

INCIDENT

Aircraft Type and Registration:	Agusta A109A II, G-ELTE	
No & Type of Engines:	2 Allison 250-C20B turboshaft engines	
Year of Manufacture:	1984	
Date & Time (UTC):	2 May 2008 at 1431 hrs	
Location:	Redhill Aerodrome, Surrey	
Type of Flight:	Private	
Persons on Board:	Crew - 2	Passengers - 4
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Minor damage	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	54 years	
Commander's Flying Experience:	8,740 hours (of which 2,240 were on type) Last 90 days - 43 hours Last 28 days - 20 hours	
Information Source:	AAIB Field Investigation	

Synopsis

Whilst in flight, the landing gear operating handle detached from the selector mechanism, preventing the landing gear from being lowered. The pilot disembarked the passengers in the hover and successfully landed the helicopter on pre-positioned car tyres.

History of the flight

The helicopter was planned to operate a passenger flight between Manchester (Barton) and Battersea Heliport, London. The commander, seated on the right, was accompanied by the helicopter owner, a PPL/CPL(H) holder, who acted as co-pilot. When the commander selected the landing gear lever up on departure, he noted that the lever operation felt unusual, in that the handle rotated in his hand. After entering the cruise,

he decided to confirm that the landing gear could be lowered again and asked the co-pilot to investigate.

When the co-pilot pulled on the handle prior to selecting the landing gear lever down, the handle and spindle became detached from the lever. Noting that the end of the spindle was threaded, he attempted to screw it back into the lever, but was unsuccessful. Several attempts were made to lower the gear by pushing down on the visible stub of the lever, but it failed to move.

The co-pilot then contacted the maintenance organisation by mobile telephone. They consulted the available technical documentation before contacting the helicopter manufacturer, who confirmed that selecting the lever

down was necessary for both normal and alternate methods of landing gear operation. The co-pilot subsequently managed to insert the threaded portion of the spindle back into the lever, but the lever still could not be moved. A small panel to the left of the lever was removed to gain better access, but this was of no benefit. In accordance with the commander's instructions, the co-pilot pulled the landing gear warning circuit breaker and then removed his collective lever to make it easier for him to exit the helicopter.

In the area of Bovingdon, the commander informed the passengers that he would be diverting to the helicopter's base at Redhill, where maintenance and operating personnel familiar with the helicopter type were available. Staff from the helicopter operator's operations department informed the emergency services and ATC at Redhill of the problem, advising them that, if necessary, the commander would disembark the passengers with the helicopter in the hover. When the commander contacted Redhill ATC, he was advised that the Aerodrome General Manager was not in favour of his proposed actions. It was suggested that the commander should divert to Biggin Hill, but he elected to continue to Redhill.

He approached the apron normally used at Redhill, where engineers were waiting, and entered a low hover. He continued to hover for some 15 minutes whilst discussions continued with ground personnel on a practical and safe course of action. ATC again informed the commander that the Aerodrome General Manager did not approve of his intended actions.

Aware that his fuel level was becoming low, the commander requested that the helicopter be refuelled in the hover. ATC informed him that no refuellers were available, as they were in the fire truck in readiness to

respond to the emergency. With the helicopter still in a low hover, he instructed the co-pilot to disembark and to liaise with the engineers.

The engineers realised that they would not be able to lower the landing gear as the uplocks could not be released without depressurizing the hydraulic system. By now, both low fuel indication lights had illuminated. The commander estimated that he had about 15 minutes of fuel remaining. It was decided that the safest course of action would be for the helicopter to land on pre-positioned car tyres. These were obtained from a local garage, once it was clear that no other practical solution was available. The commander's major concern with landing gear-up, was that the tail rotor could contact the ground, control would be lost, and the helicopter might roll over. He therefore decided to disembark the passengers in a low hover; this was completed successfully with the assistance of company personnel.

In order to minimise the risk to others, the commander then selected a remote area of the airfield in which to land. The car tyres were placed in two parallel lines and the helicopter was landed on the tyres, with the aid of an engineer giving hand signals. The helicopter remained upright and the commander shut it down in the usual manner, except that he waited for the rotor blades to stop before turning off the electrics, as the rotor brake is inoperative without a weight-on-wheels signal from the landing gear squat switch.

Landing gear selector

The landing gear on the Agusta 109 helicopter is operated via a selector lever located on the left side of the instrument panel. The lever assembly comprises a circular (wheel-shaped) handle attached to a spring-loaded telescopic spindle. The spindle locates inside a tubular lever. The lever passes through a slot in the

instrument panel and is pivoted in a housing containing the landing gear hydraulic selector valves. The lever is locked in the upper position in flight. The landing gear is operated by pulling the handle outwards axially against spring pressure to disengage a latch, then moving the lever down to the mid-position to lower the landing gear. It can be moved further down to a third position for emergency lowering. A secondary system retains the lever in the selected position. The handle and spindle spring back in when released.

The spindle is threaded into the latch of the lever. It is prevented from unscrewing by a locking collar positioned near its outer end. The collar incorporates two anti-rotation lugs which engage in recesses in the end of the lever and internal slots in the handle. A spring

circlip positioned in an internal groove inside the tubular section of the lever retains the locking collar in position against spring pressure. The wheel-shaped handle is retained on the end of the spindle by a roll pin.

A cross-section of the assembly is presented in Figure 1.

Selector mechanism examination

The landing gear selector assembly was removed and examined by the component manufacturer in the presence of representatives from the aircraft manufacturer and the AAIB. On disassembly, it was found that the spring circlip had come out of its locating groove, permitting the locking collar to move longitudinally and disengage, freeing the handle and spindle to rotate. The circlip

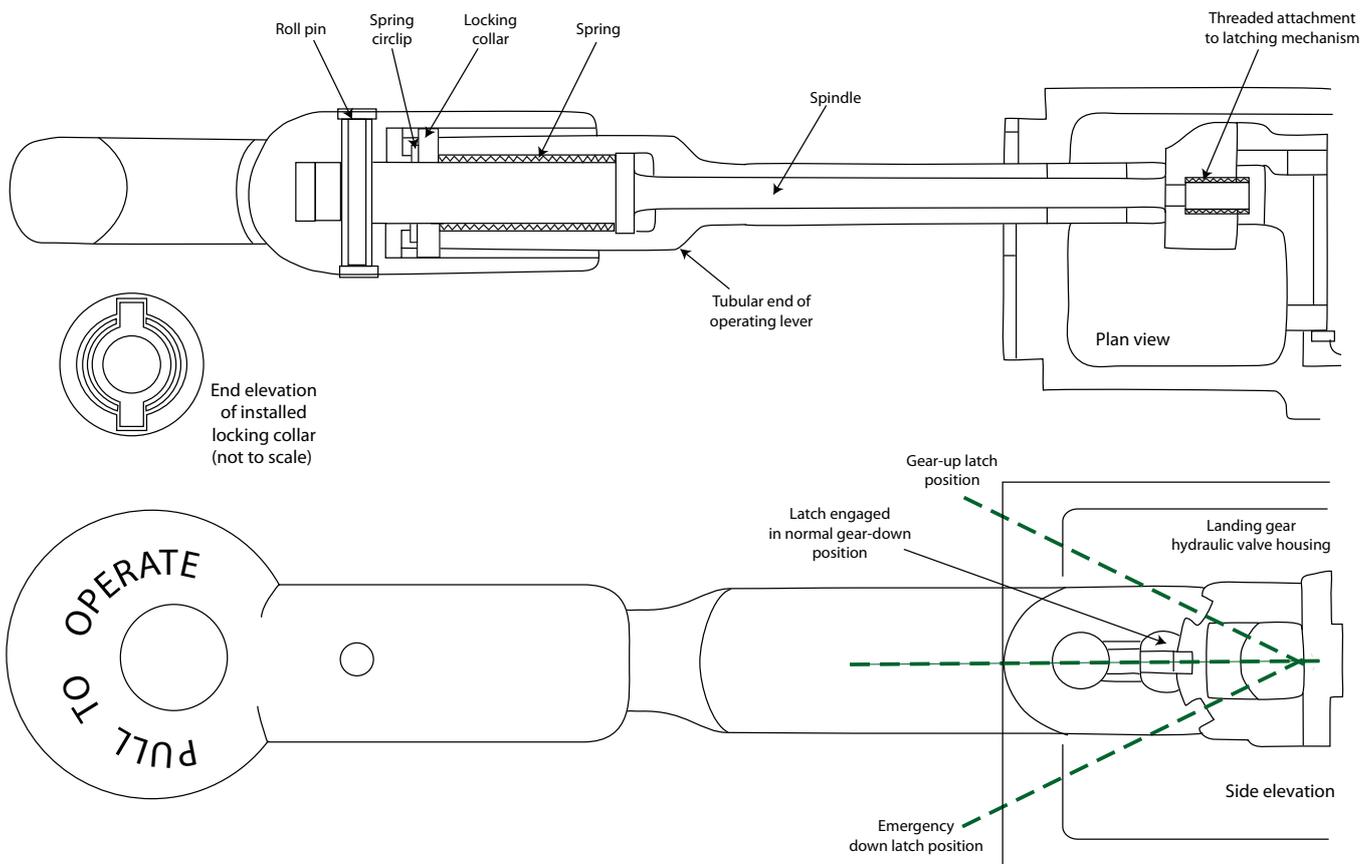


Figure 1
Landing gear selector assembly

and groove were undamaged and it was surmised that the circlip may have been incorrectly located during assembly of the mechanism. Records showed that the selector assembly had been overhauled by the component manufacturer approximately two years before the incident. There was no record of any difficulties having been experienced when assembling the unit. According to the aircraft maintenance records the unit had been recently fitted to G-ELTE.

Assembly demonstration

The component manufacturer demonstrated the normal method of installing a circlip, spindle and handle into a selector valve. The circlip was driven into its locating groove using dedicated tooling consisting of two components. The first was an aluminium alloy block with an internally tapering bore and a short end section counter-bored to a larger diameter to fit over the exposed end of the cylindrical operating lever. The second comprised a thin-walled tubular drift. During this demonstration, problems were encountered in installing the circlip and a large hammer was applied to the drift to drive the circlip into the correct position. The correct positioning of the circlip in its retaining groove could not be determined easily by inspection once assembly was complete. Examination of the main part of the tool revealed that it had sustained considerable damage to its tapered internal bore over a long period of time, leaving it extensively scored and grooved. The thin-gauge tubular drift was also extensively damaged on its end face. These defects, coupled with the short length of counter-bore, hindered the easy inward movement and retention of the correct alignment of the circlip as it was driven into the locating groove.

At the request of the helicopter manufacturer, the component manufacturer subsequently introduced a visual check for correct installation of the circlip in the

retaining groove during assembly of the landing gear selector. The correct positioning of the circlip is now verified by measurement. The component manufacturer has also introduced improved tooling for installing the circlip.

Failure mode

Given the difficulties experienced during the assembly demonstration, it would appear likely that the circlip was not correctly located in its groove when the unit was last assembled.

With the circlip out of its locating groove, there may have been sufficient frictional resistance between the circlip and the operating lever to enable a number of landing gear operating cycles to take place before the circlip became displaced outwards sufficiently for the locking collar to disengage. The spindle would then have been free to rotate and, over an indeterminate period of time, unthread itself from the lever. (Approximately 17 rotations of the handle are required for the spindle to detach from the lever). When the circlip becomes dislodged from its retaining groove, the spring action of the handle is lost. For reasons which were not apparent, the crew did not report experiencing this.

Both handle rotation and the loss of spring-back action of the handle should be immediately evident to the pilot. According to the helicopter manufacturer, landing gear operation is not compromised until the handle and spindle become detached from the lever.

Operational considerations

The commander elected to divert to the helicopter's home base at Redhill as expertise and assistance were readily available there. Although the Aerodrome General Manager was not in favour of the commander's actions, the passengers were safely disembarked in the

hover. (CAA safety advice contained in booklet '*CAP 745 Aircraft Emergencies, Considerations for Air Traffic Controllers*' states, on page 25: '*Passengers can be disembarked in the hover following a landing gear problem*'). Engineers at Redhill were able to assist the

commander in effecting a safe landing on pre-positioned car tyres. Had the helicopter diverted elsewhere, these facilities would not have been available and the landing may not have been so successful.