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Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2023-1467; Special Conditions No. 25-840-SC]

Special Conditions: The Boeing Company Model 737-10 Airplane; Dynamic Test Requirements for Single Occupant Oblique Seats With or Without Airbags and / or 3-Point Restraints.

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions; request for comments.

SUMMARY: These special conditions are issued for The Boeing Company (Boeing) Model 737-10 series airplane. This airplane will have a novel or unusual design feature when compared to the state of technology envisioned in the airworthiness standards for transport-category airplanes. This design feature is oblique (side-facing) single-occupant seats equipped with airbag devices or 3-point restraints. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. 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]. Send comments on or before [INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: Send comments identified by Docket No. FAA-2023-1467 using any of the following methods:

- *Federal eRegulations Portal:* Go to https://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.
- *Docket:* Background documents or comments received may be read at https://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 Shelden, Cabin Safety Section, AIR-624, Technical Policy Branch, Policy and Standards Division, Aircraft Certification Service, Federal Aviation Administration, 2200 South 216th Street, Des Moines, Washington 98198; telephone and fax 206-231-3214; email John.Shelden@faa.gov.

SUPPLEMENTARY INFORMATION:

The substance of these special conditions has been published in the Federal Register for public comment in several prior instances with no substantive comments received. Therefore, the FAA finds, pursuant to 14 CFR 11.38(b), that new comments are unlikely, and notice and comment prior to this publication are unnecessary.

Privacy

Except for Confidential Business Information (CBI) as described in the following paragraph, and other information as described in title 14, Code of Federal Regulations (14 CFR) 11.35, the FAA will post all comments received without change to

https://www.regulations.gov/, including any personal information you provide. The FAA will also post a report summarizing each substantive verbal contact received about these special conditions.

Confidential Business Information

CBI is commercial or financial information that is both customarily and actually treated as private by its owner. Under the Freedom of Information Act (FOIA) (5 U.S.C. 552), CBI is exempt from public disclosure. If your comments responsive to these special conditions contain commercial or financial information that is customarily treated as private, that you actually treat as private, and that is relevant or responsive to these special conditions, it is important that you clearly designate the submitted comments as CBI. Please mark each page of your submission containing CBI as "PROPIN." The FAA will treat such marked submissions as confidential under the FOIA, and the indicated comments will not be placed in the public docket of these special conditions. Send submissions containing CBI to John Shelden, Cabin Safety Section, AIR-624, Technical Policy Branch, Policy and Standards Division, Aircraft Certification Service, Federal Aviation Administration, 2200 South 216th Street, Des Moines, Washington 98198; telephone and fax 206-231-3214; email John.Shelden@faa.gov. Comments the FAA receives, which are not specifically designated as CBI, will be placed in the public docket for these special conditions.

Comments Invited

The FAA invites 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.

The FAA will consider all comments received by the closing date for comments and will consider comments filed late if it is possible to do so without incurring delay. The FAA may change these special conditions based on the comments received.

Background

On October 28, 2022, Boeing applied for a change to Type Certificate No. A16WE for the installation of oblique (side-facing) passenger seats with or without airbag devices or 3-point restraints in the Boeing Model 737-10 series airplanes. The Boeing Model 737-10 series airplanes are twin-engine, transport category airplanes with a maximum certified passenger capacity of up to 230, and a maximum takeoff weight of approximately 197,900 lbs.

Type Certification Basis

Under the provisions of title 14, Code of Federal Regulations (14 CFR) 21.101, Boeing must show that the Model 737-10 series airplanes, as changed, continue to meet the applicable provisions of the regulations listed in Type Certificate No. A16WE or the applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA.

If the Administrator finds that the applicable airworthiness regulations (e.g., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Boeing Model 737-10 series airplane because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Boeing Model 737-10 series airplane must comply with the 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 737-10 series airplane will incorporate a seating configuration that is novel or unusual due to the installation of oblique (side-facing) passenger seats and surrounding furniture that introduces occupant alignment and loading concerns. These oblique seats may be installed at an angle of 18 to 45 degrees to the aircraft centerline and may include a 3-point restraint system and/or airbags, for occupant restraint and injury protection.

Discussion

Title 14, Code of Federal Regulations (14 CFR) 25.785(d) requires that each occupant of a seat that makes more than an 18 degree angle with the vertical plane containing the airplane centerline must be protected from head injury by a safety belt and an energy absorbing rest that will support the arms, shoulders, head, and spine, or by a safety belt and shoulder harness that will prevent the head from contacting any injurious object.

The proposed Boeing Model 737-10 airplane seat installation is novel in that the current requirements do not adequately address protection of the occupant's neck and spine for seating configurations that are positioned at angles greater than 18 degrees up to and including 45 degrees from the airplane centerline. The installation of passenger seats at angles of 18 to 45 degrees to the airplane centerline is unique due to the seat/occupant

interface with the surrounding furniture that introduces occupant alignment/loading concerns with or without the installation of a 3-point or airbag restraint system, or both. In order to provide a level of safety that is equivalent to that afforded to occupants of forward and aft facing seating, additional airworthiness standards, in the form of new special conditions, are necessary.

The FAA has been conducting and sponsoring research on appropriate injury criteria for oblique (side-facing) seat installations. To reflect current research findings, the FAA issued policy statement PS-AIR-25-27. FAA-sponsored research has found that an un-restrained flailing of the upper torso, even when the pelvis and torso are nearly aligned, can produce serious spinal and torso injuries. At lower impact severities, even with significant misalignment between the torso and pelvis, these injuries did not occur. Tests with an FAA H-III anthropomorphic test dummy (ATD) have identified a level of lumbar spinal tension corresponding to the no-injury impact severity. This level of tension is included as a limit in the special conditions. The spine tension limit selected is conservative with respect to other aviation injury criteria since it corresponds to a no-injury loading condition.

As noted in the special conditions for each airbag restraint system, because an airbag restraint system is essentially a single use device, there is the potential that it could deploy under crash conditions that are not sufficiently severe as to require head injury protection from the airbag restraint system. Since an actual crash is frequently composed of a series of impacts before the airplane comes to rest, this could render the airbag restraint system useless if a larger impact follows the initial impact. This situation does not exist with energy absorbing pads or upper torso restraints, which tend to provide protection according to the severity of the impact. Therefore, the installation of the airbag restraint system should be such that the airbag restraint system will provide protection when it is required, and will not expend its protection when it is not needed.

Because these airbag restraint systems may or may not activate during various crash conditions, the injury criteria listed in these special conditions and in § 25.562 must be met in an event that is slightly below the activation level of the airbag restraint system. If an airbag restraint system is included with the oblique seats, the system must meet the requirements in one of the airbag (inflatable restraint) special conditions applicable to the Boeing Model 737 series airplanes. These special conditions supplement part 25 and, more specifically, supplement §§ 25.562 and 25.785.

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 737-10 series airplane. Should Boeing apply at a later date for a change to the type certificate to include another model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, these special conditions would apply to that model as well.

Conclusion

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

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

Authority Citation

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(f), 106(g), 40113, 44701, 44702, and 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 The Boeing Company Model 737-10 series airplanes.

In addition to the requirements of § 25.562, passenger seats installed at an angle between 18 degrees and 45 degrees from the aircraft centerline must meet the following:

1. Head Injury Criteria (HIC).

Compliance with § 25.562(c)(5) is required, except that, if the anthropomorphic test dummy (ATD) has no apparent contact with the seat/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 that 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.

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.

a. 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 lbs. for tension

ii. F_{zc} = 1385 lbs. for compression

iii. M_{yc} = 229 lb-ft in flexion

iv. M_{yc} = 100 lb-ft in extension

b. In addition, peak F_z must be below 937 lbs. in tension and 899 lbs. in compression.

c. Rotation of the head about its vertical axis relative to the torso is limited to 105 degrees in either direction from forward facing.

d. 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 lbs.

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 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 from the nominal seated position. Evaluation during rebound does not need to 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.

Note: Boeing must demonstrate that the installation of seats via plinths or pallets meets all applicable requirements. Compliance with the guidance contained in policy memorandum PS-ANM-100-2000-00123, "Guidance for Demonstrating Compliance with Seat Dynamic Testing for Plinths and Pallets," dated February 2, 2000, is acceptable to the FAA.

8. Inflatable Airbag Restraint Systems Special Conditions.

If inflatable airbag restraint systems are installed, the airbag systems must meet the requirements in special conditions 25-386-SC, or other airbag system special conditions which are applicable to the Boeing Model 737 series airplanes.

Issued in Des Moines, WA, on August 9, 2023.

Paul R. Siegmund,
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Policy and Standards Division,
Aircraft Certification Service

[FR Doc. 2023-17403 Filed: 8/14/2023 8:45 am; Publication Date: 8/15/2023]