

Cessna 337 GP, N456TL

AAIB Bulletin No: 12/2003	Ref: EW/G2003/05/05	Category: 1.3
Aircraft Type and Registration:	Cessna 337 GP, N456TL	
No & Type of Engines:	2 Teledyne Continental TSIO-360-C piston engines	
Year of Manufacture:	1977	
Date & Time (UTC):	3 May 2003 at 1202 hrs	
Location:	Coventry Airport, West Midlands	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 2
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Minor lower skin and rear propeller damage	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	41 years	
Commander's Flying Experience:	4,980 hours (of which 470 were on type)	
	Last 90 days - 98 hours	
	Last 28 days - 14 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and telephone enquiries by the AAIB	

Synopsis

The right main landing gear failed to lock in the down position during the final approach to land. The landing gear motor circuit breaker had tripped and a further attempt to lower the gear after resetting the breaker produced a smell of electrical burning. Attempts to lock the right main gear down using the emergency hand pump proved unsuccessful and a gear-up landing was performed, with both engines shut down. Subsequent investigation revealed that the right main gear hydraulic actuator was weak in operation due to an internal leak across the piston seals, and that the right gear was prevented from fully extending due to the downlock stop bolt on the leg jamming on a burr on the downlock cam.

History of flight

The aircraft had departed from Coventry Airport on a test flight after recent maintenance work, which included an annual inspection. The flight had progressed normally until the final approach to land. When the pilot selected the landing gear down, the green down and locked indicator light failed to illuminate. He retarded the throttles to check for the gear warning horn, which duly sounded,

confirming that the landing gear had not locked down. A go-around was initiated and the aircraft was positioned to a local holding area, to perform a recycle of the gear. It was then observed that the circuit breaker for the landing gear motor had tripped. The circuit breaker was reset and the gear was successfully retracted. On selecting the gear down again, the green light once again failed to illuminate, but this time a strong smell of electrical burning was apparent. The circuit breaker was immediately pulled and the pilot returned the aircraft to the close proximity of the airport. The burning smell soon dissipated and no further attempt was made to reset the circuit breaker. The procedure in the Pilot's Operating Handbook (POH) for manual lowering of the landing gear using the hand pump was then reviewed. The procedure was actioned exactly as detailed, but the green gear down light still failed to illuminate. The rear passenger, who was a licensed aircraft engineer and well acquainted with this type of aircraft, observed that the right main landing gear was not extending fully. The nose and left main gear were confirmed to be fully down by another aircraft flying in the circuit and by ATC after a fly-past of the tower. The aircraft was then positioned in a holding pattern just to the south west of the airport to burn off fuel whilst various options were discussed with ATC and the Chief Engineer of the maintenance company.

Four further attempts were made to lower the gear using the emergency hand pump and various flight manoeuvres were performed to try and persuade the right main gear to fully extend, but these proved unsuccessful. After discussion with ATC and the airport fire service, the pilot chose to perform a gear up landing on the grass adjacent to Runway 23, just beyond holding point 'Kilo'. The gear was raised manually and a practice approach was flown with a go-around just prior to the touchdown point. The tower noticed that the main gear doors were still open, despite the yellow gear up light being illuminated. After further pumping of the emergency pump handle, the doors were fully closed and this was confirmed by ATC during a second practice approach. The pilot shut down the front engine on the initial part of the approach in accordance with the gear up landing procedure in the POH. Once the aircraft was safely assured of landing, he also shut down the rear engine. The pilot executed a successful gear up landing with the airfield emergency services in attendance. All three occupants immediately vacated the aircraft with only one minor injury reported. The aircraft sustained minor damage to the fuselage lower skin and the rear propeller.

The aircraft was recovered from the grass by placing it on a sled and towing it to a suitable area of hard standing. It was then jacked up and an attempt was made to lower the landing gear, whereupon it was confirmed that the right main gear would not lock down.

Main landing gear operation

The Cessna 337 has a retractable tricycle landing gear which is hydraulically operated, with hydraulic power being provided by an electrically-driven pump. An emergency hand pump allows the gear to be operated manually in the event of a failure. The two main gear struts retract rearward and upward into the belly of the fuselage. Each main gear is operated by a hydraulic linear actuator, with the shaft of the piston doubling as a rack which drives a pinion gear. The pinion gear drives a rotary output shaft which is connected to the main landing gear leg and which either extends or retracts the leg, depending on the direction of rotation of the shaft. Downlock linkages are used to secure the gears in the down position. The downlock cams are secured in place by small hydraulic linear actuators, which also retract the cams before the gear retracts. When the gear is lowered, the downlock actuators normally remain retracted until the gear is fully down. The actuators then extend to lock the main gear legs in the down position. If for some reason a downlock actuator does not fully retract, the stop bolt on the gear leg is designed to ride the cam and push the downlock forward out of the way, allowing the gear to fully extend.

Engineering investigation

Tests performed with the aircraft on jacks showed that when the landing gear was lowered using the emergency hand pump, it was possible to prevent it from fully extending by hand resistance against the direction of lowering. This led to the suspicion that there was an internal leak across the piston seals of its hydraulic actuator. It was thought likely that, with air loads applied, this leakage would have slowed the landing gear extension cycle sufficiently to allow the downlock actuator to start to

engage before full extension. This would have allowed the downlock stop bolt on the landing gear leg to contact the downlock cam. Should this occur, the gear is designed to push the downlock cam forward and out of the way as it extends, but it was found that the downlock bolt head was engaging on a burr on the cam, causing them to lock together with the right main gear only partially extended. Closer inspection revealed witness marks on the downlock cam which suggested that the problem had been occurring in-flight for some time. These witness marks were not seen during the annual check due to the cam being covered in grease, as this is lubricated in accordance with the manufacturers' instructions. Although ground retraction tests of the landing gear were performed during the annual check prior to the accident, in the absence of air loads, these were satisfactory and in accordance with the maintenance manual limits. After replacement of the actuator seals and the downlock cam, ground retractions, with simulated air loads, were completed satisfactorily.

The AAIB report EW/G2003/07/25, contained in monthly Bulletin 11/2003, reports on another recent incident involving a gear up landing on a Cessna F337G on 11 July 2003. An investigation revealed that the failure of the landing gear to lower in that incident was attributable to a lack of fluid in the hydraulic reservoir for the landing gear. The two incidents therefore do not appear to be related.