

**SERIOUS INCIDENT**

<b>Aircraft Type and Registration:</b>	Boeing 787-9 Dreamliner, G-TUIM	
<b>No &amp; Type of Engines:</b>	2 General Electric Co GENX-1B70/P2G01 turbofan engines	
<b>Year of Manufacture:</b>	2018 (Serial no: 62742)	
<b>Date &amp; Time (UTC):</b>	6 July 2018 at 1711 hrs	
<b>Location:</b>	London Gatwick Airport	
<b>Type of Flight:</b>	Commercial Air Transport (Passenger)	
<b>Persons on Board:</b>	Crew - 11	Passengers - 353
<b>Injuries:</b>	Crew - None	Passengers - None
<b>Nature of Damage:</b>	None	
<b>Commander's Licence:</b>	Airline Transport Pilot's Licence	
<b>Commander's Age:</b>	45 years	
<b>Commander's Flying Experience:</b>	11,576 hours (of which 2,708 were on type) Last 90 days - 165 hours Last 28 days - 74 hours	
<b>Information Source:</b>	Aircraft Accident Report Form submitted by the pilot	

**Synopsis**

The aircraft was on approach to Runway 26L at London Gatwick Airport and was being configured to land. After FLAPS 1 was selected, there was a progressive deterioration in normal flight controls, landing gear lowering and nosewheel steering capabilities. The crew performed a go-around and actioned the relevant checklists. The aircraft landed safely with FLAPS 20 set but with the nosewheel steering inoperative.

The cause of the system degradation was a failure of the Nose Landing Gear Isolation Valve (NLGIV). Following this event, the manufacturer changed its procedures in relation to the manufacturing and testing of the NLGIV.

**History of the flight**

The aircraft was on a flight from Tenerife South Airport (GCTS) to London Gatwick Airport (EGKK) and was being radar vectored on the base leg for an ILS approach to Runway 26L. The weather was good with CAVOK and a light wind. During the configuration for landing, and after FLAPS 1 was selected, there was a progressive deterioration in normal flight controls, landing gear lowering and nosewheel steering capabilities. Initially, the SLATS PRIMARY FAIL and FLAPS PRIMARY FAIL EICAS<sup>1</sup> messages were displayed after which there was

**Footnote**

<sup>1</sup> Engine Indication and Crew Alerting System (EICAS).

difficulty in lowering the nose landing gear and a fault was indicated with the nose wheel steering system. Given the deteriorating and complex situation, the crew discontinued the approach and used ATC to provide radar vectors and monitoring to allow them to action several checklists. The nose landing gear was lowered using the alternate system, but a fault was indicated with the nosewheel steering. The effects of landing without nosewheel steering were discussed, along with considerations associated with the need to land using FLAPS 20. Autobrake 4 was to be used initially, using rudder for directional control. Once the rollout was stabilized and the aircraft was approaching 80 KIAS, manual braking would be commenced to disconnect the autobrake and complete the rollout with a fairly high rate of deceleration. The commander's interest in stopping quickly was to allow spare runway distance to bring the aircraft back to the centreline using differential braking if required.

A NITS<sup>2</sup> brief was given to the cabin crew for a precautionary landing due to the flap and slat issue, which was then upgraded on the final approach to cover an emergency landing once the potential ramifications of the nosewheel steering problem had been considered. The Senior Cabin Crew Member (SCCM) initially briefed the other cabin crew using the interphone for a precautionary landing but, on instruction from the commander, he then briefed the passengers and cabin crew for an emergency landing and on the brace positions. He then looked out of the window and realised the aircraft was quite low. Having not heard any "CREW AT STATIONS" or "BRACE" commands from the flight deck, he initiated the "BRACE, BRACE, HEADS DOWN, HEADS DOWN" commands, which were heard by the other cabin crew and repeated by them. After the aircraft landed and came to a stop, the "CABIN CREW STANDBY, STANDBY" PA was made by the commander. Shortly afterwards, the commander made the "CABIN CREW NORMAL OPERATIONS, NORMAL OPERATIONS" PA and provided an explanatory PA to the passengers. The aircraft was towed to stand where the passengers were disembarked normally.

### Recorded information

At 1652 hrs, during the descent and passing 5,500 ft, heading 054° M and approximately 3 nm north of the Mayfield VOR, FLAPS 1 was selected<sup>3</sup>. The EICAS caution SLATS PRIMARY FAIL was displayed and reported to ATC after which the crew actioned the Electronic Check List (ECL). The aircraft made a right turn under radar vectors, levelling at 4,000 ft, and continued in an extended orbit to the right. During the orbit, FLAPS 5 was selected and the EICAS displayed FLAPS PRIMARY FAIL. The ECL actions were carried out which required a FLAPS 20 landing. The aircraft completed the orbit and was vectored to the north-east, and, during a level left turn to intercept the localiser, FLAPS 20 was selected using the electrical alternate system. The aircraft was established on the localiser at approximately 18 nm, configured at FLAPS 20 and 154 KIAS. At approximately 9 DME the landing gear was selected down after which the EICAS message GEAR DISAGREE was displayed. The commander advised that the nose landing gear indication was a cross-hatched box, indicating the nose landing gear was in transit. Prior to capturing the Glideslope (GS), the approach was broken off and a left turn to the south was flown, continuing into another

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### Footnote

<sup>2</sup> Nature; Intentions; Timings; Special instructions (NITS).

<sup>3</sup> In the FLAPS 1 position, the leading edge slats extend to the mid position; the trailing edge flaps do not extend.

extended orbit during which the nose landing gear was successfully lowered using the alternate system. The aircraft was repositioned onto the ILS and a stable approach was made with the autopilot disengaged at 1,140 ft (threshold elevation 196 ft). The aircraft landed, and no difficulty was reported with directional control on the runway where the aircraft was brought to a stop after a landing roll of 5,513 feet. The aircraft came to a stop at 1712 hrs and the engines were shut down at 1719 hrs.

### Aircraft information

This was the third incident involving G-TUIM in a week where similar indications of system degradation had occurred but it was the first where problems with the nose landing gear and nosewheel steering were indicated.

1. On 30 June 2018, on the base leg to LGW a SLATS PRIMARY FAIL message was displayed on the EICAS. The approach was continued to a normal landing and rollout.
2. On 4 July 2018, left downwind for Runway 09L, on selection of FLAPS 1, an EICAS message SLATS PRIMARY FAIL was displayed and the ECL actioned. On selection of FLAPS 5, the FLAPS PRIMARY FAIL caption was displayed. The approach was delayed and, after completion of the ECL and a recalculation of the landing distance required, a FLAPS 20 landing was carried out.

The engineering department carried out the required system and serviceability checks which were passed satisfactorily. It was decided to order a replacement Hydraulic Control Unit (HCU) and maintenance action was planned for the aircraft.

During the event on 6 July 2018 there were similar slats and flaps system failures but, additionally, there were GEAR DISAGREE and NOSE WHEEL STEERING EICAS messages. The reported failures also highlighted that the hydraulic synoptic page<sup>4</sup> displayed an 'amber cross' through the Nose Landing Gear Isolation Valve (NLGIV). The NLGIV subsequently failed a serviceability test and was replaced. The aircraft was returned to service and had not experienced any recurrence of the problem by the time of publication of this report.

### Engineering

The incident was discussed with the operator's engineering reliability team, and the aircraft manufacturer was requested to examine the fault and to address concerns regarding the NLGIV, as well as system monitoring and functionality. As a result, the manufacturer considered whether a cold-soaked condition might affect the valve operation and considered a possible amendment and Fault Identification Manual (FIM) revision. The manufacturer also found that early in the Boeing 787 programme there were similar events that had been investigated. The root cause was found to be brinelling (an undesirable wear) of an internal component called the 'pintle' and 'coining' of a valve seat. This condition was not identified by the original Acceptance Test Procedure (ATP), so the ATP was altered to identify this condition. Manufacturing changes were also made to ensure that 'brinelling' did not occur on delivered parts.

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#### Footnote

<sup>4</sup> The EICAS displays general views (synoptics) of each aircraft system on system 'pages'.

A response from the manufacturer received on 10 October 2018 regarding the NLGIV advised that the NLGIV was cold tested to -40°F. The unit failed to open under those conditions and the failure was repeatable. This finding will support future work and potential mitigating actions, which were being examined. A FIM revision is being made and an amendment to the Aircraft Maintenance Manual to add an operational test of the valve.

### Analysis

The flight crew were confronted with an escalating degradation of normal systems that progressed from an initial failure of the primary slats and flaps systems. When the landing gear was selected DOWN, a GEAR DISAGREE message was displayed on the EICAS indicating that the nose landing gear had not achieved the selected position. The alternate landing gear lowering system was used to lower the nose landing gear into the correct position, but a further message indicated a fault with the nosewheel steering. ATC was used to assist the crew by directing them to fly orbits during which they were able to action the ECL and discuss their plan for the landing. The commander carried out a NITS brief for the SCCM, briefing a precautionary landing. With the additional problem of the nosewheel steering, however, this was upgraded to a briefing for an emergency landing, and the SCCM carried out the required cabin briefing and actions. When the SCCM realised that the aircraft was close to landing and no orders had been received from the flight deck, he issued the “BRACE, BRACE, HEADS DOWN, HEADS DOWN” command which ensured that those in the cabin were properly prepared. The landing rollout was safely accomplished using the rudder for aerodynamic directional control followed by differential braking to maintain the runway centreline. The engines were stopped on the runway and the aircraft towed to the parking stand and the passengers disembarked normally.

### Conclusion

The incident was caused by the NLGIV failing to open when commanded which meant that the leading-edge slats, trailing edge flaps, nose landing gear and nosewheel steering would not operate normally. The alternate electrical system was used to select FLAPS 20 and lower the nose landing gear.

### Safety Action

Following this incident, the aircraft manufacturer:

1. Introduced changes to the component Acceptance Test Procedure for the NLGIV
2. Made changes to the manufacturing procedures of the NLGIV to prevent brinelling.
3. Made amendments to the FIM and AMM to add operational tests of the NLGIV.

### Bulletin addendum

An addendum was issued concerning this report on 11 April 2019 and can be viewed [online](#). The addendum will also appear in the May 2019 Bulletin.