYLS
No & Type of Engines:	2 Continental Motors Corp. TSIO-520-AE piston engines
Year of Manufacture:	1982
Date & Time (UTC):	31 December 2007 at 1016 hrs
Location:	Guernsey Airport, Channel Islands
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to aircraft nose and propellers
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	39 years
Commander's Flying Experience:	5,400 hours (of which 16 were on type) Last 90 days - 52 hours Last 28 days - 21 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Shortly after touching down after a normal approach, the nose landing gear collapsed, causing substantial damage to the aircraft. It was established that the nose gear actuator locking lugs had failed, allowing the nose gear to unlock and collapse forward on touchdown. Evidence was found of pre-existing cracks in the locking lugs; however, it was not determined by what mechanism the cracks had propagated.

History of the flight

The pilot approached Guernsey from the north and was given clearance for a right-hand base leg join for Runway 27. On base leg, he selected the first stage of flap and lowered the landing gear and recalled hearing the usual noises and observing the normal trim changes. He confirmed three green 'down and locked' indications were showing and that the gear was actually down by looking in the landing gear viewing mirror. On final approach, he selected landing flap and received the clearance to land. The approach was reportedly stable, with no crosswind and the aircraft touched down on the runway just beyond the numbers. On lowering the nose, it continued to drop and it quickly became apparent from the nose-down attitude and the damage to the now stationary propellers, that the nose gear had collapsed. The aircraft travelled in a straight line with its nose scraping on the runway surface, coming to rest about 300 m along the runway. The pilot was uninjured and exited normally via the rear door.

Aircraft information

Background information

The Cessna T303 Crusader is an all-metal, low-wing, six-seat, twin-engined aircraft with a tricycle landing gear. A total of 315 were manufactured. G-CYLS was serial number T303-00005 and was built in 1982. It held a current EASA Certificate of Airworthiness, valid until 18 May 2008.

Aircraft damage

The aircraft sustained structural damage to its nose, which had buckled. It was also heavily abraded on its underside from sliding along the runway surface, Figure 1. The propellers were also badly damaged from striking the runway. Closer examination revealed that the locking lugs of the nose gear actuator had fractured, causing the gear to unlock and collapse forward as weight was applied to it on landing.

Nose landing gear description

The nose gear, which retracts forwards, consists of a shock strut mounted in a trunnion assembly, a nosewheel, shimmy damper and a double-acting hydraulic actuator for extension and retraction. The upper end of the actuator is fixed to the aircraft structure and the end of the actuator ram is attached to the rear of the nose gear.

Figure 1

Photograph of G-CYLS showing damage to nose of aircraft

During gear extension, hydraulic pressure is ported to retract the actuator ram, causing the nose gear to extend rearward. When fully down, spring-loaded locking hooks on the end of the ram engage onto downlock pins on the body of the actuator. The gear is thus mechanically locked in the down position by the body of the actuator, which acts as a rigid drag strut. The downlock pins are located in locking lugs on the actuator body and are retained by roll-pins.

Nose gear actuator information

The actuator fitted to G-CYLS was manufactured in 1981 and was identified with part number 1280514-11 and serial number 133. Enquiries of the aircraft manufacturer revealed that there are no overhaul or special inspection requirements for the nose gear actuator. It is therefore possible that the failed actuator had been on the aircraft since aircraft build.

Nose gear actuator examination

The failed actuator was subjected to detailed metallurgical examination. Both locking lugs had fractured, liberating a segment of each lug and its downlock pin, Figure 2. However, the roll-pins had remained in the lugs.

Of the two fractures on each lug, one was solely the result of ductile overload and thus secondary to the initial failure; the other exhibited much less deformation. One of the two 'primary' fractures was very flat in appearance with no obvious signs of ductile overload and was also

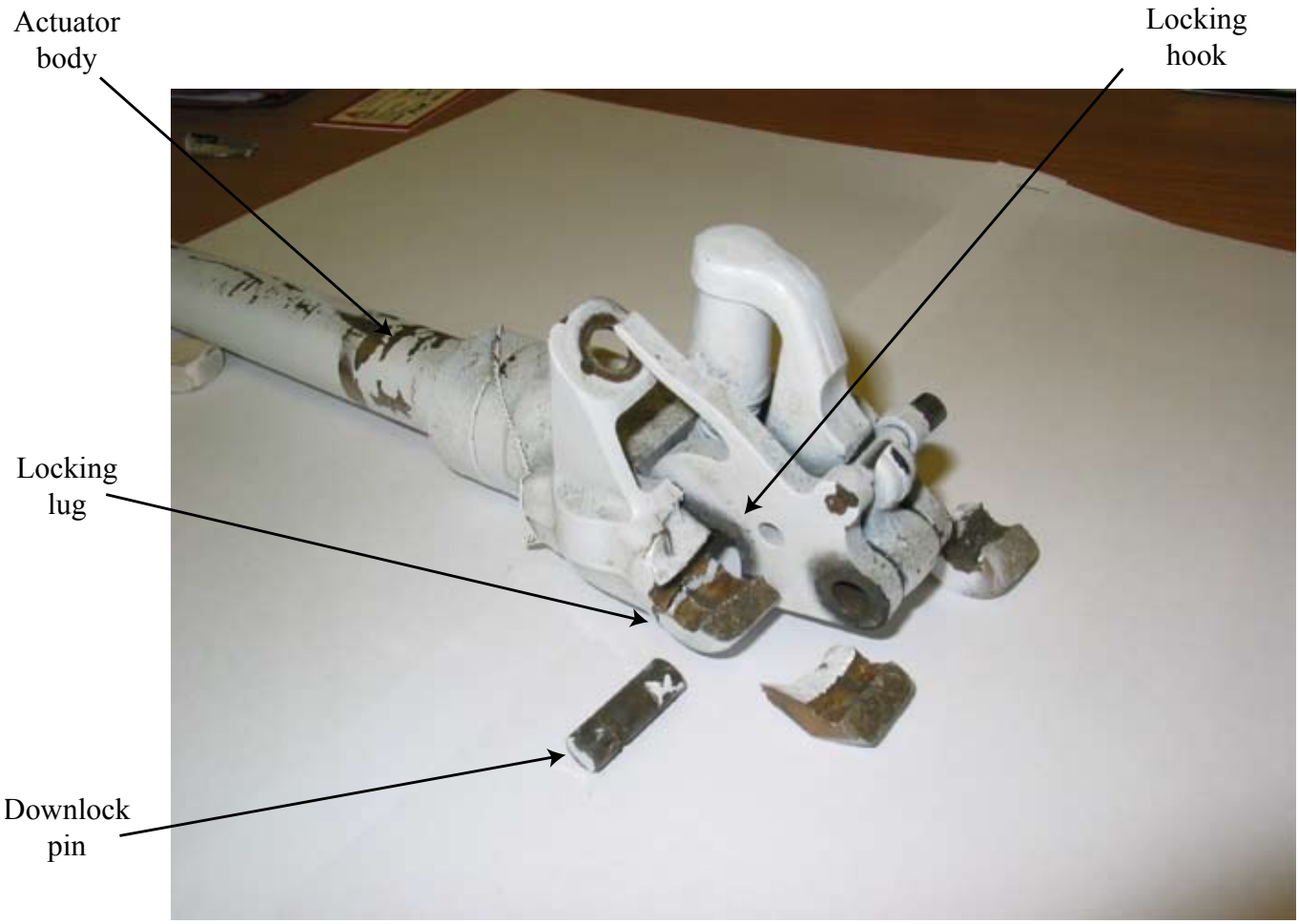

Figure 2

G-CYLS nose gear actuator showing fractured locking lugs
(actuator ram in fully retracted position)

considerably more discoloured by corrosion products than the other, Figure 3. The other primary fracture differed in having a lesser degree of discoloration and a clearly visible region of ductile overload.

Detailed fractographic examination, using optical and scanning electron microscopy, showed the primary fractures to be generally intergranular in nature, with no evidence of fatigue propagation. It was not possible to state with any certainty what mechanism had caused the primary fractures.

Metallographic examination of the lugs revealed an unfavourable grain orientation around the ends of the lugs, such that the applied loads were acting along the grain boundaries; this was evidenced by the directions of the primary fractures being parallel to the grain boundaries.

Discussion

The discoloration of the primary fractures of the actuator locking lugs is indicative that these had been present for some time, in contrast to the fresh appearance of the final ductile overload failures that resulted in the nose gear collapse. The cracks had therefore occurred over a period of time, but it was not clear what mechanism had caused the primary fractures. It is conceivable that

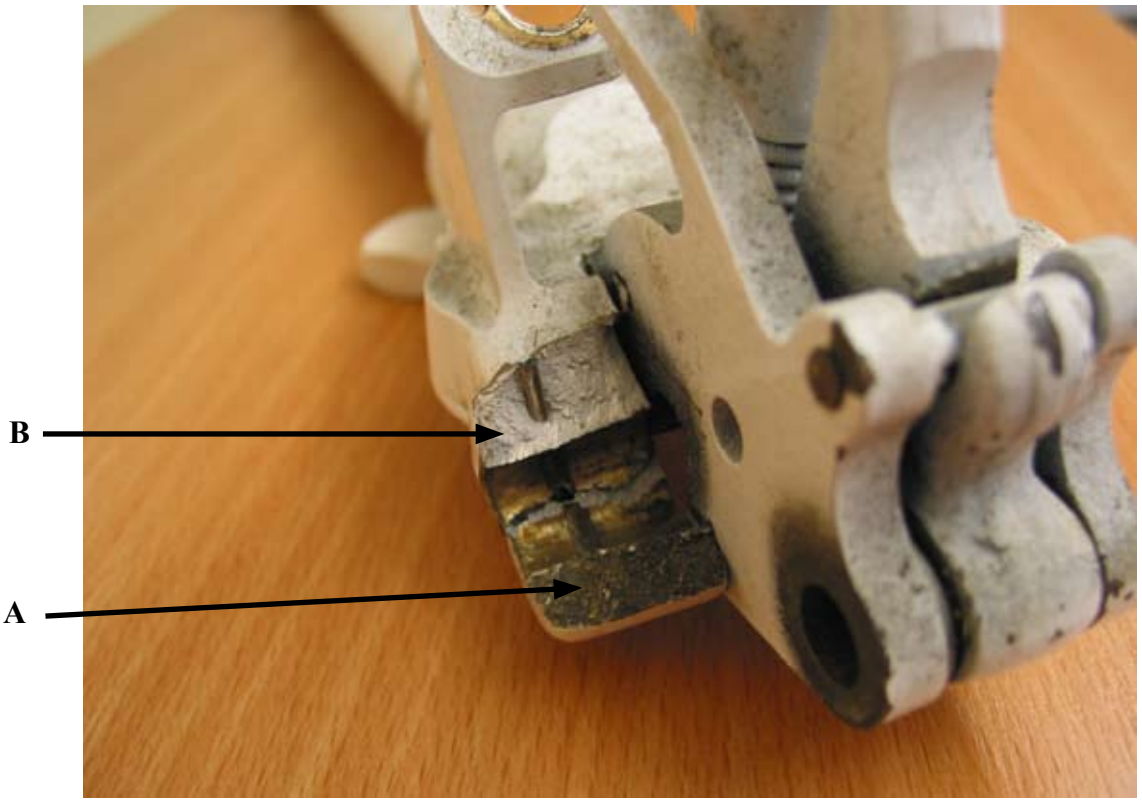

Figure 3

Photograph showing primary (A) and secondary (B) fractures of nose gear actuator locking lug

a discrete occurrence such as a shock load from a heavy landing, or mishandling during towing, may have been the initiating event.

The unfavourable orientation of the grain boundaries at the ends of the lugs is likely to have had a significant influence on the local strength of the material, effectively providing planes of weakness for crack initiation and propagation.

The aircraft manufacturer reported that they were aware of occurrences of lugs/pins failures on this actuator. In their experience, rough ground handling creates more damage than normal operations and they are of the opinion that the subject failure was likely to have been induced by earlier (rough) ground handling.

Safety action

In the original design, as shown in Figure 2, a groove was cut into the pin and the roll-pin engaged with this groove to retain the pin. In the new design, the groove was eliminated, as it acted as a stress concentration, and replaced by a hole through the pin into which the roll-pin is inserted.