

INCIDENT

Aircraft Type and Registration:	Fokker F28 Mark 0100, G-BXWE	
No & Type of Engines:	2 Rolls-Royce Tay 650-15	
Year of Manufacture:	1991	
Date & Time (UTC):	14 August 2004 at 1940 hrs	
Location:	London Heathrow Airport, London	
Type of Flight:	Public Transport (Passenger)	
Persons on Board:	Crew - None	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	Not known	
Commander's Flying Experience:	Not known	
Information Source:	AAIB Field Investigation	

Synopsis

After recycling the landing gear, consulting with company engineers and carrying out the prescribed procedure for alternate landing gear lowering, the crew were committed to landing the aircraft with a nose landing gear unsafe indication. The aircraft landed with out incident; the nose landing gear indicated safe during the landing roll. Subsequent engineering investigations revealed that the Aircraft Maintenance Manual (AMM) procedure for checking the nose landing gear downlock plunger clearance was ambiguous, in that it did not make it clear that it is necessary to apply a rearward force on the nose landing gear when checking the downlock plunger clearance. It is believed that this caused the nosed landing gear downlock to be misrigged. In response to the airline's recommendation, the aircraft manufacturer has agreed to amend the AMM procedure.

History of flight

The aircraft was on a scheduled passenger flight from Brussels to London Heathrow. When the landing gear was selected down on final approach to London Heathrow the nose landing gear 'down

and locked' green light failed to illuminate. This was accompanied by landing gear unsafe visual and double-chime aural warnings. A go-around was flown and the landing gear was recycled, but the same warnings recurred. The Quick Reference Handbook (QRH) procedure for alternate landing gear lowering ('ALT LG PROC') was then carried out, with the same result. The flight crew advised the cabin crew and passengers of the problem and contacted ATC to advise them of the situation.

The aircraft then proceeded to the 'Biggin' hold, where the crew discussed the problem with their operations and engineering departments on the company radio frequency. Following the advice given, the crew declared a 'MAYDAY' and the commander briefed to the Senior Cabin Attendant for the 'LANDING WITH GEAR UP/UNSAFE' condition, so that the passengers could be briefed prior to landing.

On the final approach to land, the nose gear unsafe warnings recurred and as the aircraft descended through 1,000 feet, the red 'LG NOT DOWN' message appeared, accompanied by the master caution triple-chime aural warning. The tower at London Heathrow advised the crew that all three landing gear and the main gear doors appeared to be down. The aircraft landed normally and was slowed using 'emergency maximum' reverse thrust, with normal braking being used only after the ground speed had decreased to below 10 kt. The aircraft stopped on the runway and contact was established with the emergency services by radio and via an open cockpit window. After disembarking the passengers via steps, the aircraft was recovered by engineers to the company's hangar at Heathrow.

Flight recorders

The aircraft was equipped with a solid state flight data recorder (SSFDR) of 50 hours duration and a solid state cockpit voice recorder (SSCVR) of 30 minutes duration.

The data for the final approach to land showed the following sequence of events (see Figure 1). At 1837 hrs, at about 2,000 feet amsl with the autopilot and autothrust engaged, at an airspeed of 130 kt, and flap 42 selected, the aircraft turned onto a heading of 270° and established the localiser and glideslope. The aircraft then started to descend. The left and right main gear indicated down and locked. The nose gear indication was in the up position.

At about 920 feet radio altimeter (RA) a master warning was recorded. The descent continued and 45 seconds later the autopilot was disengaged at an airspeed of 131 kt.

At 50 feet RA the airspeed was 127 kt. Ten seconds later, at an airspeed of 124 kt, both the left and right weight on wheel parameters were momentarily recorded, the normal acceleration value was 1.23g and the pitch attitude was 2.37° nose-up. Over the next four seconds the pitch attitude increased slightly to 2.54° nose-up and then over the next two seconds decreased to 1.58° nose-up.

The airspeed had reduced to 114 kt at this time and the right weight on wheel parameter was then recorded. Reverse thrust was then selected.

During the next three seconds the pitch attitude increased slightly to 2.02° nose-up and the airspeed had reduced to 110 kt, the left weight on wheel parameter was then recorded. Over the next 3.5 seconds the pitch attitude decreased to a nose-down attitude of 0.08° and about one second later the nose gear was recorded in the down position, the master warning at this time was also no longer recorded. The aircraft continued to decelerate at an average of 1.5 metres per second until it came to a stop.

Nose landing gear downlock operation

The nose landing gear on the Fokker F28 Mark 0100 is of the forward-retracting type. The gear is locked in the down position by a spring-loaded plunger mounted on the top of the leg (see Figure 2). During gear extension, the plunger contacts a ramp on the downlock bracket, which compresses the plunger into its housing against the force of the spring. When the gear is in the fully down position, the plunger lines up with a hole at the base of the ramp and extends under spring pressure, thus locking the leg in position. The extension of the plunger triggers the nose gear down and locked proximity sensors to illuminate the green gear indication light in the cockpit.

The downlock bracket is shimmed, to ensure that the downlock plunger is located centrally in the hole when the gear is down. If the clearance is incorrect, the downlock plunger may be prevented from fully extending due to the excessive friction caused by the plunger being forced against the sides of the hole. If the plunger is not fully extended, the down and locked proximity sensors may not be triggered.

The bottom of the downlock plunger is attached to a connecting rod, which is in turn connected to the nose gear retract actuator. During the early part of the retraction cycle, the retract actuator causes the connecting rod to move downwards, pulling the downlock plunger with it, thus unlocking the nose gear prior to retraction.

Engineering investigation

Examination of the aircraft was overseen by the AAIB. It was established that when the engineers visited the cockpit after the aircraft had stopped on the runway, the nose gear green down and locked light was illuminated. This corroborated the flight data recorder evidence that the nose gear had gone fully into lock during the landing roll.

Extensive troubleshooting in the hangar, including testing of the nose landing gear indication system and gear retraction/extension tests, failed to identify any defects. Following advice from the aircraft manufacturer, the nose landing gear downlock plunger clearance was measured; this was reported to be satisfactory. The aircraft was returned to service, with no further reports of problems.

The aircraft was subsequently on a Base Maintenance check between 19 and 28 September 2004, during which the downlock plunger clearance was rechecked after further consultation with the aircraft manufacturer. On this occasion, the clearance was found to be outside the Aircraft Maintenance Manual (AMM) limits of 0.003 to 0.020 inch and the shimming was adjusted to increase the clearance to bring it within limits. According to the aircraft manufacturer, too small a clearance increases the chances of the downlock plunger not fully engaging, due to the increased friction on the plunger caused by the misalignment.

A year earlier, on 26 September 2003, the aircraft had experienced a nose landing gear unsafe condition on approach. The aircraft landed safely and troubleshooting did not highlight any defects with the nose landing gear.

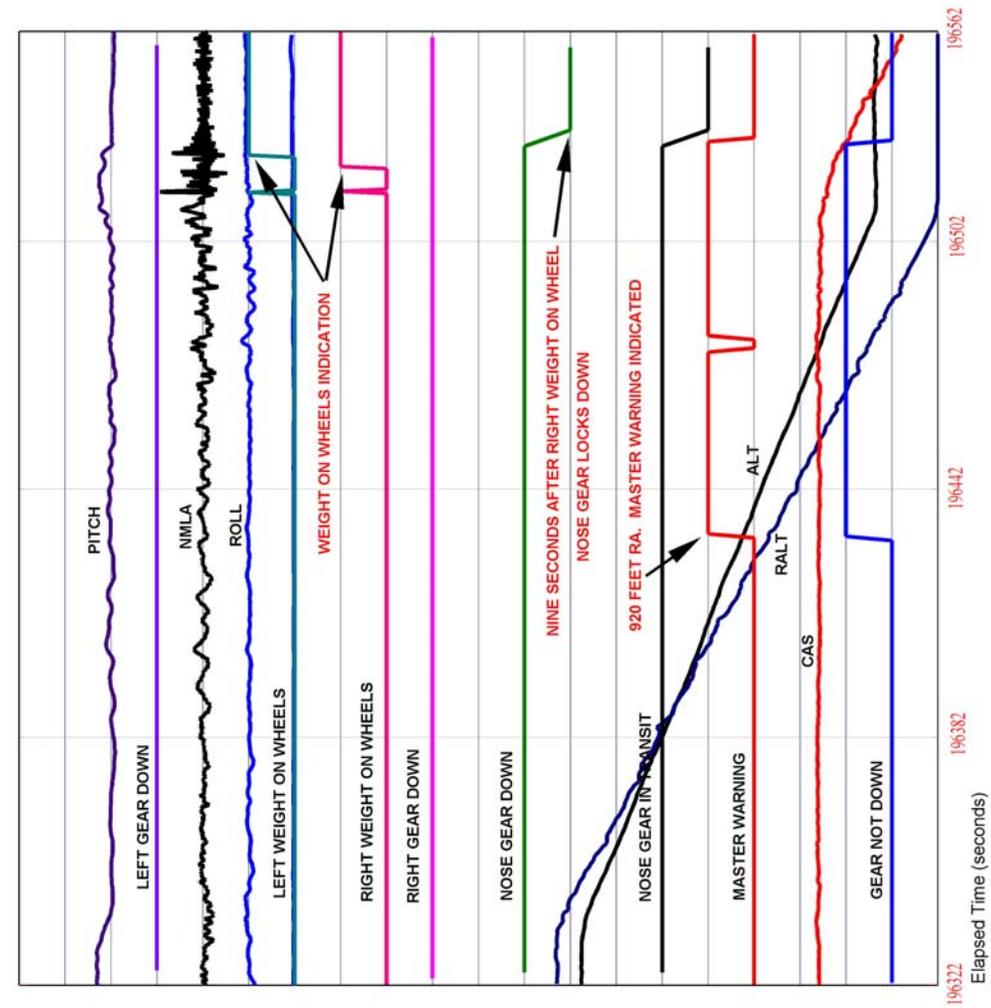
On reviewing the AMM procedure for checking the downlock plunger clearance, the airline's Engineering Quality Department noted that the procedure was ambiguous, in that it did not make it clear that it is necessary to apply a rearward force on the nose landing gear when checking the downlock plunger clearance. Failing to do so will result in an incorrect measurement being obtained.

The nose landing gear on G-BXWE was replaced in June 2003, following a towing incident. It is thought that the downlock plunger clearance may not have been correctly rigged after the nose gear was installed, because of the ambiguity in the AMM procedure. This might also explain why no anomalies were found during troubleshooting after this event and the previous event in September 2003. In-service wear tends to increase the downlock plunger clearance and thus too small a clearance could only have resulted from incorrect maintenance procedures.

Follow-up action

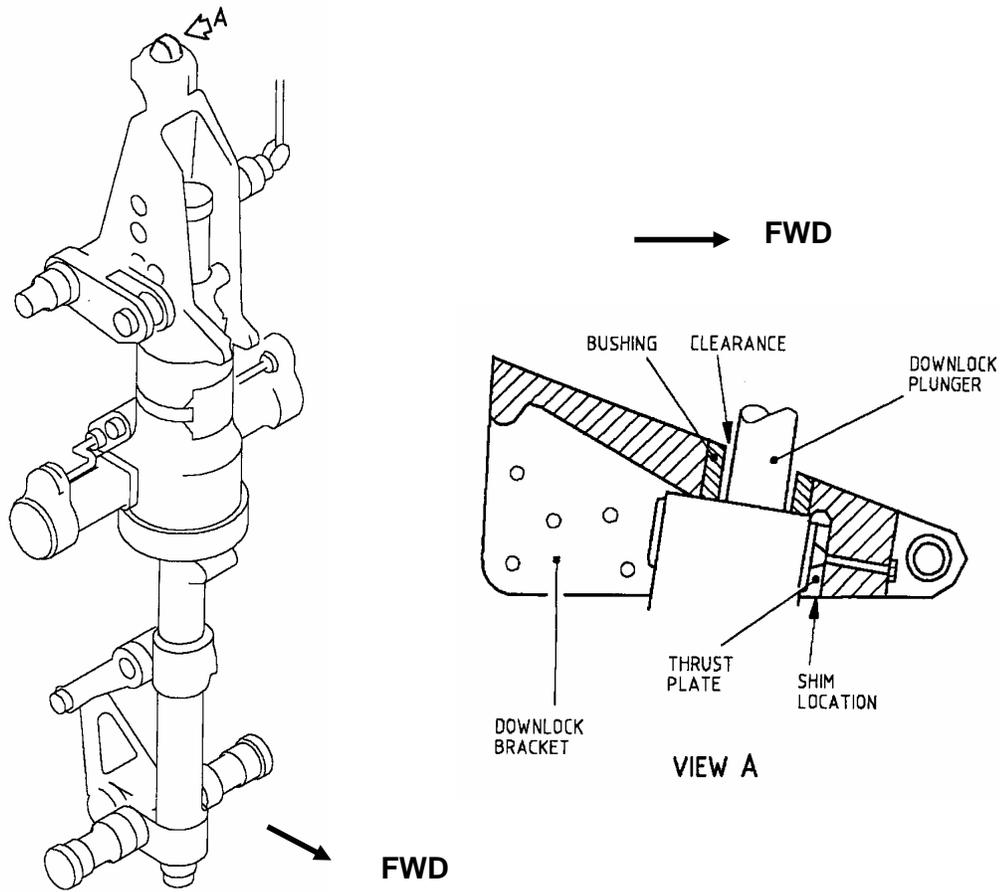
In response to the airline's recommendation, the aircraft manufacturer has agreed to amend AMM subtask 32-21-01-220-024-A00 and task 32-21-01-200-836-A to include a step to clarify that a second person is required to apply a rearward force to the nose gear when measuring the downlock plunger clearance, in order to obtain an accurate measurement.

Figure 1



G-BXWE Flight Recorder Data for Landing/Rollout

Figure 2



Nose Landing Gear Downlock Mechanism

(Diagrams taken from Fokker 100 Maintenance Manual)