

ACCIDENT

Aircraft Type and Registration:	Cessna 441 Conquest II, EI-DMG	
No & Type of Engines:	2 Honeywell (Garrett Airesearch) TPE 331-10-534S turboprop engines	
Year of Manufacture:	1980	
Date & Time (UTC):	25 June 2019 at 0800 hrs	
Location:	Glasgow Prestwick Airport	
Type of Flight:	Private	
Persons on Board:	Crew - 2	Passengers - 7
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Engines, propellers and right-hand nose locker door damaged	
Commander's Licence:	Commercial Pilot's Licence	
Commander's Age:	50 years	
Commander's Flying Experience:	4,563 hours (of which 1,035 were on type) Last 90 days - 40 hours Last 28 days - 11 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries	

Synopsis

While landing at Prestwick International Airport it became apparent that the nose landing gear had not fully extended. The aircraft's landing gear indication and warning system had not alerted the pilots to this unsafe condition. Upon realising the aircraft's nose was dropping lower than normal, the pilots increased engine power and raised the aircraft nose while they activated the landing gear emergency blow-down system. The nose landing gear fully extended and the remainder of the landing was uneventful.

At the time of publication of this report, the aircraft had not been examined but it was considered likely that a faulty downlock switch on the nose landing gear actuator could provide an explanation for the failure of the nose landing gear to deploy and the absence of appropriate indications and warnings.

History of the flight

The company-owned aircraft was operating a private flight from Waterford Airport, Ireland to Prestwick International Airport, UK. Although EI-DMG was certified for single-pilot operations it was company practice to always operate with a second pilot on board. The aircraft was being flown by the commander seated in the left seat and the company's senior pilot occupied the right seat.

The ILS approach to Runway 30 at Prestwick was uneventful. The 'Before landing checks' were carried out and the commander recalls that all three green landing gear DOWN AND LOCKED lights were illuminated. Full flap was selected for landing.

Following a smooth touchdown on the main landing gear, as the aircraft's nose began to lower both pilots noticed that it continued to lower beyond its normal position. A "scrubbing/scratching" sound was also heard. The pilots had a momentary discussion about flying a go-around but considered that this was not feasible due to the possibility of damage having been sustained. They increased the engine power, applied back pressure to the control column to keep the nose "flying" while they activated the landing gear emergency blow-down system. Upon reducing power and relaxing pressure on the control column, it was evident to the pilots that the nose landing gear had extended and the remainder of the landing roll continued uneventfully.

While taxiing to the parking area, a passenger alerted the commander to fuel leaking from the right engine. The taxi was expedited and the firewall shutoff valves were then activated. There were no injuries and the occupants disembarked normally without assistance. The aircraft sustained damage to the engines and propellers. Subsequent inspection of the runway showed propeller strike marks over a distance of several metres in the touchdown zone.

The commander advised that no anomalies with the nose landing gear were noted during the pre-flight inspection, or during landing gear retraction following takeoff from Waterford. The landing gear warning horn did not sound during the approach.

A photograph taken of EI-DMG prior to touchdown (Figure 1) shows that the nose landing gear was partially extended prior to landing.



Figure 1

EI-DMG nose landing gear partially extended prior to touchdown
(image used with permission)



Figure 2

EI-DMG after landing showing fuel leak and damage to propellers
(image used with permission)

Landing gear system description

General

The Cessna 441 has a retractable tricycle landing gear which is electrically controlled and hydraulically actuated. It is operated by the landing gear selector switch, which depending on whether selected UP or DOWN, energises either the retract or extend solenoid in the landing gear control valve.

Landing gear extension

Normal extension and retraction of the landing gear is accomplished by hydraulic actuators, one for each landing gear. During extension, hydraulic pressure is routed from the landing gear control valve to release the uplock hooks and then to the extension side of the actuators. Once the landing gear reaches the extended position, an internal spring-loaded mechanical lock will engage to hold it in the extended position. An electrical downlock switch on each actuator indicates when the piston is locked. Once the downlock mechanisms are engaged, the hydraulic bypass valve will open and allow hydraulic fluid to be routed back to the hydraulic reservoir.

A landing gear emergency blow-down system is fitted to allow landing gear extension in the event of a hydraulic problem. It is activated by pulling the emergency landing gear extension T-handle mounted under the instrument panel. Pressurised nitrogen is discharged into the hydraulic system to release the uplock hooks and then into the landing gear cylinders to drive the landing gear into the down and locked position.

Landing gear indication and warning

The landing gear position and warning system provides a visual and audible indication of the safe or unsafe position of the landing gear. Three green landing gear DOWN AND LOCKED lights, one for each landing gear, are located on the instrument panel and illuminate when the downlock switch on the respective landing gear indicates that it is fully down and locked. A single red landing gear IN TRANSIT light illuminates when any, or all, of the landing gear are unlocked or in transit.

The landing gear warning system sounds an intermittent audible warning if one or both power levers are retarded to flight idle and at least one landing gear is not down and locked. The warning horn may be silenced for this condition and will be reset when the power lever is advanced. The warning horn will also sound if the flaps are extended beyond the approach condition and at least one landing gear is not down and locked; the warning cannot be silenced in this condition.

Electrical power is continually present at all the landing gear position indicator lights when the landing gear circuit breaker is closed. An individual ground circuit for each light will cause the light to illuminate when it senses an electrical ground. The nose landing gear downlock switch is a two-pole switch. One side of the switch provides the ground circuit for the nose landing gear DOWN AND LOCKED light and the other side provides the ground circuit for the landing gear warning horn.

Examination of the aircraft

At the time of publication of this report, the maintenance agency had only conducted a preliminary examination of the aircraft's nose landing gear system, with further, detailed, examination scheduled for a later date. Neither the cause of the nose landing gear's failure to deploy, or the failure of the landing gear indication and warning system to alert the pilots to the unsafe condition had been determined, but the maintenance agency suspected it was related to a failure of the downlock switch on the nose landing gear actuator.

Information from aircraft manufacturer

The aircraft manufacturer identified several possible conditions which could explain why the nose landing gear DOWN AND LOCKED light was illuminated despite the nose landing gear not being fully extended.

The manufacturer confirmed that if the nose landing gear DOWN AND LOCKED light senses an electrical ground, it will illuminate regardless of the nose gear downlock switch position (Figure 3). It was therefore possible that a faulty downlock switch could provide a continual ground to the DOWN AND LOCKED light. Other potential sources of electrical ground could include an electrical short in the wire between the DOWN AND LOCKED light and the downlock switch; inadvertent grounding of post 9 on terminal board 1; incorrect wiring on terminal board 1; or a defect within, or shorted wire from, the annunciator logic module to post 9 on terminal board

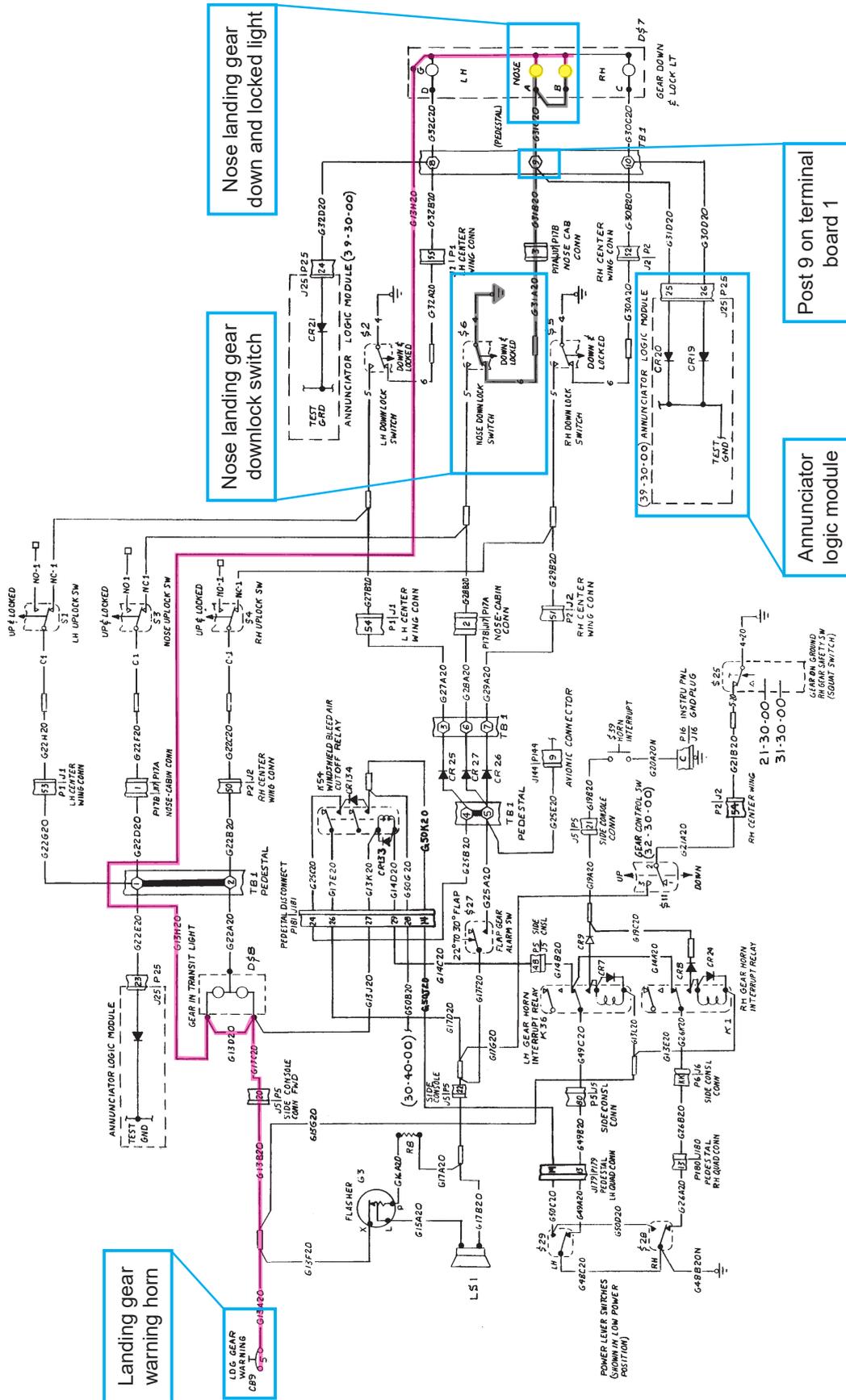


Figure 3
Landing gear and flap warning system from Cessna 441 Wiring Diagram Manual

The manufacturer also indicated that a faulty downlock switch could provide a possible explanation for the failure of the nose landing gear to fully extend. If the nose landing gear downlock switch had failed in the DOWN AND LOCKED position, when the landing gear selector switch was selected to DOWN, an immediate path to ground would exist for the nose landing gear DOWN AND LOCKED lights and also for the hydraulic bypass valve. This would cause the bypass valve to open and allow hydraulic fluid to be routed back to the hydraulic reservoir, returning the system to its 'at rest' position. The main landing gear of the Cessna 441 are assisted by airflow to reach the down and locked position. The nose landing gear is extended against the airflow and may take longer to extend. Therefore, it may be possible for the main landing gear to be driven by hydraulic power to the down and locked position but, upon receipt of an erroneous ground signal from the downlock switch, for hydraulic pressure to be prematurely removed before full extension of the nose landing gear is achieved. A failure of the downlock switch in this manner would also remove the path to ground for the landing gear warning horn, preventing its operation.

Landing gear downlock switches

Cessna Service Letter SNL89-3 '*Main and nose landing gear actuator switch sealing*' dated 17 March 1989 and Cessna Service Bulletin CBQ90-1 '*Landing gear actuators microswitch inspection and sealing procedures*' dated 23 March 1990 indicate that the downlock switch on the Cessna 441 main and nose landing gear can be susceptible to ingress of moisture or other contaminants. This can contribute to switch malfunctions and possible incorrect landing gear indications. EI-DMG was among the aircraft serial numbers identified as requiring the downlock switches to be inspected and sealed.

Discussion

The commander reported that upon selecting the landing gear down during the approach to Prestwick all three landing gear DOWN AND LOCKED lights were illuminated green. There was no activation of the landing gear warning horn and the landing gear IN TRANSIT light was not illuminated. Neither had there been any anomalies noted with the landing gear before or during the flight. The pilots were not therefore aware until landing that anything was amiss with the nose landing gear.

Although acting in a mainly observational capacity, the senior pilot instinctively acted to assist the commander when it became apparent that the nose landing gear was not down and locked. Both pilots reacted promptly to keep the aircraft nose off the runway and to activate the landing gear emergency blow-down system. Their recognition of the need to extend the emergency blow-down system during the landing roll ensured a successful outcome and minimised damage to the aircraft.

The aircraft manufacturer described several possibilities which could create an erroneous ground signal at the nose landing gear DOWN AND LOCKED light causing it to illuminate even though the nose landing gear was not fully extended. It was determined that one of these, a nose landing gear downlock switch failed in the down and locked position, could also account for improper extension of the nose landing gear and absence of the landing gear warning horn activation.

While at the time of publication it had not been determined if the nose landing gear downlock switch on EI-DMG had failed, the Cessna 441 landing gear downlock switches are known to be susceptible to moisture and/or other contaminant ingress. Although downlock switches are required to be sealed, a degraded or damaged seal could provide a path for moisture to enter the switch.

Conclusion

As the aircraft had not been examined by the maintenance agency at the time of publication, it was not possible to determine why the nose landing gear failed to deploy correctly, nor why the pilots were not alerted to this unsafe condition by the landing gear indications and warnings. However, a faulty nose landing gear downlock switch was suspected as a potential cause.