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[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2016-4136; Special Conditions No. 25-621-SC]

Special Conditions: The Boeing Company Model 777-300ER Airplanes; Dynamic Test Requirements for Single-Occupant Oblique (Side-Facing) Seats with Inflatable Restraints

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions; request for comments.

SUMMARY: These special conditions are issued to The Boeing Company (Boeing) for their Model 777-300ER airplane. This airplane has novel or unusual design features associated with single-occupant oblique (side-facing) seats equipped with inflatable restraints. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for occupants of seats installed at an angle of greater than 18 degrees, but substantially less than 90 degrees, to the vertical plane containing the centerline of the airplane, nor for inflatable restraints or related airbag devices. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

DATES: This action is effective on Boeing on **[INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. We must receive your comments by **[INSERT DATE 45 DAYS AFTER FEDERAL REGISTER PUBLICATION]**.

ADDRESSES: Send comments identified by docket number FAA-2016-4136 using any of the following methods:

- *Federal eRegulations Portal:* Go to <http://www.regulations.gov/> and follow the online instructions for sending your comments electronically.
- *Mail:* Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE., Room W12-140, West Building Ground Floor, Washington, DC, 20590-0001.
- *Hand Delivery or Courier:* Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- *Fax:* Fax comments to Docket Operations at 202-493-2251.

Privacy: The FAA will post all comments it receives, without change, to <http://www.regulations.gov/>, including any personal information the commenter provides. Using the search function of the docket Web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at <http://DocketsInfo.dot.gov/>.

Docket: Background documents or comments received may be read at <http://www.regulations.gov/> at any time. Follow the online instructions for accessing the docket or go to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: John Sheldon, Airframe and Cabin Safety, ANM-115, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington 98057-3356; telephone 425-227-2785; facsimile 425-227-1149.

SUPPLEMENTARY INFORMATION:

The FAA has determined that notice of, and opportunity for prior public comment on, these special conditions are impracticable because these procedures would significantly delay issuance of the design approval and thus delivery of the affected airplane. In addition, the substance of these special conditions has been subject to the public-comment process in several prior instances with no substantive comments received.

The FAA therefore finds that good cause exists for making these special conditions effective upon publication in the **Federal Register**.

Comments Invited

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

We will consider all comments we receive by the closing date for comments. We may change these special conditions based on the comments we receive.

Background

On December 24, 2015, Boeing Commercial Airplanes applied for a design change to type certificate no. T00001SE for single-occupant seats installed at an oblique angle to the vertical plane containing the centerline of the airplane, and equipped with inflatable lapbelts, in the Boeing Model 777-300ER airplane. The Model 777-300ER airplane is a wide body, swept wing, conventional tail, twin-engine, turbofan-powered, transport-category airplane.

Type Certification Basis

The type certification basis for the Model 777-300ER airplane is 14 CFR part 25, effective February 1, 1965, as amended by Amendments 25-1 through 25-98, including special conditions 25-295-SC, 25-187A-SC, and 25-569-SC. In addition, the certification basis includes certain special conditions, exemptions, or later amended sections of the applicable part that are not relevant to these proposed special conditions.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Boeing Model 777-300ER airplane because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Under the provisions of title 14, Code of Federal Regulations (14 CFR) 21.101, Boeing must show that the Model 777-300ER airplane, as changed, continues to meet the applicable provisions of the regulations listed in type certificate no. T00001SE or the applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA. These regulations will be incorporated into type certificate no. T00001SE after type certification approval of the 777-300ER.

In addition to the applicable airworthiness regulations and special conditions, the Boeing Model 777-300ER airplane must comply with the fuel-vent and exhaust-emission requirements of 14 CFR part 34, and the noise-certification requirements of 14 CFR part 36.

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type certification basis under § 21.101.

Novel or Unusual Design Features

The Boeing Model 777-300ER airplane will incorporate the following novel or unusual design features:

The seating configuration proposed by Boeing in certification plan no. 17174, revision A, “Installation of B/E Aerospace Super-Diamond Model Business Class Seats on WE736,” consists of Super Diamond model oblique (side-facing), business-class passenger seats installed in a Boeing Model 777-300ER airplane. These seats will also incorporate inflatable restraints.

The applicable airworthiness regulations do not contain adequate or appropriate safety standards for occupants of seats installed in the proposed configuration. To provide a level of safety equivalent to that afforded to occupants of forward- and aft-facing seats, additional airworthiness standards, in the form of special conditions, are necessary. Although special conditions no. 25-187A-SC, 25-295-SC, and 25-569-SC already apply to the 777-300ER, they do not directly address the complex occupant-loading conditions introduced by this oblique (side-facing) seat configuration, nor do they reflect the latest findings of on-going research.

Discussion

Amendment 25-15 to part 25, dated October 24, 1967, introduced the subject of side-facing seats, and a requirement that each occupant in a side-facing seat must be protected from head injury by a safety belt and a cushioned rest that will support the arms, shoulders, head, and spine.

Subsequently, Amendment 25-20, dated April 23, 1969, clarified the definition of side-facing seats to require that each occupant of a seat that is positioned at more than an 18-degree angle to the vertical plane containing the airplane centerline must be protected from head injury by a safety belt and an energy-absorbing rest that supports the arms, shoulders, head, and spine;

or by a safety belt and shoulder harness that prevents the head from contacting injurious objects. The FAA concluded that a maximum 18-degree angle would provide an adequate level of safety based on tests that were performed at the time, and thus adopted that standard.

Amendment 25-64, dated June 16, 1988, revised the emergency-landing conditions that must be considered in the design of the airplane. It revised the static-load conditions in § 25.561 and added a new § 25.562, requiring dynamic testing for all seats approved for occupancy during takeoff and landing. The intent was to provide an improved level of safety for occupants on transport-category airplanes. Because most seating on transport-category airplanes is forward-facing, the pass/fail criteria developed in Amendment 25-64 focused primarily on forward-facing seats. Therefore, the testing specified in the rule did not provide a complete measure of occupant injury in seats that are not forward-facing. However, § 25.785 does require that occupants of all seats occupied during taxi, takeoff, and landing not suffer serious injury as a result of the inertia forces specified in §§ 25.561 and 25.562.

To address recent research findings and accommodate commercial demand, the FAA developed a methodology to address all fully side-facing seats (i.e., seats oriented in the airplane with the occupant facing 90 degrees to the direction of airplane travel) and has documented those requirements in a set of proposed new special conditions. The FAA issued policy statement PS-ANM-25-03-R1 on November 12, 2012, titled, “Technical Criteria for Approving Side-Facing Seats,” which conveys the injury criteria to be used in the special conditions. Some of those criteria are applicable to oblique seats, but others are not because the motion of an occupant in an oblique seat is different from the motion of an occupant in a fully side-facing seat during emergency-landing conditions.

For shallower installation angles, the FAA has granted equivalent level of safety (ELOS) findings for oblique seat installations on the premise that an occupant's kinematics in an oblique seat during a forward impact would result in the body aligning with the impact direction. We predicted that the occupant response would be similar to an occupant of a forward-facing seat, and would produce a level of safety equivalent to that of a forward-facing seat. These ELOS findings were subject to many conditions that reflected the injury-evaluation criteria and mitigation strategies available at the time of issuance of the ELOS. However, review of dynamic test results for many of these oblique seat installations raised concerns that the premise was not correct. Potential injury mechanisms exist that are unique to oblique seats and are not mitigated by the ELOS self-alignment approach even if the occupant appears to respond similarly to a forward-facing seat.

These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

Applicability

As discussed above, these special conditions are applicable to the Boeing Model 777-300ER airplane. These special conditions can be applied to oblique seats installed in accordance with Boeing certification plan no. 17174, revision A, "Installation of B/E Aerospace Super-Diamond Business Class Seats on WE736."

The FAA will amend these special conditions, or issue new special conditions, should unusual occupant response in the required dynamic tests, or additional research into occupant-injury mechanisms, indicate that these special conditions are inadequate. Any future special conditions would include due public notice for comment.

Conclusion

This action affects only certain novel or unusual design features on one model of airplane. It is not a rule of general applicability.

Under standard practice, the effective date of final special conditions would be 30 days after the date of publication in the **Federal Register**; however, as the certification date for the Boeing Model 777-300ER airplane, as modified by Boeing, is imminent, the FAA finds that good cause exists to make these special conditions effective upon publication in the **Federal Register**.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

The Special Conditions

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for Boeing Model 777-300ER airplanes modified by Boeing.

Oblique (Side-Facing) Seats Special Conditions

In addition to the requirements of § 25.562:

1. Head Injury Criteria (HIC):

Compliance with §25.562(c)(5) is required, except that, if the anthropomorphic test device (ATD) has no apparent contact with the seat and related structure but has contact with an airbag, a HIC unlimited score in excess of 1000 is acceptable, provided the HIC15 score (calculated in accordance with 49 CFR 571.208) for that contact is less than 700.

2. **Body-to-Wall/Furnishing Contact:**

If a seat is installed aft of structure (e.g. interior wall or furnishings) that does not provide a homogenous contact surface for the expected range of occupants and yaw angles, then additional analysis and tests may be required to demonstrate that the injury criteria are met for the area which an occupant could contact. For example, if different yaw angles could result in different airbag device performance, then additional analysis or separate tests may be necessary to evaluate performance.

3. **Neck Injury Criteria:**

- a. The seating system must protect the occupant from experiencing serious neck injury. The assessment of neck injury must be conducted with the airbag device activated, unless there is reason to also consider that the neck-injury potential would be higher for impacts below the airbag-device deployment threshold.
- b. The N_{ij} , calculated in accordance with 49 CFR 571.208, must be below 1.0, where $N_{ij} = F_z/F_{zc} + M_y/M_{yc}$, and N_{ij} critical values are:
 - i. $F_{zc} = 1530$ lb for tension
 - ii. $F_{zc} = 1385$ lb for compression
 - iii. $M_{yc} = 229$ lb-ft in flexion
 - iv. $M_{yc} = 100$ lb-ft in extension
- c. In addition, peak upper-neck F_z must be below 937 lb in tension and 899 lb in compression.
- d. Rotation of the head about its vertical axis relative to the torso is limited to 105 degrees in either direction from forward-facing.

- e. The neck must not impact any surface that would produce concentrated loading on the neck.

4. Spine and Torso Injury Criteria:

- a. The lumbar spine tension (F_z) cannot exceed 1200 lb.
- b. Significant concentrated loading on the occupant's spine, in the area between the pelvis and shoulders during impact, including rebound, is not acceptable. During this type of contact, the interval for any rearward (X-axis direction) acceleration exceeding 20g must be less than 3 milliseconds as measured by the thoracic instrumentation specified in 49 CFR part 572, subpart E, filtered in accordance with SAE International (SAE) Recommended Practice J211/1, "Instrumentation for Impact Test—Part 1—Electronic Instrumentation."
- c. The occupant must not interact with the armrest or other seat components in any manner significantly different than would be expected for a forward-facing seat installation.

5. Pelvis Criteria:

Any part of the load-bearing portion of the bottom of the ATD pelvis must not translate beyond the edges of the seat bottom seat-cushion supporting structure.

6. Femur Criteria:

Axial rotation of the upper leg (about the Z-axis of the femur, per SAE Recommended Practice J211/1) must be limited to 35 degrees in the strike direction from the nominal seating position. Evaluation during rebound need not be considered.

7. ATD and Test Conditions:

Longitudinal tests conducted to measure the injury criteria above must be performed with the FAA Hybrid III ATD, as described in SAE 1999-01-1609, “A Lumbar Spine Modification to the Hybrid III ATD For Aircraft Seat Tests.” The tests must be conducted with an undeformed floor, at the most-critical yaw cases for injury, and with all lateral structural supports (e.g. armrests or walls) installed.

Inflatable Lapbelt Special Conditions

The inflatable lapbelts must meet special conditions no. 25-187A-SC, “Boeing Model 777 Series Airplanes; Seats with Inflatable Lapbelts.”

Note: As indicated in special conditions no. 25-187A-SC, inflatable lapbelts must be shown to not affect emergency-egress capabilities in the main aisle, cross-aisle, and passageway.

Issued in Renton, Washington, on July 8, 2016.

Michael Kaszycki
Assistant Manager, Transport Airplane Directorate,
Aircraft Certification Service.
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