

Safety Recommendation 2015-026

It is recommended that Boeing amend the 747-400 Approved Maintenance Manual task for removal and installation of the wing landing gear actuator, to provide clear instructions for the safe manoeuvring of the actuator in or out of its location in the wing landing gear bay.

Date Safety Recommendation made:

6 November 2015

LATEST RESPONSE

Response received:

29 February 2016

Boeing has reviewed this safety recommendation and believes the existing Airplane Maintenance Manual (AMM) procedure calls out the proper tooling to assist with the installation of the actuator and properly specifies the installation orientation of the actuator. The recommended technique for manoeuvring the actuator into or out of the installation location are not included in the AMM. The AMM is a procedural manual that assumes the maintenance called for will be performed by qualified mechanics who have received training in the use of the required tooling and in the maintenance techniques that may be necessary to complete the procedure.

Boeing does believe the figure of the retract actuator in the AMM could be improved and it is planned to update this figure to add callouts to the UP and DN hydraulic ports. This update is planned to be incorporated in the 3rd quarter 2016 publishing of the AMM.

AAIB Assessment – Adequate - Closed

RESPONSE HISTORY

N/A

Boeing 747-443,
G-VROM

Near London Gatwick
Airport

29 December 2014

Serious Incident

Safety Recommendation 2015-027

It is recommended that Boeing modify the 747-400 wing landing gear actuator to reduce the likelihood of incorrect installation occurring or remaining undetected.

Date Safety Recommendation made:

6 November 2015

LATEST RESPONSE

Response received:

29 February 2016

Boeing has reviewed this safety recommendation and does not agree that a change to the 747-400 wing landing gear actuator is necessary. The wing gear retract actuator has been in service for over 45 years and Boeing is not aware of any instances of confusion regarding the installed position. The 747-400 Airplane Maintenance Manual has very clear instructions to ensure the actuator is installed correctly, including the following note:

Note: You must put the actuator in the position with the rod end adjacent to the shock strut trunnion. The UP port faces must be on the lower side of the actuator. The DN port faces must be on the top side of the actuator.

Further, the failures resulting from improper installation of the actuator do not affect continued safe flight and landing of the aircraft. As this event demonstrated, the aircraft is equipped with the appropriate systems to detect and annunciate the hydraulic system #4 loss and the not-down-and-locked condition of the right hand wing gear. The airplane systems are designed with sufficient redundancy and isolation to ensure continued normal operation of the remaining three hydraulic systems in the case of a #4 hydraulic system failure. Flight Crew procedures are provided to allow alternate operation of systems that rely on the lost hydraulic system. The 747 flight crew procedures provide for landing on any available gear, including a configuration without the right hand wing gear. In accordance with 14 CFR 25.573, the 747 is designed and certified to land on any three of the four main gears.

AAIB Assessment – Not Adequate - Closed

RESPONSE HISTORY

N/A

**Boeing 747-443,
G-VROM**

**Near London Gatwick
Airport**

29 December 2014

Serious Incident

Safety Recommendation 2015-028

It is recommended that Boeing modify the design of the 747-400 wing landing gear door mechanism to prevent release of the strike board from the aircraft when the alternate gear extension system is used following a loss of hydraulic fluid.

Date Safety Recommendation made:

6 November 2015

LATEST RESPONSE

Response received:

29 February 2016

Boeing has received very few reports of problems with the wing gear strike board mechanism since the 747-400 went into service, and the probability of loss of wing gear extension damping is very low. As of this date we have not found any other instances of a strike board release from the aircraft under the event circumstances. Boeing does not believe a change is necessary or warranted.

AAIB Assessment – Not Adequate - Closed

RESPONSE HISTORY

N/A

Safety Recommendation 2015-029

It is recommended that Boeing amend the 747-400 Quick Reference Handbook to warn flight crews of the potential for, and provide guidance in the event of, an unsuccessful extension of the wing landing gear, when the alternate gear extension system is used following hydraulic system 4 low quantity and pressure warnings.

Date Safety Recommendation made:

6 November 2015

LATEST RESPONSE

Response received:

29 February 2016

Boeing's Quick Reference Handbook (QRH) procedures are designed assuming a single fault is present and the actionable event is the only event. Further, the procedures assume that the aircraft is dispatched in the certified and delivered condition and has been maintained in accordance with the applicable Boeing AMM, MEL, and DDG. The QRH Checklist Instructions state:

While every attempt is made to supply needed non-normal checklists, it is not possible to develop checklists for all conceivable situations....In some multiple failure situations, the flight crew may need to combine the elements of more than one checklist.

Boeing further states in the Flight Crew Training Manual section for Situations Beyond the Scope of Non-Normal Checklists:

It is rare to encounter in-flight events which are beyond the scope of the Boeing recommended NNCs. In these situations the flight crew may be required to accomplish multiple NNCs, selected elements of several different NNCs applied as necessary to fit the situation, or be faced with little or no specific guidance except their own judgment and experience. Because these situations are rare, it is not practical or possible to create definitive flight crew NNCs to cover all events.

Boeing believes the existing guidance in the QRH was adequate for the issues the flight crew confronted in this incident as NNCs were available for both the indicated hydraulic failure and the gear disagree. The event flight crew effectively used the existing QRH procedures to safely return to London Gatwick.

It would be impractical to create Non-Normal Checklists for the very specific combination of failures experienced in this event and maintain the usability and manageability of the QRH for flight crew use.

AAIB Assessment – Partially Adequate - Closed

RESPONSE HISTORY

N/A