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**[4910-13]**

## **DEPARTMENT OF TRANSPORTATION**

### **Federal Aviation Administration**

#### **14 CFR Part 25**

**[Docket No. FAA-2016-1085; Special Conditions No. 25-618-SC]**

#### **Special Conditions: Gulfstream Aerospace Corporation Model GVII-G500**

#### **Airplane, Technical Criteria for Approving Side-Facing Seats**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions; request for comments.

**SUMMARY:** These special conditions are issued for the Gulfstream Aerospace Corporation (Gulfstream) Model GVII-G500 airplane. This airplane will have a novel or unusual design feature associated with side-facing seats. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** The effective date of these special conditions is **[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-2016-1085 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:** Dan Jacquet, Airframe and Cabin Safety, ANM-115, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington 98057-3356; telephone 425-227-2676; facsimile 425-227-1149.

## **SUPPLEMENTARY INFORMATION:**

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 issuance.

### **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 March 29, 2012, Gulfstream Aerospace Corporation applied for a type certificate for their new Model GVII-G500 airplane. The Model GVII-G500 airplane will be a business jet capable of accommodating up to 19 passengers. It will incorporate a low, swept-wing design with winglets and a T-tail. The powerplant will consist of two aft-fuselage-mounted Pratt & Whitney turbofan engines.

### **Type Certification Basis**

Under Title 14, Code of Federal Regulations (14 CFR) 21.17, Gulfstream must show that the Model GVII-G500 airplane meets the applicable provisions of 14 CFR part 25, as amended by Amendments 25-1 through 25-129.

If the Administrator finds that the applicable airworthiness regulations (i.e., part 25) do not contain adequate or appropriate safety standards for the Model GVII-G500 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 or similar 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, Model GVII-G500 airplanes 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 must issue a finding of regulatory adequacy under section 611 of Public Law 92-574, the “Noise Control Act of 1972.”

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 § 21.17(a)(2).

### **Novel or Unusual Design Features**

The Model GVII-G500 airplane will incorporate the following novel or unusual design feature:

Gulfstream wants the option to include side-facing seats in their new Model GVII-G500 airplane. Side-facing seats (i.e., seats positioned in the airplane with the occupant facing 90 degrees to the direction of airplane travel) are considered a novel design for transport-category airplanes that include Amendment 25-64 in their certification basis, and were not considered when those airworthiness standards were issued. The FAA has determined that the existing regulations do not provide adequate or appropriate safety standards for occupants of side-facing seats. To provide a level of safety that is equivalent to that afforded to occupants of forward- and

aft-facing seats, additional airworthiness standards in the form of special conditions are necessary.

## **Discussion**

On June 16, 1988, 14 CFR part 25 was amended to revise the emergency-landing conditions that must be considered in the design of transport-category airplanes. Amendment 25-64 revised the static-load conditions in § 25.561, and added a new § 25.562 that required dynamic testing for all seats approved for occupancy during takeoff and landing. The intent of Amendment 25-64 was to provide an improved level of safety for occupants on transport-category airplanes. However, because most seating on transport-category airplanes is forward-facing, the pass/fail criteria developed in Amendment 25-64 focused primarily on these seats.

For some time, the FAA granted exemptions for the multiple-place side-facing-seat installations because the existing test methods and acceptance criteria did not produce a level of safety equivalent to the level of safety provided for forward-and aft-facing seats. These exemptions were subject to many conditions that reflected the injury-evaluation criteria and mitigation strategies available at the time of the exemption issuance. The FAA also issued special conditions to address single-place side-facing seats because we believed that those conditions provided the same level of safety as for forward- and aft-facing seats.

Continuing concerns regarding the safety of side-facing seats prompted the FAA to conduct research to develop an acceptable method of compliance with §§ 25.562 and 25.785(b) for side-facing seat installations. That research has identified injury considerations and evaluation criteria in addition to those previously used to approve side-facing seats (see published report DOT/FAA/AR-09/41, July 2011). One particular concern that was identified during the FAA's research program, but not addressed in the previous special conditions, was the significant leg

injuries that can occur to occupants of both single- and multiple-place side-facing seats. Because this type of injury does not occur on forward- and aft-facing seats, the FAA determined that, to achieve the level of safety envisioned in Amendment 25-64, additional requirements would be needed as compared to previously issued special conditions. Nonetheless, the research has now allowed the development of a single set of special conditions that is applicable to all fully side-facing seats.

On November 5, 2012, the FAA released PS-ANM-25-03-R1, “Technical Criteria for Approving Side-Facing Seats,” to update existing FAA certification policy on §§ 25.562 and 25.785(a) at Amendment 25-64 for single- and multiple-place side-facing seats. This policy addresses both the technical criteria for approving side-facing seats and the implementation of those criteria. The FAA methodology detailed in PS-ANM-25-03-R1 has been used in establishing a new set of proposed special conditions. Some of the conditions issued for previous exemptions are still relevant and are included in these new special conditions. However, others have been replaced by different criteria that reflect current research findings.

### **Applicability**

As discussed above, these special conditions are applicable to the Gulfstream Model GVII-G500 airplane. Should Gulfstream apply at a later date for a change to the type certificate to include another model incorporating 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 airplane. It is not a rule of general applicability.

The substance of these special conditions has been subjected to the notice and comment period in several prior instances and has been derived without substantive change from those previously issued. It is unlikely that prior public comment would result in a significant change from the substance contained herein. Therefore, the FAA has determined that prior public notice and comment are unnecessary and impracticable, and good cause exists for adopting these special conditions upon publication in the **Federal Register**.

The FAA is requesting comments to allow interested persons to submit views that may not have been submitted in response to the prior opportunities for comment described above.

#### **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.

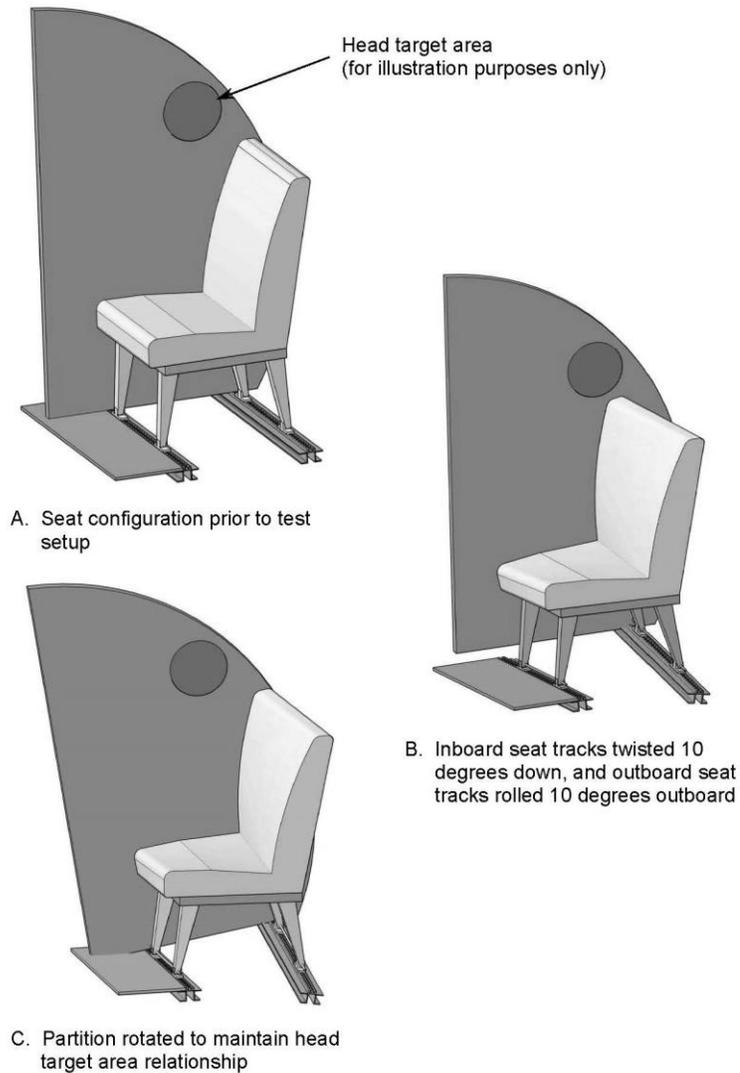
#### **The Special Conditions**

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 the Gulfstream Aerospace Corporation Model GVII-G500 airplane.

In addition to the airworthiness standards in §§ 25.562 and 25.785, the FAA issues the following special conditions (based on Policy Statement PS-ANM-25-03-R1) as part of the type certification basis for the Gulfstream Model GVII series airplanes. Items 1 and 2 are applicable to all side-facing seat installations, whereas items 3 through 16 represent additional requirements applicable to side-facing seats equipped with an airbag system in the shoulder belt.

1. Additional requirements applicable to tests or rational analysis conducted to show compliance with §§ 25.562 and 25.785 for side-facing seats:

- a. The longitudinal test(s) conducted in accordance with § 25.562(b)(2), to show compliance with the seat-strength requirements of § 25.562(c)(7) and (8) and these special conditions, must have an ES-2re anthropomorphic test dummy (ATD) (49 CFR part 572 subpart U) or equivalent, or a Hybrid II ATD (49 CFR part 572, subpart B as specified in § 25.562) or equivalent, occupying each seat position and including all items (e.g., armrest, interior wall, or furnishing) contactable by the occupant if those items are necessary to restrain the occupant. If included, the floor representation and contactable items must be located such that their relative position, with respect to the center of the nearest seat place, is the same at the start of the test as before floor misalignment is applied. For example, if floor misalignment rotates the centerline of the seat place nearest the contactable item 8 degrees clockwise about the airplane x-axis, then the item and floor representations must be rotated by 8 degrees clockwise also, to maintain the same relative position to the seat place, as shown in Figure 1. Each ATD's relative position to the seat after application of floor misalignment must be the same as before misalignment is applied. To ensure proper occupant seat loading, the ATD pelvis must remain supported by the seat pan, and the restraint system must remain on the pelvis and shoulder of the ATD until rebound begins. No injury-criteria evaluation is necessary for tests conducted only to assess seat-strength requirements.



**Figure 1**

- b. The longitudinal test(s) conducted in accordance with § 25.562(b)(2), to show compliance with the injury assessments required by § 25.562(c) and these special conditions, may be conducted separately from the test(s) to show structural integrity. In this case, structural-assessment tests must be conducted as specified in paragraph 1a, above, and the injury-assessment test must be conducted without yaw or floor misalignment. Injury assessments may be accomplished by testing with ES-2re ATD (49 CFR part 572 subpart U) or equivalent at all places. Alternatively, these

- assessments may be accomplished by multiple tests that use an ES-2re ATD at the seat place being evaluated, and a Hybrid II ATD (49 CFR part 572, subpart B, as specified in § 25.562) or equivalent used in all seat places forward of the one being assessed, to evaluate occupant interaction. In this case, seat places aft of the one being assessed may be unoccupied. If a seat installation includes adjacent items that are contactable by the occupant, the injury potential of that contact must be assessed. To make this assessment, tests may be conducted that include the actual item, located and attached in a representative fashion. Alternatively, the injury potential may be assessed by a combination of tests with items having the same geometry as the actual item, but having stiffness characteristics that would create the worst case for injury (injuries due to both contact with the item and lack of support from the item).
- c. If a seat is installed aft of structure (e.g., an interior wall or furnishing) that does not have a homogeneous surface contactable by the occupant, additional analysis and/or test(s) may be required to demonstrate that the injury criteria are met for the area that an occupant could contact. For example, different yaw angles could result in different injury considerations and may require additional analysis or separate test(s) to evaluate.
  - d. To accommodate a range of occupant heights (5th percentile female to 95th percentile male), the surface of items contactable by the occupant must be homogenous 7.3 inches (185 mm) above and 7.9 inches (200 mm) below the point (center of area) that is contacted by the 50th percentile male size ATD's head during the longitudinal test(s) conducted in accordance with paragraphs a, b, and c, above. Otherwise, additional head-injury criteria (HIC) assessment tests may be necessary. Any surface

(inflatable or otherwise) that provides support for the occupant of any seat place must provide that support in a consistent manner regardless of occupant stature. For example, if an inflatable shoulder belt is used to mitigate injury risk, then it must be demonstrated by inspection to bear against the range of occupants in a similar manner before and after inflation. Likewise, the means of limiting lower-leg flail must be demonstrated by inspection to provide protection for the range of occupants in a similar manner.

- e. For longitudinal test(s) conducted in accordance with § 25.562(b)(2) and these special conditions, the ATDs must be positioned, clothed, and have lateral instrumentation configured as follows:

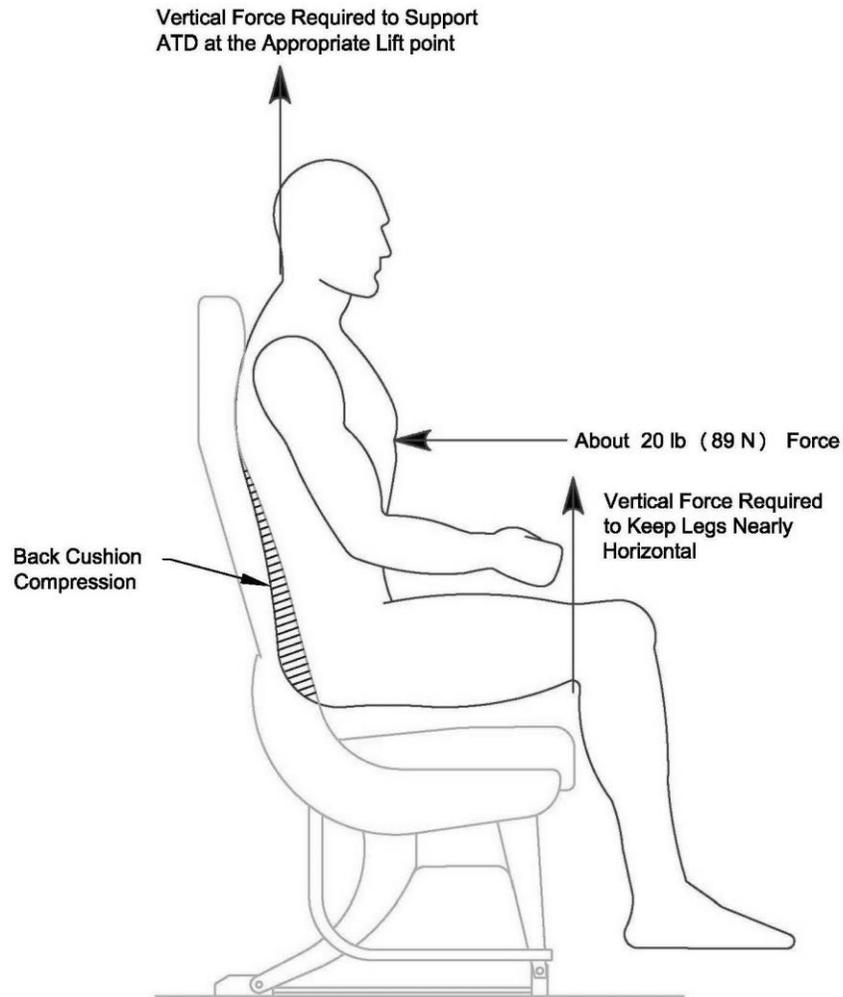
- (1) ATD positioning:

- Lower the ATD vertically into the seat while simultaneously (see Figure 2 for illustration):

- (a) Aligning the midsagittal plane (a vertical plane through the midline of the body; dividing the body into right and left halves) with approximately the middle of the seat place.

- (b) Applying a horizontal x-axis direction (in the ATD coordinate system) force of about 20 lb (89 N) to the torso at approximately the intersection of the midsagittal plane and the bottom rib of the ES-2re or lower sternum of the Hybrid II at the midsagittal plane, to compress the seat back cushion.

- (c) Keeping the upper legs nearly horizontal by supporting them just behind the knees.



**Figure 2**

- (d) After all lifting devices have been removed from the ATD:
- (i) Rock it slightly to settle it into the seat.
  - (ii) Separate the knees by about 4 inches (100 mm).
  - (iii) Set the ES-2re ATD's head at approximately the midpoint of the available range of z-axis rotation (to align the head and torso midsagittal planes).

- (iv) Position the ES-2re ATD's arms at the joint's mechanical detent that puts them at approximately a 40-degree angle with respect to the torso. Position the Hybrid II ATD hands on top of its upper legs.
  - (v) Position the feet such that the centerlines of the lower legs are approximately parallel to a lateral vertical plane (in the airplane coordinate system).
- (2) ATD clothing: Clothe each ATD in form-fitting, mid-calf-length (minimum) pants and shoes (size 11E) weighing about 2.5 lb (1.1 Kg) total. The color of the clothing should be in contrast to the color of the restraint system. The ES-2re jacket is sufficient for torso clothing, although a form-fitting shirt may be used in addition if desired.
- (3) ES-2re ATD lateral instrumentation: The rib-module linear slides are directional, i.e., deflection occurs in either a positive or negative ATD y-axis direction. The modules must be installed such that the moving end of the rib module is toward the front of the airplane. The three abdominal-force sensors must be installed such that they are on the side of the ATD toward the front of the airplane.
- f. The combined horizontal/vertical test, required by § 25.562(b)(1) and these special conditions, must be conducted with a Hybrid II ATD (49 CFR part 572 subpart B as specified in § 25.562), or equivalent, occupying each seat position.
  - g. Restraint systems:
    - (1) If inflatable restraint systems are used, they must be active during all dynamic tests conducted to show compliance with § 25.562.

- (2) The design and installation of seat-belt buckles must prevent unbuckling due to applied inertial forces or impact of the hands or arms of the occupant during an emergency landing.
2. Additional performance measures applicable to tests and rational analysis conducted to show compliance with §§ 25.562 and 25.785 for side-facing seats:
- a. Body-to-body contact: Contact between the head, pelvis, torso, or shoulder area of one ATD with the adjacent-seated ATD's head, pelvis, torso, or shoulder area is not allowed. Contact during rebound is allowed.
  - b. Thoracic: The deflection of any of the ES-2re ATD upper, middle, and lower ribs must not exceed 1.73 inches (44 mm). Data must be processed as defined in Federal Motor Vehicle Safety Standards (FMVSS) 571.214.
  - c. Abdominal: The sum of the measured ES-2re ATD front, middle, and rear abdominal forces must not exceed 562 lbs (2,500 N). Data must be processed as defined in FMVSS 571.214.
  - d. Pelvic: The pubic symphysis force measured by the ES-2re ATD must not exceed 1,350 lbs (6,000 N). Data must be processed as defined in FMVSS 571.214.
  - e. Leg: Axial rotation of the upper-leg (femur) must be limited to 35 degrees in either direction from the nominal seated position.
  - f. Neck: As measured by the ES-2re ATD and filtered at Channel Frequency Class 600 as defined in SAE J211, "Instrumentation for Impact Test—Part 1—Electronic Instrumentation."
- (1) The upper-neck tension force at the occipital condyle (O.C.) location must be less than 405 lb (1,800 N).

- (2) The upper-neck compression force at the O.C. location must be less than 405 lb (1,800 N).
  - (3) The upper-neck bending torque about the ATD x-axis at the O.C. location must be less than 1,018 in-lb (115 Nm).
  - (4) The upper-neck resultant shear force at the O.C. location must be less than 186 lb (825 N).
- g. Occupant (ES-2re ATD) retention: The pelvic restraint must remain on the ES-2re ATD's pelvis during the impact and rebound phases of the test. The upper-torso restraint straps (if present) must remain on the ATD's shoulder during the impact.
- h. Occupant (ES-2re ATD) support:
- (1) Pelvis excursion: The load-bearing portion of the bottom of the ATD pelvis must not translate beyond the edges of its seat's bottom seat-cushion supporting structure.
  - (2) Upper-torso support: The lateral flexion of the ATD torso must not exceed 40 degrees from the normal upright position during the impact.
3. For seats with an airbag system in the shoulder belts, show that the airbag system in the shoulder belt will deploy and provide protection under crash conditions where it is necessary to prevent serious injury. The means of protection must take into consideration a range of stature from a 2-year-old child to a 95th percentile male. The airbag system in the shoulder belt must provide a consistent approach to energy absorption throughout that range of occupants. When the seat system includes an airbag system, that system must be included in each of the certification tests as it would be installed in the airplane. In addition, the following situations must be considered:

- a. The seat occupant is holding an infant.
- b. The seat occupant is a pregnant woman.
4. The airbag system in the shoulder belt must provide adequate protection for each occupant regardless of the number of occupants of the seat assembly, considering that unoccupied seats may have an active airbag system in the shoulder belt.
5. The design must prevent the airbag system in the shoulder belt from being either incorrectly buckled or incorrectly installed, such that the airbag system in the shoulder belt would not properly deploy. Alternatively, it must be shown that such deployment is not hazardous to the occupant, and will provide the required injury protection.
6. It must be shown that the airbag system in the shoulder belt is not susceptible to inadvertent deployment as a result of wear and tear, or inertial loads resulting from in-flight or ground maneuvers (including gusts and hard landings), and other operating and environmental conditions (vibrations, moisture, etc.) likely to occur in service.
7. Deployment of the airbag system in the shoulder belt must not introduce injury mechanisms to the seated occupant, or result in injuries that could impede rapid egress. This assessment should include an occupant whose belt is loosely fastened.
8. It must be shown that inadvertent deployment of the airbag system in the shoulder belt, during the most critical part of the flight, will either meet the requirement of § 25.1309(b) or not cause a hazard to the airplane or its occupants.
9. It must be shown that the airbag system in the shoulder belt will not impede rapid egress of occupants 10 seconds after airbag deployment.
10. The airbag system must be protected from lightning and high-intensity radiated fields (HIRF). The threats to the airplane specified in existing regulations regarding lightning,

§ 25.1316, and HIRF, § 25.1317, are incorporated by reference for the purpose of measuring lightning and HIRF protection.

11. The airbag system in the shoulder belt must function properly after loss of normal aircraft electrical power, and after a transverse separation of the fuselage at the most critical location. A separation at the location of the airbag system in the shoulder belt does not have to be considered.
12. It must be shown that the airbag system in the shoulder belt will not release hazardous quantities of gas or particulate matter into the cabin.
13. The airbag system in the shoulder-belt installation must be protected from the effects of fire such that no hazard to occupants will result.
14. A means must be available for a crewmember to verify the integrity of the airbag system in the shoulder-belt activation system prior to each flight, or it must be demonstrated to reliably operate between inspection intervals. The FAA considers that the loss of the airbag-system deployment function alone (i.e., independent of the conditional event that requires the airbag-system deployment) is a major-failure condition.
15. The inflatable material may not have an average burn rate of greater than 2.5 inches/minute when tested using the horizontal flammability test defined in part 25, appendix F, part I, paragraph (b)(5).

16. The airbag system in the shoulder belt, once deployed, must not adversely affect the emergency-lighting system (i.e., block floor proximity lights to the extent that the lights no longer meet their intended function).

Issued in Renton, Washington, on April 27, 2016.

Dionne Palermo  
Acting Manager, Transport Airplane Directorate  
Aircraft Certification Service  
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