INCIDENT

Aircraft Type and Registration:	Boeing 747-436, G-CIVX	
No & Type of Engines:	4 x Rolls-Royce RB211-524G2 turbine engines	
Year of Manufacture:	1998 (Serial no: 28852)	
Date & Time (UTC):	30 January 2016 at 1712 hrs	
Location:	After takeoff from London Heathrow Airport	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 17	Passengers - 293
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	N/A	
Commander's Flying Experience:	N/A hours Last 90 days - N/A hours Last 28 days - N/A hours	
Information Source:	AAIB Field Investigation	

Synopsis

This was the aircraft's first flight after maintenance, during which the Landing Gear Control Module (LGCM) was replaced. After retracting the landing gear following takeoff from Heathrow, the crew were unable to move the landing gear lever from the UP to the OFF position, as it had become jammed in the UP detent. The crew elected to return to Heathrow and, in accordance with 747 Flight Crew Operations Manual Non-Normal Checklist procedures, the landing gear was lowered using the alternate extension system. The aircraft landed safely, with only the nose and body landing gear deployed.

The landing gear lever jam was attributed to a maintenance error which had resulted in incorrect rigging of the landing gear lever system during the LGCM replacement, due to the omission to insert a rig pin in the selector valve quadrant. The operator has taken safety actions intended to prevent a recurrence.

History of the flight

The aircraft was on its first flight after an 'A' Check scheduled maintenance input. This check included an incoming defect which involved the replacement of the LGCM, which incorporates the landing gear lever. After takeoff the crew noticed that the landing gear lever felt unusual as they moved it from the DN (down) into the UP position; they then found that it could not be moved from the UP to the OFF detents (the OFF position depressurises the landing gear hydraulic system).

The crew discussed the problem with engineering staff on the ground and decided to return to Heathrow. The nose and the two body landing gear were lowered using the alternate gear extension procedure, and the aircraft landed successfully without the two wing landing gear having deployed.

Aircraft inspection

Inspection and function checks were carried out at the operator's main base following the incident. The LGCM was found to be mechanically jammed in the UP position. The lever could only be moved to the OFF or DN positions by the application of excessive force.

Aircraft information

The landing gear on a Boeing 747 is mechanically commanded and hydraulically actuated. There is a three-position handle in the cockpit with the following spring-loaded detents: DN, OFF and UP. The handle must be pulled outwards against spring pressure to enable it to be moved to another position. The handle is part of the LGCM (Figure 1).

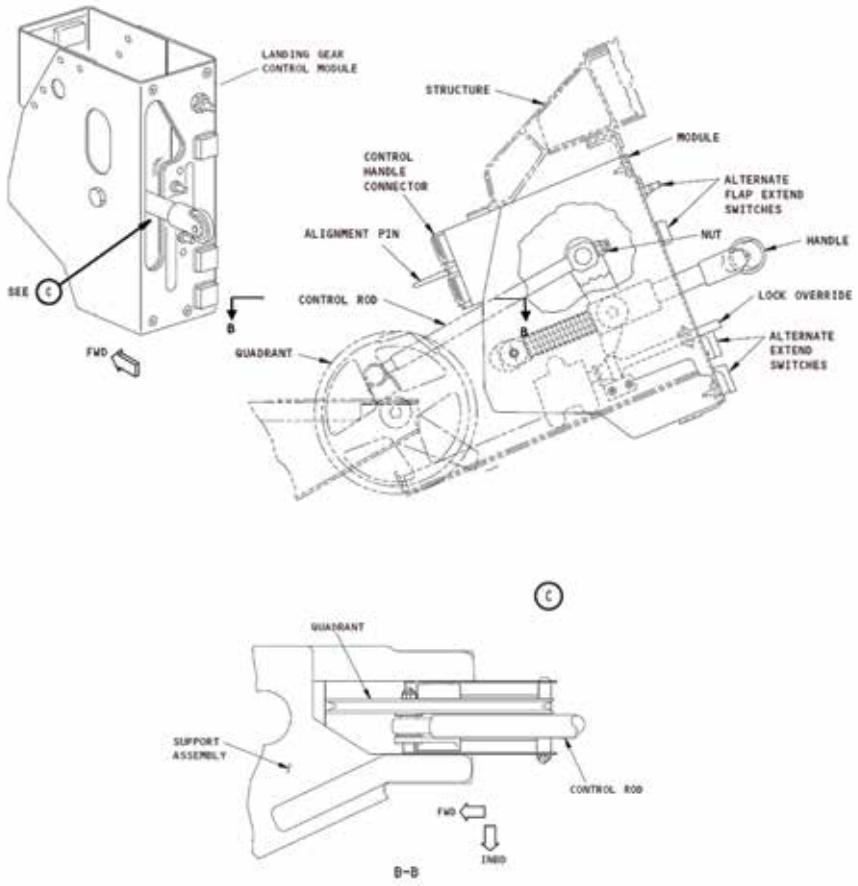

Figure 1

Landing Gear Control Module showing handle and control rod

The handle is connected to a control rod, which in turn is connected to a quadrant, and attached to the quadrant is a cable that runs to the wing gear selector valve quadrant located in the right hand body gear wheel well. Another cable runs from the wing gear selector valve quadrant to the nose/body gear selector valve quadrant located in the left-hand body gear wheel well (Figures 2 and 3).

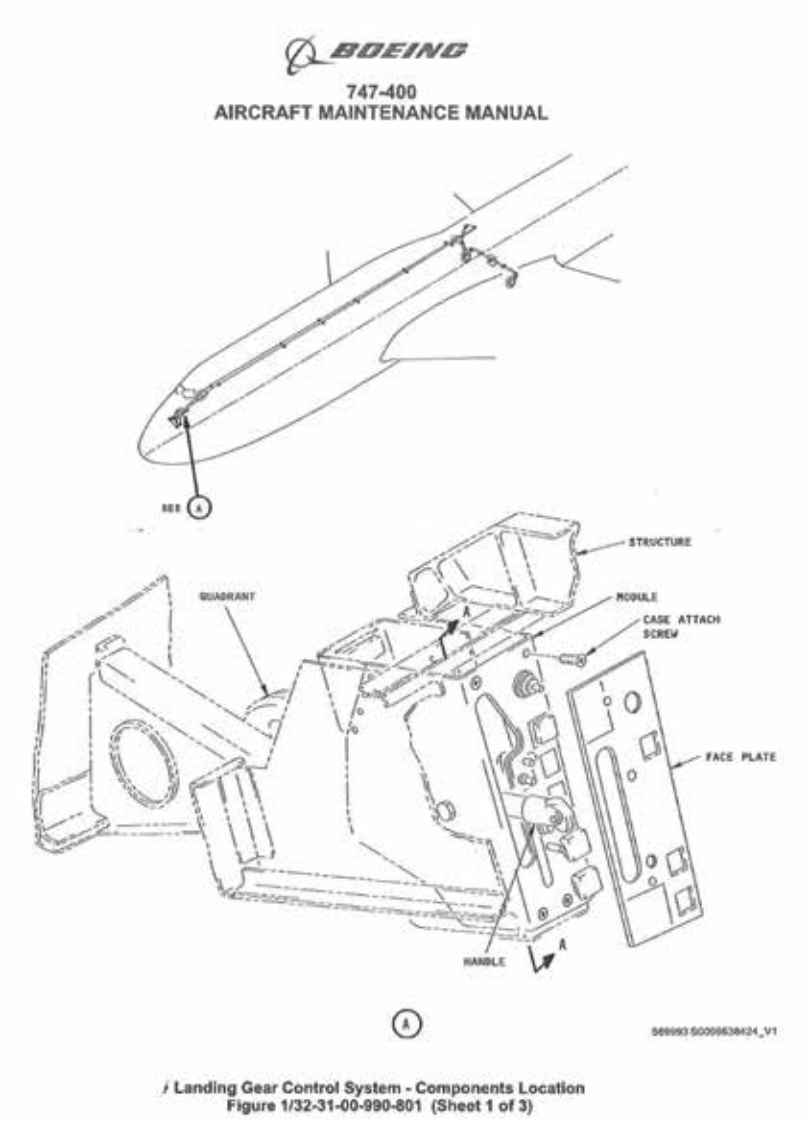

Figure 2

Landing Gear Control Module and cable runs

The quadrant in each wheel well is connected to a selector valve by a mechanical lever. When a replacement LGCM is installed, it is a requirement in the Aircraft Maintenance Manual (AMM) to insert a rig pin in the selector valve quadrant (Figure 3).

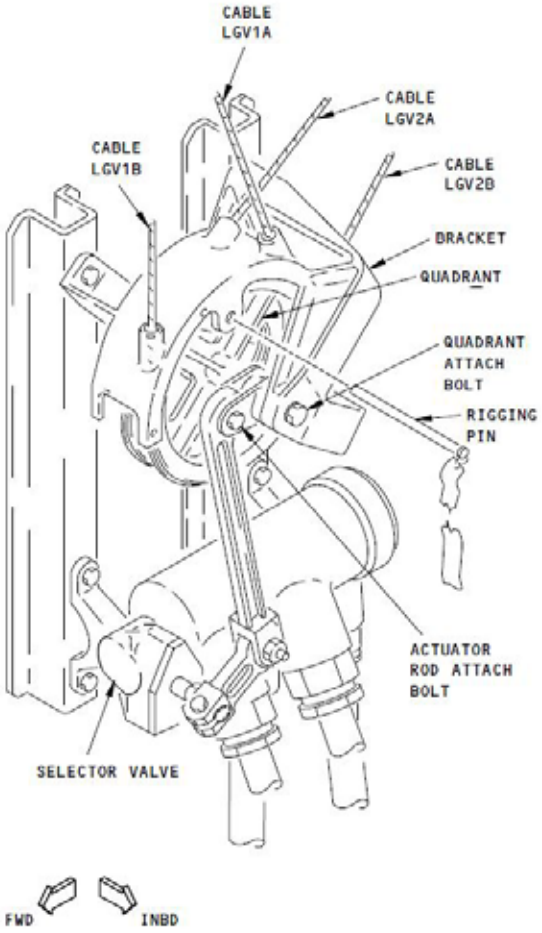

Figure 3

Wing Gear Selector Valve Installation - note rig pin
(Nose/Body Gear Selector Valve Installation similar)

Inspection of the LGCM

The LGCM was stripped at the AAIB with a representative from the operator. There were no significant findings.

Maintenance investigation

The maintenance conducted on the LGCM was reviewed as part of the operator's internal investigation into the incident.

The night shift had raised the task cards for the removal and re-rigging of the original LGCM; these cards included the tasks of fitting the rig pin in the selector valve quadrant, function checks and a duplicate inspection. The night shift staff removed and re-rigged the LGCM, but did not have time to compete the function checks, and the task cards were left uncertified.

The re-rigged LGCM failed the function check made by the day shift, and the day shift then fitted a replacement serviceable LGCM. The task cards raised by the day shift staff for replacing the LGCM did not contain a task for the fitment and removal of the rig pins in the

selector valve quadrants. The task cards raised by the night shift were used to certify the function checks.

Three day shift engineers were involved in the fitting of the LGCM. They had the relevant sections of the AMM and the applicable Temporary Revision (TR) to the AMM, generated by the operator to provide additional information on the task. The engineers became focused on achieving the correct adjustment and hence were using the TR (which did not specify the need to fit the rig pins). A consequence of omitting to use the rig pin was the need to use five shims to enable the LGCM to be fitted to the instrument panel; three shims are more typical for a correctly rigged system.

One of the engineers, who was positioned near the quadrant in the right-hand wheel well, noticed that the rig pin was not fitted and that the quadrant was moving (by inputs from another engineer in the cockpit). He was concerned that he might be injured, and took a planned break that was overdue. This break caused a distraction, and the fitting of the rig pin was omitted.

Analysis and safety actions

The jammed landing gear lever was attributed to a rig pin not being inserted in the landing gear system during maintenance, which led to additional and unnecessary shims being used to rig the landing gear lever.

The following causal factors were identified by the operator's maintenance investigation:

i. The distraction of the engineer when he saw the quadrant move and he took his break;

ii. Deficiencies in the operator's task card system;

iii. The omission of the need to fit the rig pin in the operator's TR for this task;

iv. An inadequate handover between the night shift and the day shift.

As a result of this incident the operator has taken a number of safety actions, including:

a. Updating the TR so that technical management are consulted if more than three rigging shims are used for this task and to include a requirement to fit rig pins and to check that the rig pins can be inserted freely once function checks are completed;

b. Holding staff briefings to reinforce the requirements to adhere to handover procedures;

c. Publishing a bulletin to highlight this incident, including the distraction aspect;

d. Introduction of additional skills training in task card generation.