

BOEING COMMERCIAL AIRPLANES

FLIGHT OPERATIONS TECHNICAL BULLETIN

NUMBER: 737-13-1
747-400-65
747-8-5
757-85
767-87
777-38
787-12

DATE: May 1, 2013

This bulletin provides information which may prove useful in airline operations or airline training. The information provided in this bulletin is not critical to flight safety. The information may not apply to all customers; specific effectivity can be determined by contacting The Boeing Company. This information will remain in effect depending on production changes, customer-originated modifications, and Service Bulletin incorporation. Information in this bulletin is supplied by The Boeing Company and may not be approved or endorsed by the FAA at the time of writing. Appropriate formal documentation will be revised, as necessary, to reflect the information contained in this bulletin. For further information, contact Boeing Commercial Airplanes, Chief Pilot – Flight Technical and Safety, P. O. Box 3707, Mail Code 20-95, Seattle, Washington 98124-2207; Phone +1 (206) 544-8024; or Facsimile +1 (206) 662-4747.

SUBJECT: Rejected Takeoff (RTO) Non-Normal Maneuver

ATA NO: 0200-00

APPLIES TO: 737-100/200/300/400/500/600/700/800/900, 747-400/8, 757-200/300, 767-200/300/400, 777-200/300, 787-8

REASON: To provide background information about the RTO non-normal maneuver and to clarify the use of automatic speedbrake extension.

BACKGROUND INFORMATION

The Rejected Takeoff (RTO) non-normal maneuvers for the 737, 747, 757 and 767 models require the Captain to simultaneously close the thrust levers, raise the SPEED BRAKE lever, and apply maximum reverse thrust consistent with conditions. This is commonly known as a three-step maneuver, i.e., thrust levers, speed brakes and reverse thrust. The 777 and 787 are the only models approved to use a two-step RTO maneuver which allows the thrust reversers to automatically deploy the speedbrakes. With the two-step maneuver, the flight crew only verifies that the speedbrakes are extended.

Previous Boeing analysis and experience indicated that if the RTO maneuver was accomplished correctly, use of the reverse thrust levers to automatically deploy the speedbrakes (a two-step maneuver) was equivalent in effect to the manual deployment of the speedbrakes on the 747-400, 757, 767, and 777 airplanes. Based on this understanding, Boeing provided No Technical Objection (NTO) statements to operators to use a two-step procedure for those models. Use of a two-step maneuver reduces the time for thrust reverser deployment and is similar to normal landing actions. Seeing the benefits of a two-step procedure, Boeing pursued a change to the published RTO maneuver that would implement the two-step maneuver across the 737, 747-400, 757, 767 and 777 models.

Since these models had not been certified using auto-deployment of the speedbrakes, Boeing conducted an in-depth investigation to confirm previous certification analyses would not be invalidated. The investigation determined the two-step procedure increased stress on the thrust reverser hardware beyond that used for certification analysis on the 737, 747-400, 757 and 767 models. As such, it is unacceptable to use a two-step maneuver for these models. Further, any previous NTO statement approving the use of a two-step maneuver for the 747-400, 757, and 767 airplanes should be considered invalid.

737-100/200, 737-300/400/500 and 737NG:

During certification tests of a CFM56-7 engine EEC software upgrade, a remote condition was identified in which rapid thrust reverser deployment after operating at high forward thrust could exceed thrust reverser design load limits.

The 737NG reverser blocker door design is such that the design load of the thrust reverser inner wall is highest when the translating sleeve is 60% deployed. To prevent exceeding the design load, the engine must be spooled down before reverse thrust is selected. Tests determined that a minimum of 3.1 seconds between high forward thrust and thrust reverser deployment was needed to ensure the thrust reverser design load limits are not exceeded. Flight tests have shown that this 3.1 second delay can be achieved by sequentially retarding the thrust levers to idle, manually raising the SPEED BRAKE lever, and then deploying the thrust reversers. Flight tests have also shown that a two-step maneuver, i.e., retarding the thrust levers to idle and deploying the thrust reversers, thus automatically raising the speed brakes, does not provide the needed time delay.

This condition is not unique to this EEC software upgrade; the same condition exists in all previous EEC software versions. The condition is, therefore, possible on all 737NG airplanes.

After discussions with the FAA, it was decided that all 737NG airplanes must use the three-step RTO maneuver as published in the FCOM/QRH and in AFM Section 2, Page 14. For commonality between the 737NG, 737-300/400/500 and 737-100/200, Boeing will not approve a different maneuver for the earlier 737 models.

747-400, 757 and 767:

Boeing's assessment of the two-step maneuver found it increased the stress/loading on the thrust reverser hardware during translating sleeve deployment in the transient condition. The two-step maneuver reduces the time from "Throttle Chop" to "Spoiler Select" and the time from "Throttle Chop" to "Reverser Deploy". For example, on the 747-400, the time from "Throttle Chop" to "Reverser Deploy" is reduced by almost 0.5 seconds when a two-step RTO maneuver is used.

This resulted in 13% greater thrust at thrust reverser deployment for 747-400 airplanes with GE CF6-80C2 engines. The load increase in the transient condition deviates from what Boeing certified for the 747-400, 757, and 767 models.

747-8:

Rapid deployment of the thrust reversers during transient conditions was considered in the design of the EEC software for the 747-8 airplanes. The 747-8 EEC does not allow the thrust reverser isolation valve to open until N1 has dropped below the necessary threshold to protect structure. As such, a two-step maneuver would be acceptable for the 747-8. But, for commonality between the 747-400 and 747-8, the three-step maneuver is used for the 747-8 model.

777 and 787:

Rapid deployment of the thrust reversers during transient conditions was considered in the design of the EEC software for the 777 and 787 airplanes. The 777 and 787 EECs are programmed to slightly delay thrust reverser deployment when the reverse thrust levers are pulled.

For the 777, this EEC feature makes an RTO maneuver that uses the reverse thrust levers to deploy the speedbrakes an acceptable alternative to an RTO maneuver that uses manual speedbrake extension before applying reverse thrust. With this feature, the FAA has agreed that using the reverse thrust levers to automatically deploy speedbrakes during an RTO maneuver, if accomplished correctly, is equivalent in effect to manual deployment of the speedbrakes. Recently, the 777 maneuver has been revised from a three-step to a two-step maneuver.

The 787 automatically extends the speedbrakes if on the ground, above 85 knots, either thrust lever has been in the takeoff range, and then both thrust levers are moved to idle. Thus, the two-step procedure is by design. Consequently, the published 787 maneuver uses a two-step maneuver.

OPERATING INFORMATION

737-100/200, 737-300/400/500 and 737NG:

For the 737NG, the two-step RTO maneuver, i.e., retarding the thrust levers to idle and deploying the thrust reversers, thus automatically raising the speed brakes, is not a certified Boeing Procedure. These requirements are reflected in the RTO maneuver in the 737NG AFM.

To ensure compliance with engine certification requirements, the RTO maneuver should be accomplished as a three-step maneuver: close the thrust levers, manually raise the SPEED BRAKE lever, and apply reverse thrust up to the maximum amount consistent with conditions.

For commonality, the same three-step RTO maneuver should be used on the 737-100/200 and 737-300/400/500 airplanes.

747-400, 747-8, 757 and 767:

For the 747-400, 757 and 767 airplanes, the two-step RTO maneuver, i.e., retarding the thrust levers to idle and deploying the thrust reversers, thus automatically raising the speed brakes, is not a certified Boeing Procedure.

To ensure compliance with engine certification requirements, the RTO maneuver should be accomplished as a three-step maneuver: close the thrust levers, manually raise the SPEED BRAKE lever, and apply reverse thrust up to the maximum amount consistent with conditions.

For commonality, the same three-step RTO maneuver should be used on the 747-8 airplane.

NOTE: All previously-issued NTOs allowing the use of a two-step RTO maneuver for these models are rescinded.

777 and 787:

For the 777 and 787 airplanes, the two-step RTO maneuver, i.e., retarding the thrust levers to idle and deploying the thrust reversers, thus automatically raising the speed brakes, is the Boeing approved maneuver.

777 operators who wish to use the three-step RTO maneuver for fleet commonality will be granted an NTO for the 777, upon request.