



**[4910-13]**

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 25**

**[Docket No. FAA-2015-1482; Special Conditions No. 25-600-SC]**

**Special Conditions: Gulfstream Model GVII-G500 airplanes, Automatic Speed Protection for Design Dive Speed**

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

**ACTION:** Final special conditions.

**SUMMARY:** These special conditions are issued for the Gulfstream Model GVII-G500 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 associated with a reduced margin between design cruising speed,  $V_C/M_C$ , and design diving speed,  $V_D/M_D$ , based on the incorporation of a high-speed protection system that limits nose-down pilot authority at speeds above  $V_C/M_C$ . 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:** Effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

**FOR FURTHER INFORMATION CONTACT:** Walt Sippel, FAA, Airframe and Cabin Safety Branch, ANM-115, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone 425-227-2774; facsimile 425-227-1232.

## **SUPPLEMENTARY INFORMATION:**

### **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 large-cabin business jet with seating for 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.

The Model GVII-G500 will have a wingspan of approximately 87 feet and a length of just over 91 feet. Maximum takeoff weight will be approximately 76,850 pounds and maximum takeoff thrust will be approximately 15,135 pounds. Maximum range will be approximately 5,000 nautical miles, and maximum operating altitude will be 51,000 feet.

### **Type Certification Basis**

Under the provisions of Title 14, Code of Federal Regulations (14 CFR) 21.17, Gulfstream must show that the Model GVII-G500 airplane meets the applicable provisions of part 25 as amended by Amendments 25-1 through 25-137.

In addition, the certification basis includes other regulations, special conditions, and exemptions that are not relevant to these 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 Model GVII-G500 airplanes

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, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Model GVII-G500 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; and the FAA must issue a finding of regulatory adequacy under § 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 Gulfstream Model GVII-G500 airplane will incorporate the following novel or unusual design feature:

For this airplane, Gulfstream will reduce the margin between  $V_C/M_C$  and  $V_D/M_D$ , required by 14 CFR 25.335(b), based on the incorporation of a high-speed protection system in the airplane’s flight-control laws. The high-speed protection system limits nose-down pilot authority at speeds above  $V_C/M_C$ , and prevents the airplane from performing the maneuver required under § 25.335(b)(1).

## Discussion

Title 14, Code of Federal Regulations (14 CFR) 25.335(b)(1) is an analytical envelope condition which was originally adopted in Part 4b of the Civil Air Regulations to provide an acceptable speed margin between design cruise speed and design dive speed. Flutter clearance design speeds and airframe design loads are impacted by the design dive speed. While the initial condition for the upset specified in the rule is 1g level flight, protection is afforded for other inadvertent overspeed conditions as well. Section 25.335(b)(1) is intended as a conservative enveloping condition for potential overspeed conditions, including non-symmetric ones. To establish that potential overspeed conditions are enveloped, Gulfstream must demonstrate that any reduced speed margin based on the high-speed protection system in the Model GVII-G500 airplane will not be exceeded in inadvertent or gust-induced upsets resulting in initiation of the dive from non-symmetric attitudes; or that the airplane is protected by the flight-control laws from getting into non-symmetric upset conditions. Gulfstream must conduct a demonstration that includes a comprehensive set of conditions as described below.

These special conditions are in lieu of § 25.335(b)(1). Section 25.335(b)(2), which also addresses the design dive speed, is applied separately (Advisory Circular (AC) 25.335-1A provides an acceptable means of compliance to § 25.335(b)(2)).

Special conditions are necessary to address the Model GVII-G500 airplane high-speed protection system. These special conditions identify various symmetric and non-symmetric maneuvers that will ensure that an appropriate design dive speed,  $V_D/M_D$ , is established.

Special Condition 2 of these special conditions references AC 25-7C, section 8, paragraph 32, "Gust Upset," included here for reference:

In the following three upset tests, the values of displacement should be appropriate to the airplane type and should depend upon airplane stability and inertia characteristics. The lower and upper limits should be used for airplanes with low and high maneuverability, respectively.

- (i) With the airplane trimmed in wings-level flight, simulate a transient gust by rapidly rolling to the maximum bank angle appropriate for the airplane, but not less than 45 degrees nor more than 60 degrees. The rudder and longitudinal control should be held fixed during the time that the required bank is being attained. The rolling velocity should be arrested at this bank angle. Following this, the controls should be abandoned for a minimum of 3 seconds after  $V_{MO}/M_{MO}$ , or after 10 seconds, whichever occurs first.
- (ii) Perform a longitudinal upset from normal cruise. Airplane trim is determined at  $V_{MO}/M_{MO}$  using power and thrust required for level flight, but with not more than maximum continuous power and thrust. This is followed by a decrease in speed, after which an attitude of 6 to 12 degrees nose down, as appropriate for the airplane type, is attained with the power, thrust, and trim initially required for  $V_{MO}/M_{MO}$  in level flight. The airplane is permitted to accelerate until 3 seconds after  $V_{MO}/M_{MO}$ . The force limits of § 25.143(d) for short term application apply.
- (iii) Perform a two-axis upset, consisting of combined longitudinal and lateral upsets. Perform the longitudinal upset, as in paragraph (ii) above, and when the pitch attitude is set, but before reaching  $V_{MO}/M_{MO}$ , roll the airplane to

between 15 and 25 degrees. The established attitude should be maintained until 3 seconds after  $V_{MO}/M_{MO}$ .

Special Conditions 3 and 4 of these special conditions indicate that failures of the high-speed protection system must be improbable and must be annunciated to the pilots. If these two criteria are not met, then the probability that the established dive speed will be exceeded, and the resulting risk to the airplane, are too great. On the other hand, if the high-speed protection system is known to be inoperative, then dispatch of the airplane may be acceptable as allowed by Special Condition 5 of these special conditions. Dispatch would only be acceptable if appropriate reduced operating speeds,  $V_{MO}/M_{MO}$ , as well as the overspeed warning for exceeding those speeds, are provided in both the airplane flight manual and on the flightdeck display, and are equivalent to that of the normal airplane with the high-speed protection system operative.

We do not believe that application of the “Interaction of Systems and Structures” Special Conditions (reference GVI Issue Paper A-2), or EASA Certification Specification 25.302, are appropriate in this case, because design dive speed is, in and of itself, part of the design criteria. Stability and control, flight loads, and flutter evaluations all depend on the design dive speed. Therefore, a single design dive speed should be established that will not be exceeded, taking into account the performance of the high-speed protection system as well as its failure modes, failure indications, and accompanying flight-manual instructions.

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.

## **Discussion of Comments**

Notice of proposed special conditions no. 25-15-08-SC for the Gulfstream Model GVII-G500 airplane was published in the Federal Register on August 18, 2015 [80 FR 49936]. No comments were received, and the special conditions are adopted as proposed.

## **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, the special conditions would apply to that model as well.

## **Conclusion**

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

## **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 Gulfstream Model GVII-G500 airplanes.

1. In lieu of compliance with § 25.335(b)(1), if the flight-control system includes functions that act automatically to initiate recovery before the end of the 20-second period specified in § 25.335(b)(1),  $V_D/M_D$  must be determined from the greater of the speeds resulting

from conditions (a) and (b) of these special conditions. The speed increase occurring in these maneuvers may be calculated if reliable or conservative aerodynamic data are used.

(a) From an initial condition of stabilized flight at  $V_C/M_C$ , the airplane is upset so as to take up a new flight path 7.5 degrees below the initial path. Control application, up to full authority, is made to try to maintain this new flight path. Twenty seconds after initiating the upset, manual recovery is made at a load factor of 1.5g (0.5 acceleration increment), or such greater load factor that is automatically applied by the system with the pilot's pitch control neutral. Power, as specified in § 25.175(b)(1)(iv), is assumed until recovery is initiated, at which time power reduction, and the use of pilot-controlled drag devices, may be used.

(b) From a speed below  $V_C/M_C$ , with power to maintain stabilized level flight at this speed, the airplane is upset so as to accelerate through  $V_C/M_C$  at a flight path 15 degrees below the initial path (or at the steepest nose-down attitude that the system will permit with full control authority if less than 15 degrees). The pilot's controls may be in the neutral position after reaching  $V_C/M_C$  and before recovery is initiated. Recovery may be initiated 3 seconds after operation of the high-speed warning system by application of a load of 1.5g (0.5 acceleration increment), or such greater load factor that is automatically applied by the system with the pilot's pitch control neutral. Power may be reduced simultaneously. All other means of decelerating the airplane, the use of which is authorized up to the highest speed reached in the maneuver, may be used. The interval between successive pilot actions must not be less than 1 second.

2. The applicant must also demonstrate that the speed margin, established as above, will not be exceeded in inadvertent or gust-induced upsets resulting in initiation of the dive from non-symmetric attitudes, unless the airplane is protected by the flight-control laws from getting into non-symmetric upset conditions. The upset maneuvers described in Advisory Circular

25-7C, “Flight Test Guide for Certification of Transport Category Airplanes,” section 8, paragraph 32, sub-paragraphs c(3)(a), (b), and (c), may be used to comply with this requirement.

3. The probability of any failure of the high-speed protection system, which would result in an airspeed exceeding those determined by Special Conditions 1 and 2, must be less than  $10^{-5}$  per flight hour.

4. Failures of the system must be annunciated to the pilots. Flight manual instructions must be provided that reduce the maximum operating speeds,  $V_{MO}/M_{MO}$ . With the system failed, the operating speed must be reduced to a value that maintains a speed margin between  $V_{MO}/M_{MO}$  and  $V_D/M_D$ , and that is consistent with showing compliance with § 25.335(b) without the benefit of the high-speed protection system.

5. The applicant may request that the Master Minimum Equipment List relief for the high-speed protection system be considered by the FAA Flight Operations Evaluation Board, provided that the flight manual instructions indicate reduced maximum operating speeds as described in Special Condition 4. In addition, the flightdeck display of the reduced operating speeds, as well as the overspeed warning for exceeding those speeds, must be equivalent to that of the normal airplane with the high-speed protection system operative. Also, the applicant must show that no additional hazards are introduced with the high-speed protection system inoperative.

Issued in Renton, Washington, September 25, 2015.

Michael Kaszycki  
Acting Manager, Transport Airplane Directorate  
Aircraft Certification Service

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