Administration, McLean, VA 22102–5090, (703) 883–4232, TTY (703) 883–4434; or Laura D. McFarland, Senior Attorney, Office of General Counsel, Farm Credit Administration, McLean, VA 22102–5090, (703) 883–4020, TTY (703) 883–4020.

(12 U.S.C. 2252(a)(9) and (10))

Dated: April 5, 2006.

Roland E. Smith,

Secretary, Farm Credit Administration Board.

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. NM305; Special Conditions No. 25–316–SC]

Special Conditions: Airbus Model A380–800 Airplane; Dynamic Braking, Interaction of Systems And Structures, Limit Pilot Forces, Side Stick Controllers, Dive Speed Definition, Electronic Flight Control System-Lateral-Directional Stability, Longitudinal Stability, And Low Energy Awareness, Electronic Flight Control System-Control Surface Awareness, Electronic Flight Control System-Flight Characteristics Compliance Via the Handling Qualities Rating Method, Flight Envelope Protection-General Limiting Requirements, Flight Envelope Protection-Normal Load Factor (G) Limiting, Flight Envelope Protection-High Speed Limiting, Flight Envelope Protection-Pitch And Roll Limiting, Flight Envelope Protection-High Incidence Protection and Alpha-Floor Systems, High Intensity Radiated Fields (HIRF) Protection, and Operation Without Normal Electrical Power

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final Special Conditions.

SUMMARY: These Special Conditions are issued for the Airbus A380–800 airplane. This airplane will have novel or unusual design features when compared to the state of technology envisioned in the airworthiness standards for transport category airplanes. These design features include side stick controllers, a body landing gear in addition to conventional wing and nose landing gears, electronic flight control systems, and flight envelope protection. These Special Conditions also pertain to the effects of such novel or unusual design features, such as their effects on the structural performance of the airplane. Finally, the Special Conditions pertain to the effects of certain conditions on these novel or unusual design features, such as the effects of high intensity radiated fields (HIRF) or of operation without normal electrical power. Additional Special Conditions will be issued for other novel or unusual design features of the Airbus A380–800 airplanes. A list is provided in the section of this document entitled ''Discussion of Novel or Unusual Design Features.''

EFFECTIVE DATE: March 30, 2006.

FOR FURTHER INFORMATION CONTACT: Holly Thorson, FAA, International Branch, ANM–116, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue, SW., Renton, Washington 98055–4056; telephone (425) 227–1357; facsimile (425) 227–1149.

SUPPLEMENTARY INFORMATION

Background

Airbus applied for FAA certification/validation of the provisionally-designated Model A3XX–100 in its letter AI/L 810.0223/98, dated August 12, 1998, to the FAA. Application for certification by the Joint Aviation Authorities (JAA) of Europe had been made on January 16, 1998, reference AI/L 810.0019/98. In its letter to the FAA, Airbus requested an extension to the 5-year period for type certification in accordance with 14 CFR 21.17(c).

The request was for an extension to a 7-year period, using the date of the initial application letter to the JAA as the reference date. The reason given by Airbus for the request for extension is related to the technical challenges, complexity, and the number of new and novel features on the airplane. On November 12, 1998, the Manager, Aircraft Engineering Division, AIR–100, granted Airbus' request for the 7-year period based on the date of application to the JAA.

In its letter AI/LE–A 828.0040/99 Issue 3, dated July 20, 2001, Airbus stated that its target date for type certification of the Model A380–800 had been moved from May 2005, to January 2006, to match the delivery date of the first production airplane. In a subsequent letter (AI/L 810.0223/98 issue 3, dated January 27, 2006), Airbus stated that its target date for type certification is October 2, 2006. In accordance with 14 CFR 21.17(d)(2), Airbus chose a new application date of December 20, 1999, and requested that the 7-year certification period which had already been approved be continued. The FAA has reviewed the part 25 certification basis for the Model A380–800 airplane, and no changes are required based on the new application date.

The Model A380–800 airplane will be an all-new, four-engine jet transport airplane with a full double-deck, two-aisle cabin. The maximum takeoff weight will be 1.235 million pounds with a typical three-class layout of 555 passengers.

Type Certification Basis

Under the provisions of 14 CFR 21.17, Airbus must show that the Model A380–800 airplane meets the applicable provisions of 14 CFR part 25, as amended by Amendments 25–1 through 25–98. If the Administrator finds that the applicable airworthiness regulations do not contain adequate or appropriate safety standards for the Airbus A380–800 airplane because of novel or unusual design features, Special Conditions are prescribed under the provisions of 14 CFR 21.16.

In addition to the applicable airworthiness regulations and Special Conditions, the Airbus Model A380–800 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. In addition, the FAA must issue a finding of regulatory adequacy pursuant to section 611 of Public Law 93–574, the ''Noise Control Act of 1972.''

Special Conditions, as defined in 14 CFR 11.19, are issued in accordance with 14 CFR 11.38 and become part of the type certification basis in accordance with 14 CFR 21.17(a)(2).

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 the provisions of 14 CFR 21.101.

Discussion of Novel or Unusual Design Features

The Airbus A380–800 airplane will incorporate a number of novel or unusual design features. Because of rapid improvements in airplane technology, the applicable airworthiness regulations do not contain adequate or appropriate safety standards for these design features.

These Special Conditions for Airbus Model A380 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.

These Special Conditions are identical or nearly identical to those previously required for type certification of the basic Model A340 airplane or earlier models. One exception is the Special Conditions pertaining to Interaction of Systems and Structures. It was not required for the basic Model A340 but was required for type certification of the larger, heavier Model A340–500 and—600 airplanes.

In general, the Special Conditions were derived initially from standardized requirements developed by the Aviation Rulemaking Advisory Committee (ARAC), comprised of representatives of the FAA, Europe's Joint Aviation Authorities (now replaced by the European Aviation Safety Agency), and industry. In some cases, a draft Notice of Proposed Rulemaking has been prepared but no final rule has yet been promulgated.

Additional Special Conditions will be issued for other novel or unusual design features of the Airbus Model A380–800 airplane. Those Special Conditions pertain to the following topics:

- Fire protection,
- Evacuation, including availability of stairs in an emergency,
- Emergency exit arrangement—outside viewing,
- Escape system inflation systems,
- Escape systems installed in non-pressurized compartments,
- Ground turning loads,
- Crashworthiness,
- Flotation and ditching,
- Discrete gust requirements,
- Transient engine failure loads,
- Airplane jacking loads,
- Landing gear pivoting loads,
- Design roll maneuvers,
- Extendable length escape systems,
- Reinforced flightdeck bulkhead, and
- Lithium ion battery installations.

1. Dynamic Braking

The A380 landing gear system will include body gear in addition to the conventional wing and nose gear. This landing gear configuration may result in more complex dynamic characteristics than those found in conventional landing gear configurations. Section 25.493(d) by itself does not contain an adequate standard for assessing the braking loads for the A380 landing gear configuration.

Due to the potential complexities of the A380 landing gear system, in addition to meeting the requirements of § 25.493(d), a rational analysis of the braked roll conditions is necessary. Airbus Model A340–500 and –600 also have a body-mounted main landing gear in addition to the wing and nose gears. Therefore, Special Conditions similar to those required for that model are appropriate for the model A380–800.

2. Interaction of Systems and Structures

The A380 is equipped with systems which affect the airplane's structural performance either directly or as a result of failure or malfunction. The effects of these systems on structural performance must be considered in the certification analysis. This analysis must include consideration of normal operation and of failure conditions with required structural strength levels related to the probability of occurrence.

Previously, Special Conditions have been specified to require consideration of the effects of systems on structures. The Special Conditions for the Model A380 are nearly identical to those issued for the Model A340–500 and –600 series airplanes.

3. Limit Pilot Forces

Like some other Airbus models, the Model A380 airplane is equipped with a side stick controller instead of a conventional control stick. This kind of controller is designed to be operated using only one hand. The requirement of § 25.397(c), which defines limit pilot forces and torques for conventional wheel or stick controls, is not appropriate for a side stick controller. Therefore, Special Conditions are necessary to specify the appropriate loading conditions for this kind of controller.

Special Conditions for side stick controllers have already been developed for the Airbus model A320 and A340 airplanes, both of which also have a side stick controller instead of a conventional control stick. The same Special Conditions are appropriate for the model A380 airplane.

4. Side Stick Controllers

The A380—like its predecessors, the A320, A330, and A340—will use side stick controllers for pitch and roll control. Regulatory requirements for conventional wheel and column controllers, such as requirements pertaining to pilot strength and controllability, are not directly applicable to side stick controllers. In addition, pilot control authority may be uncertain, because the side sticks are not mechanically interconnected as with conventional wheel and column controls.

In previous Airbus airplane certification programs, Special Conditions pertaining to side stick controllers were addressed in three separate issue papers, entitled ''Pilot Strength,'' ''Pilot Coupling,'' and ''Pilot Control.'' The resulting separate Special Conditions are combined in these Special Conditions under the title of ''Side Stick Controllers.'' In order to harmonize with the JAA, the following has been added to Special Conditions 4.c. Side Stick Controllers:

Pitch and roll control force and displacement sensitivity must be compatible, so that normal inputs on one control axis will not cause significant unintentional inputs on the other.

5. Dive Speed Definition

Airbus proposes to reduce the speed spread between V_C and V_D required by § 25.335(b), based on the incorporation of a high speed protection system in the A380 flight control laws. The A380—like the A320, A330, and A340—is equipped with a high speed protection system which limits nose down pilot authority at speeds above V_C/M_C and prevents the airplane from actually performing the maneuver required under § 25.335(b)(1).

Section 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. Freedom from flutter and airframe design loads is affected 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 all potential overspeed conditions, including non-symmetric ones. To establish that all potential overspeed conditions are enveloped, the applicant must demonstrate either of the following:

- Any reduced speed margin—based on the high speed protection system in the A380—will not be exceeded in inadvertent or gust induced upsets, resulting in initiation of the dive from non-symmetric attitudes; or
- The airplane is protected by the flight control laws from getting into non-symmetric upset conditions.

In addition, the high speed protection system in the A380 must have a high level of reliability.

6. Electronic Flight Control System: Lateral-Directional Stability, Longitudinal Stability, and Low Energy Awareness

In lieu of compliance with the regulations pertaining to lateral-directional and longitudinal stability, these Special Conditions ensure that the model A380 will have suitable airplane handling qualities throughout the normal flight envelope (reference paragraphs 6.a. and 6.b.).

The unique features of the A380 flight control system and side-stick controllers, when compared with conventional airplanes with wheel and column controllers, do not provide conventional awareness to the flight crew of a change in speed or a change in the direction of flight (reference paragraph 6.c.). These Special Conditions requires that adequate awareness be provided to the pilot of a low energy state (low speed, low thrust, and low altitude) below normal operating speeds.

a. *Lateral-directional Static Stability:* The model A380 airplane has a flight control design feature within the normal operational envelope in which side stick deflection in the roll axis commands roll rate. As a result, the stick force in the roll axis will be zero (neutral stability) during the straight, steady sideslip flight maneuver of § 25.177(c) and will not be "substantially proportional to the angle of sideslip," as required by the regulation.

The electronic flight control system (EFCS) on the A380 as on its predecessors—the A320, A330 and A340—contains fly-by-wire control laws that result in neutral lateral-directional static stability. Therefore, the conventional requirements of the regulations are not met.

With conventional control system requirements, positive static directional stability is defined as the tendency to recover from a skid with the rudder free. Positive static lateral stability is defined as the tendency to raise the low wing in a sideslip with the aileron controls free. The regulations are intended to accomplish the following:

- Provide additional cues of inadvertent sideslips and skids through control force changes.
- Ensure that short periods of unattended operation do not result in any significant changes in yaw or bank angle.
- Provide predictable roll and yaw response.
- Provide acceptable level of pilot attention (i.e., workload) to attain and maintain a coordinated turn.

b. *Longitudinal Static Stability:* The longitudinal flight control laws for the A380 provide neutral static stability within the normal operational envelope. Therefore, the airplane design does not comply with the static longitudinal stability requirements of §§ 25.171, 25.173, and 25.175.

Static longitudinal stability on conventional airplanes with mechanical links to the pitch control surface means that a pull force on the controller will result in a reduction in speed relative to the trim speed, and a push force will result in higher than trim speed. Longitudinal stability is equired by the regulations for the following reasons:

- Speed change cues are provided to the pilot through increased and decreased forces on the controller.
- Short periods of unattended control of the airplane do not result in significant changes in attitude, airspeed, or load factor.
- A predictable pitch response is provided to the pilot.
- An acceptable level of pilot attention (i.e., workload) to attain and maintain trim speed and altitude is provided to the pilot.
- Longitudinal stability provides gust stability.

The pitch control movement of the side stick is a normal load factor or "g" command which results in an initial movement of the elevator surface to attain the commanded load factor. That movement is followed by integrated movement of the stabilizer and elevator to automatically trim the airplane to a neutral (1g) stick-free stability. The flight path commanded by the initial side stick input will remain stick-free until the pilot gives another command. This control function is applied during "normal" control law within the speed range from $V\alpha_{prot}$ (the speed at the angle of attack protection limit) to V_{MO}/M_{MO}. Once outside this speed range, the control laws introduce the conventional longitudinal static stability as described above.

As a result of neutral static stability, the A380 does not meet the requirements of part 25 for static longitudinal stability.

c. *Low Energy Awareness:* Static longitudinal stability provides an awareness to the flight crew of a low energy state (low speed and thrust at low altitude). Past experience on airplanes fitted with a flight control system which provides neutral longitudinal stability shows there are insufficient feedback cues to the pilot of excursion below normal operational speeds. The maximum angle of attack protection system limits the airplane angle of attack and prevents stall during normal operating speeds, but this system is not sufficient to prevent stall at low speed excursions below normal operational speeds. Until intervention, there are no stability cues, because the airplane remains trimmed. Additionally, feedback from the pitching moment due to thrust variation is reduced by the flight control laws. Recovery from a low speed excursion may become hazardous when the low speed is associated with low altitude and the engines are operating at low thrust or with other performance limiting conditions.

7. Electronic Flight Control System: Control Surface Awareness

With a response-command type of flight control system and no direct coupling from cockpit controller to control surface, such as on the A380, the pilot is not aware of the actual surface deflection position during flight maneuvers. Some unusual flight conditions, arising from atmospheric conditions or airplane or engine failures or both, may result in full or nearly full surface deflection. Unless the flight crew is made aware of excessive deflection or impending control surface deflection limiting, piloted or auto-flight system control of the airplane might be inadvertently continued in a way which would cause loss of control or other unsafe handling or performance characteristics.

These Special Conditions requires that suitable annunciation be provided to the flight crew when a flight condition exists in which nearly full control surface deflection occurs. Suitability of such a display must take into account that some pilot-demanded maneuvers (e.g., rapid roll) are necessarily associated with intended full or nearly full control surface deflection. Therefore, simple alerting systems which would function in both intended or unexpected control-limiting situations must be properly balanced between needed crew awareness and not getting nuisance warnings.

8. Electronic Flight Control System: Flight Characteristics Compliance Via the Handling Qualities Rating Method (HQRM)

The Model A380 airplane will have an Electronic Flight Control System (EFCS). This system provides an electronic interface between the pilot's flight controls and the flight control surfaces (for both normal and failure states). The system also generates the actual surface commands that provide for stability augmentation and control about all three airplane axes. Because EFCS technology has outpaced existing regulations—written essentially for unaugmented airplanes with provision for limited ON/OFF augmentation—suitable Special Conditions and a method of compliance are required to aid in the certification of flight characteristics.

These Special Conditions and the method of compliance presented in Appendix 7 of the Flight Test Guide, AC 25–7A, provide a means by which one may evaluate flight characteristics—as, for example, ''satisfactory,'' ''adequate,'' or ''controllable''—to determine compliance with the regulations. The HQRM in Appendix 7 was developed for airplanes with control systems having similar functions and is employed to aid in the evaluation of the following:

- All EFCS/airplane failure states not shown to be extremely improbable and where the envelope (task) and atmospheric disturbance probabilities are each 1.
- All combinations of failures, atmospheric disturbance level, and flight envelope not shown to be extremely improbable.

The HQRM provides a systematic approach to the assessment of handling qualities. It is not intended to dictate program size or need for a fixed number of pilots to achieve multiple opinions. The airplane design itself and success in defining critical failure combinations from the many reviewed in Systems Safety Assessments would dictate the scope of any HQRM application.

Handling qualities terms, principles, and relationships familiar to the aviation community have been used to formulate the HQRM. For example, we have established that the well-known COOPER–HARPER rating scale and the proposed FAA three-part rating system are similar. This approach is derived in part from the contract work on the flying qualities of highly augmented/relaxed static stability airplanes, in relation to regulatory and flight test guide requirements. The work is reported in DOT/FAA/CT–82/130, Flying Qualities of Relaxed Static Stability Aircraft, Volumes I and II.

9. Flight Envelope Protection: General Limiting Requirements

These Special Conditions and the following ones—pertaining to flight envelope protection—present general limiting requirements for all the unique flight envelope protection features of the basic A380 Electronic Flight Control System (EFCS) design. Current regulations do not address these types of protection features. The general limiting requirements are necessary to ensure a smooth transition from normal flight to the protection mode and adequate maneuver capability. The general limiting requirements also ensure that the structural limits of the airplane are not exceeded. Furthermore, failure of the protection feature must not create hazardous flight conditions. Envelope protection parameters include angle of attack, normal load factor, bank angle, pitch angle, and speed. To accomplish these envelope protections, one or more significant changes occur in the EFCS control laws as the normal flight envelope limit is approached or exceeded.

Each specific type of envelope protection is addressed individually in the Special Conditions which follow.

10. Flight Envelope Protection: Normal Load Factor (G) Limiting

The A380 flight control system design incorporates normal load factor limiting on a full time basis that will prevent the pilot from inadvertently or intentionally exceeding the positive or negative airplane limit load factor. This limiting feature is active in all normal and alternate flight control modes and cannot be overridden by the pilot. There is no requirement in the regulations for this limiting feature.

Except for the Airbus airplanes with fly-by-wire flight controls, the normal load factor limit is unique in that traditional airplanes with conventional flight control systems (mechanical linkages) are limited in the pitch axis only by the elevator surface area and deflection limit. The elevator control power is normally derived for adequate controllability and maneuverability at the most critical longitudinal pitching moment. The result is that traditional airplanes have a significant portion of the flight envelope in which maneuverability in excess of limit structural design values is possible.

Part 25 does not require a demonstration of maneuver control or handling qualities beyond the design limit structural loads. Nevertheless, some pilots have become accustomed to the availability of this excess maneuver capacity in case of extreme emergency, such as upset recoveries or collision avoidance. Airbus is aware of the concern and has published the results of its research which indicate the following:

- Pilots rarely, if ever, use the excess maneuvering capacity in collision avoidance maneuvers, and
- Other features of its flight control system would have prevented most, if not all, of the upset cases on record where pilots did exceed limit loads during recovery.

Because Airbus has chosen to include this optional design feature for which part 25 does not contain adequate or appropriate safety standards, Special Conditions pertaining to this feature are included. These Special Conditions establish minimum load factor requirements to ensure adequate maneuver capability during normal flight. Other limiting features of the normal load factor limiting function, as discussed above, that would affect the upper load limits are not addressed in these Special Conditions. The phrase ''in the absence of other limiting factors'' has been added relative to past similar Special Condition to clarify that while the main focus is on the lower load factor limits, there are other limiting factors that must be considered in the load limiting function.

11. Flight Envelope Protection: High Speed Limiting

The longitudinal control law design of the A380 incorporates a high speed limiting protection system in the normal flight mode. This system prevents the pilot from inadvertently or intentionally exceeding the airplane maximum design speeds, V_D M_D. Part 25 does not address such a system that would limit or modify flying qualities in the high speed region.

The main features of the high speed limiting function are as follows:

- It protects the airplane against high speed/high mach number flight conditions beyond V_{MO}/M_{MO}.
- It does not interfere with flight at V_{MO}/M_{MO}, even in turbulent air.
- It still provides load factor limitation through the ''pitch limiting'' function described below.
- It restores positive static stability beyond V_{MO}/M_{MO}.

This Special Condition establishes requirements to ensure that operation of the high speed limiter does not impede normal attainment of speeds up to the overspeed warning.

12. Flight Envelope Protection: Pitch and Roll Limiting

Currently, part 25 does not specifically address flight characteristics associated with fixed attitude limits. Airbus proposes to implement pitch and roll attitude limiting functions on the A380 via the Electronic Flight Control System (EFCS) normal modes. These normal modes will prevent airplane pitch attitudes greater than +30 degrees and less than −15 degrees and roll angles greater than plus or minus 67 degrees. In addition, positive spiral stability is introduced for roll angles greater than 33 degrees at speeds below V_{MO}/M_{MO}. At speeds greater than V_{MO}/M_{MO}, the maximum aileron control force with positive spiral stability results in a maximum bank angle of 45 degrees.

These Special Conditions establish requirements to ensure that pitch limiting functions do not impede normal maneuvering and that pitch and roll limiting functions do not restrict or prevent attaining certain roll angles necessary for emergency maneuvering.

Special Conditions to supplement § 25.143 concerning pitch and roll limits were developed for the A320, A330 and A340 in which performance of the limiting functions was monitored throughout the flight test program. The FAA expects similar monitoring to take place during the A380 flight test program to substantiate the pitch and roll attitude limiting functions and the appropriateness of the chosen limits.

13. Flight Envelope Protection: High Incidence Protection and Alpha-floor Systems

The A380 is equipped with a high incidence protection system that limits the angle of attack at which the airplane can be flown during normal low speed operation and that cannot be overridden by the flight crew. The application of this limitation on the angle of attack affects the longitudinal handling characteristics of the airplane, so that there is no need for the stall warning system during normal operation. In addition, the alpha-floor function automatically advances the throttles on the operating engines whenever the airplane angle of attack reaches a predetermined high value. This function is intended to provide increased climb capability. This Special Conditions thus addresses the unique features of the low speed high incidence protection and the alpha-floor systems on the A380.

The high incidence protection system prevents the airplane from stalling, which means that the stall warning system is not needed during normal flight conditions. If there is a failure of the high incidence protection system that is not shown to be extremely improbable, the flight characteristics at the angle of attack for C_{LMAX} must be suitable in the traditional sense, and stall warning must be provided in a conventional manner.

14. High Intensity Radiated Fields (HIRF) Protection

The Airbus Model A380–800 will utilize electrical and electronic systems which perform critical functions. These systems may be vulnerable to high-intensity radiated fields (HIRF) external to the airplane. There is no specific regulation that addresses requirements for protection of electrical and electronic systems from HIRF. With the trend toward increased power levels from ground-based transmitters and the advent of space and satellite communications, coupled with electronic command and control of the airplane, the immunity of critical avionics/electronics and electrical systems to HIRF must be established.

To ensure that a level of safety is achieved that is equivalent to that intended by the regulations incorporated by reference, Special Conditions are needed for the Airbus Model A380 airplane. These Special Conditions require that avionics/electronics and electrical systems that perform critical functions be designed and installed to preclude component damage and interruption.

It is not possible to precisely define the HIRF to which the airplane will be exposed in service. There is also uncertainty concerning the effectiveness of airframe shielding for HIRF. Furthermore, coupling of electromagnetic energy to cockpit-installed equipment through the cockpit window apertures is undefined. Based on surveys and analysis of existing HIRF emitters, adequate protection from HIRF exists when there is compliance with either paragraph a. or b. below:

a. A minimum threat of 100 volts rms (root-mean-square) per meter electric field strength from 10 KHz to 18 GHz.

(1) The threat must be applied to the system elements and their associated wiring harnesses without the benefit of airframe shielding.

(2) Demonstration of this level of protection is established through system tests and analysis.

b. A threat external to the airframe of the field strengths indicated in the table below for the frequency ranges indicated. Both peak and average field strength components from the table below are to be demonstrated.

Frequency	Field strength (volts per meter)	
	Peak	Average
10 kHz–100 kHz	50	50
100 kHz–500 kHz	50	50
500 kHz–2 MHz	50	50
2 MHz–30 MHz	100	100
30 MHz–70 MHz	50	50
70 MHz–100 MHz	50	50
100 MHz–200 MHz	100	100
200 MHz–400 MHz	100	100
400 MHz–700 MHz	700	50
700 MHz–1 GHz	700	100
1 GHz–2 GHz	2000	200
2 GHz–4 GHz	3000	200
4 GHz–6 GHz	3000	200
6 GHz–8 GHz	1000	200
8 GHz–12 GHz	3000	300
12 GHz–18 GHz	2000	200
18 GHz–40 GHz	600	200

The field strengths are expressed in terms of peak root-mean-square (rms) values over the complete modulation period.

The threat levels identified above are the result of an FAA review of existing studies on the subject of HIRF.

15. Operation Without Normal Electrical Power

This Special Condition was developed to address fly-by-wire airplanes starting with the Airbus Model A330. As with earlier airplanes, the Airbus A380–800 fly-by-wire control system requires a continuous source of electrical power for the flight control system to remain operable.

Section 25.1351(d), ''Operation without normal electrical power,'' requires safe operation in visual flight rules (VFR) weather conditions for at least five minutes with inoperative normal power. This rule was structured around a traditional design utilizing mechanical control cables for flight control while the crew took time to sort out the electrical failure, start the engine(s) if necessary, and re-establish some of the electrical power generation capability.

To maintain the same level of safety as that associated with traditional designs, the Model A380 design must not be time limited in its operation, including being without the normal source of engine or Auxiliary Power Unit (APU) generated electrical power. Service experience has shown that the loss of all electrical power generated by the airplane's engine generators or APU is not extremely improbable. Thus, it must be demonstrated that the airplane can continue through safe flight and landing—including steering and braking on the ground for airplanes using steer/brake-by-wire—using its emergency electrical power systems. These emergency electrical power systems must be able to power loads that are essential for continued safe flight and landing.

Discussion of Comments

Notice of Proposed Special Conditions No. 25–04–05–SC for the Airbus A380 airplane was published in the **Federal Register** on April 12, 2005 (70 FR 19015). The only commenter, the Boeing Company, submitted comments on all proposed Special Conditions, except Special Condition No. 12.

Boeing submitted comments in support of proposed Special Conditions No. 1, 3, 4, 8, and 11. No change to those special conditions was requested. In addition, Boeing submitted comments requesting a change to proposed Special Conditions 2, 5, 6, 7, 9, 10, 12, 13, 14, and 15. Those comments are discussed below.

Comments on Special Conditions No. 2. Interaction of Systems and Structures

Requested change 1: The Boeing Company states that paragraph c.(2)(d), Warning considerations, ''should be revised to use nomenclature that is consistent with 14 CFR 25.1322 and, thus, less onerous on system failure detection expectations.'' Specifically, Boeing suggests using the text of the final version of the Load and Dynamics Harmonization Working Group (LDHWG) report of January 2003 that was accepted by the Aviation Rulemaking Advisory Committee (ARAC).

FAA response: The FAA agrees, in part, with this comment and, accordingly, has changed the sentence which states ''The flight crew must be made aware of these failures before flight,'' to ''As far as reasonably practicable, the flight crew must be made aware of these failures before flight.'' The other changes suggested would not substantively affect the Special Conditions and, therefore, were not adopted. The FAA does not agree, however, that retaining the proposed nomenclature makes the requirement more onerous.

Requested change 2: The Boeing Company says that proposed Special Conditions No. 2, paragraph c (2)(e), Dispatch with known failure conditions, ''should be revised to stay within the scope of Part 25.'' Boeing adds that the proposed Special Conditions ''is attempting to require what is acceptable for [Minimum Equipment List] MEL dispatch with system failures, which falls under part 121 requirements (specifically 14 CFR 121.628). Dispatch considerations and intervals should be determined in coordination with the Flight Operations Evaluation Board (FOEB) in establishing the Master Minimum Equipment List (MMEL).''

Specifically, Boeing objects to the fact that the proposed Special Conditions ''excludes the consideration of the probability of dispatching with known failures to be considered in the Time of Occurrence loads conditions, described in paragraph c. (2)(c)(1) and its Figure 1 (Factor of safety at the time of occurrence). This would effectively preclude failure conditions that meet the no-single-failure criterion and are almost, but not quite, extremely improbable without this dispatch probability consideration.''

FAA response: The FAA does not agree that a certification standard for what is acceptable when the airplane is dispatched with known failure conditions is outside the scope of part 25. Acceptable dispatch configurations for the airplane are essentially variations of the type design and, as such, should not compromise the level of safety provided by the airplane's certification basis. Section 121.628 does not contain standards by which to judge the safety of MMEL dispatch configurations. It is the certification basis for the airplane, including any special conditions, that provides these standards. Limitations on acceptable dispatch configurations are legitimate subjects of these standards, and such limitations have been included previously on Special Conditions pertaining to Interaction of Systems and Structures. Such limitations may be necessary, depending on the severity of the potential consequences of failure conditions that could occur following dispatch under the MMEL.

In terms of the comment that the proposed Special Conditions would ''effectively preclude failure conditions that meet the no-single-failure criterion * * * '' we agree that the Special Conditions should be clearer about how the provisions of paragraph (c) and Figure 1 apply. We have revised the text of Special Conditions No. 2, paragraph c (2)(e), accordingly.

Comments on Special Conditions No. 5. Dive Speed Definition

Requested change 1: The Boeing Company states that on the design for the Boeing Model 777, a dive speed definition with a speed protection system was the subject of an equivalent level of safety finding. According to Boeing, ''since the Model A380 is similarly pursuing relief from the Dive Speed Definition, it should also be required to include bank angle protection features designed to failure rates less than 10E–5 per flight hour in order to be consistent with previous FAA positions.''

FAA response: The FAA does not agree. The A380 does not have the same protective functions as the Boeing Model 777. In particular, it does not have a similar bank angle protection feature. However, the A380 has protective systems that compensate for a reduced speed margin. The proposed Special Conditions specify maximum failure rates for these protective systems which are consistent with the approach taken on the Boeing 777. Accordingly, we have not changed the text of proposed Special Conditions No. 5.

Requested change 2: The Boeing Company also suggests that the maximum failure rate specified for the protective systems is stated differently in the equivalent level of safety finding for the Boeing Model 777 airplane and in the Special Conditions proposed for the A380. Boeing says, ''For consistency of application and interpretation, the FAA should revise the Special Conditions to require that each of the A380 compensating features also meet the minimum 10E–5 failure rate criterion.''

FAA response: The FAA does not agree. The A380 includes failure annunciation features not included in the Boeing 777. The FAA considered these annunciation features and follow-on pilot actions defined in the airplane flight manual in determining adequate requirements for maximum failure rate for the A380 protective systems. We determined that a higher maximum failure rate (10E–3 per flight hour) for such systems would provide adequate overall airplane level protection. The FAA did not consider such annunciation features and follow-on pilot actions during certification of the Boeing 777, because such features were not presented to the FAA by the Boeing Company. Nevertheless, the FAA considers the overall airplane level of protection to be essentially the same in the two cases.

Comments on Special Conditions No. 6. Electronic Flight Control System: Lateral-directional Stability, Longitudinal Stability, and Low Energy Awareness

Requested change 1: The Boeing Company says that in the certification programs for Airbus Models A330, A340, and A340–500/600, the Special Conditions required demonstration of ''dynamic'' and ''static'' longitudinal stability and that the same requirement should be added for consistency.

FAA response: The FAA does not agree. In past certification programs on Airbus airplanes with electronic flight control systems, a requirement to demonstrate dynamic stability was included in Special Conditions, because the FAA initially thought that the requirement for heavy damping of any short period oscillation, as contained in § 25.181(a), might not be appropriate for the electronic flight control system of Airbus airplanes. However, the FAA later learned that direct compliance with § 25.181 (a) could be demonstrated on Airbus airplanes.

When Airbus initiated the certification process for the A380, the FAA and the Joint Aviation Authorities (JAA) harmonized their corresponding Special Conditions, including that pertaining to Electronic Flight Control System-Longitudinal Stability. As a result of the transition of authority from the JAA to the European Aviation Safety Agency (EASA), EASA is now the certifying authority for the Airbus A380 airplane. This harmonized A380 Special Conditions does not include a dynamic requirement, because direct compliance with § 25.181(a) will be demonstrated. Therefore, we have not revised the text of the proposed Special Conditions.

Requested change 2: Boeing suggests that some of the qualifying terms used are not defined, so that the Special

Conditions may not be applied consistently.

FAA response: The FAA agrees that—when we use words which have a specific meaning in the context of a Special Conditions—we should define or explain them. Therefore, we have revised the text of the Special Conditions to add definitions of the terms ''suitable'' and ''adequate awareness.''

Comments on Special Conditions No. 7. Electronic Flight Control System: Control Surface Awareness

Requested change: The Boeing Company comments that, ''The intent of these Special Conditions is to provide suitable annunciation to the flight crew when the flight control surfaces are close to their authority limits without crew awareness.'' Boeing notes that ''in a similar recent Issue Paper on the Boeing Model 787, the FAA references autopilot back-drive in flight conditions described in these Special Conditions. Without autopilot back-drive, control saturation is further exacerbated.'' The company suggests that a crew procedure be required when control saturation occurs along with Airplane Flight Manual (AFM) instructions.

FAA response: The FAA does not agree. The Special Conditions for indication of flight control position are relevant to electronic flight control systems, regardless of whether or not the pilots' controls are back-driven. While it is true that the differences in the designs may affect the magnitude of the difference between control position and surface position, the basic requirement for surface position awareness applies to both design types. Both the A380 Special Conditions and the 787 Special Conditions issue paper noted by Boeing refer to the need for a specific crew action. For both airplanes, the acceptability of those crew actions will be determined as part of finding compliance with their associated Special Conditions. However, the differences in the designs do not warrant an additional, specific requirement for a crew procedure based solely on the fact that the A380 control is not back-driven.

The Boeing Company further requests that the statement ''without being commanded by the crew *or autopilot*'' be included in the Special Conditions. The FAA does not agree with this request, because the suggested change would exclude the autopilot from the basic Special Conditions requirement to provide an annunciation to the flight crew. The autopilot drives the control surface without pilot input and, therefore, could create flight conditions in which the control surface deflection is approaching a limit without being commanded by the crew. Accordingly, we have not changed the text of the proposed Special Conditions.

Comments on Special Conditions No. 9. Flight Envelope Protection: General Limiting Requirements

Requested change: The Boeing Company observes that Special Conditions issued for earlier Airbus models that employ envelope protection functions within the Electronic Flight Control System (EFCS) have specifically addressed abnormal attitudes, while the proposed Special Conditions for the Model A380 do not. Specifically, Boeing suggests ''revising the proposed Special Conditions by adding a paragraph to address abnormal attitudes and EFCS impact on recovery to normal attitudes.''

FAA response: The FAA agrees that the paragraph addressing abnormal attitudes should be included in the Special Conditions as in past certification programs on Airbus airplanes. It was the FAA's intent to cover this topic in other Special Conditions, in order to harmonize with the approach used by the JAA. As a result of administrative oversight, the FAA did not include this topic in other Special Conditions, so it has been added to Special Condition No. 9. Since this requirement has been included in multiple previous FAA Special Conditions for Airbus airplanes without significant public comment, the FAA has determined that it can be added to Special Condition No. 9 without further notice and comment.

Comments on Special Conditions No. 10. Flight Envelope Protection: Normal Load Factor (G) Limiting

Requested change: The Boeing Company states that the text of these Special Conditions differs from similar ones issued previously for Airbus Models A320, A330, and A340, in that the phrase ''in the absence of other limiting factors'' has been added as a condition of applying the required action. Boeing suggests that, ''With this additional phrase, the applicability of this Special Conditions is ambiguous; it allows this Special Conditions essentially to be ignored when other 'limiting factors' are present.'' Therefore, Boeing recommends that the phrase be either removed or explained.

FAA response: The phrase ''in the absence of other limiting factors'' was added to the proposed Special Conditions to harmonize with the JAA. The FAA does not agree that the phrase is ambiguous or that it allows the Special Conditions to be ignored when other limiting factors are present. It simply means that there are other limiting factors, such as those discussed in the preamble, that would establish the upper boundary for normal load factor and that the Special Conditions are addressing only the lower boundary. Accordingly, we have not revised the text of the proposed Special Conditions but have added a sentence of explanation to the preamble.

Comment on Special Conditions No. 13. Flight Envelope Protection: High Incidence Protection and Alpha-Floor Systems

Requested change 1: The Boeing Company recommends that we ''change the procedure for determining minimum operating speeds, so that angle-of-attack limiting envelope protection functions are active during the maneuvers used to define the Reference Stall Speed.'' Boeing also requests that paragraph c. (5)(g) specify that the high incidence protection system should be ''operating normally'' instead of ''adjusted to a high enough incidence to allow full development of the 1g stall.''

FAA response: The meaning of the request is unclear, since it is not the intent of paragraph c. (5) to determine either minimum operating speeds or the reference stall speed. The FAA does not agree with the request to revise the text. The intent of paragraph c. (5) is to set the conditions for determining V_{CLMAX} as defined in paragraph c. (4). Without adjusting the high incidence protection system angle, it would not be possible to achieve the 1g stall speed, V_{CLMAX}. V_{CLMAX} is not a minimum operating speed but rather a speed that depends on a specific test procedure and on the stall characteristics of the airplane. The reference stall speed is selected by the applicant, but it must be greater than or equal to V_{CLMAX}. Accordingly, we have not revised the text of the proposed Special Conditions.

Requested change 2: The Boeing Company suggests that—to be consistent with the criteria, intent, and philosophy of prior Issue Papers and Special Conditions—certain changes be made to the proposed Special Conditions. These changes pertain to (1) failure annunciation, (2) prohibition of dispatch with the high incidence protection and alpha floor systems inoperative, (3) additional demonstration for alpha floor system inoperative, and (4) testing with system components set to adverse tolerances limits.

FAA Response. (1) Failure Annunciation: The FAA does not agree that annunciation of failure of the stall protection system and loss of control capability should be specified in these Special Conditions. Annunciation of a system failure condition is covered in § 25.1309(c). Paragraph 13(d)(2) of these Special Conditions states that stall warning must be provided in accordance with § 25.207 following failures of the high incidence protection system not shown to be extremely improbable.

(2) *No dispatch with system inoperative:* As noted in the FAA response to Boeing's comment on Special Condition No. 2, the FAA has the authority, under part 25, to identify limitations to dispatch configurations in the MMEL, when necessary for type certification. However, in the case of Special Condition No. 13, we have determined that specific limitations on dispatch following failures of the high incidence protection and alpha floor protection systems are not needed for type certification. The FAA Flight Operations Evaluation Board should still determine the dispatch capability of the A380 relevant to these two systems, as part of the their normal processes for operational approvals.

(3) *Additional demonstration for alpha floor system inoperative:* The FAA does not agree that—to satisfy the intent of paragraph d(2)—the requirement should include the failure of the alpha floor system. Paragraph d(2) refers to paragraphs b(1), (2), and (3), and states that stall warning must be provided if these requirements are not met. The alpha floor system is independent of the high incidence protection system. If the alpha floor system fails, it should have no effect on the function and requirements of the high incidence protection system and should not invoke stall warning.

(4) *Requirement to test with system components set to adverse tolerance limits:* The Boeing Company suggests that the Special Conditions require that ''Unless angle of attack (AOA) protection system (stall warning and stall identification) production tolerances are acceptably small, so as to produce insignificant changes in performance determinations, the flight test settings for stall warning and stall identification should be set at the low AOA tolerance limit; high AOA tolerance limits should be used for characteristics evaluations.'' The FAA agrees that the above statement should be included in these Special Conditions. However, as this statement also pertains to production tolerances for the angle-of-attack protection system, application to the Airbus A380 should include tolerances for the angle-of-attack limits set for the high incidence protection system as well as for the backup stall warning system. The FAA has revised the text of the Special Conditions, accordingly.

Comments on Special Conditions No. 14. High Intensity Radiated Fields (HIRF) Protection

Requested change: The Boeing Company says that the requirement for ''engineering validation of maintenance'' which has been included in previous Special Conditions is not included and requests that it be added.

FAA Response: ''Engineering validation of maintenance'' is a method of compliance issue that is addressed in issue papers. It has not been included in previously-published special conditions and is not appropriate for Special Condition No. 14.

Comments on Special Condition No. 15. Operation Without Normal Electrical Power

Requested change: The Boeing Company comments that, ''this proposed Special Condition is attempting to advance safety standards through the use of Special Conditions'' and that ''the current regulations, §§ 25.1351(d), 25.671(d) and 25.1309, considering the intended operation of the airplane and its longest diversion, provide appropriate and adequate safety standards.'' Boeing requests that the proposed Special Conditions be replaced with information about appropriate means of compliance.

FAA response: The FAA does not agree. The A380 design incorporates electronic flight controls which are a new and novel feature not envisioned when § 25.1351(d) was promulgated. In addition, § 25.1351(d) is inadequate, because it requires only 5 minutes of standby power. The A380 would be incapable of continued safe flight and landing with less than 5 minutes of standby power. Therefore, Special Conditions that address operations without normal electrical power are appropriate for the A380 fly-by-wire airplane, and we have not revised the text of the proposed Special Conditions.

Clarification

In addition to changes made in responses to comments, the FAA has revised the wording of one of the provisions of Special Conditions No. 13, Flight Envelope Protection: High Incidence Protection and Alpha-floor Systems. The wording of paragraph j (1) has been slightly revised to clarify the intent.

Applicability

As discussed above, these Special Conditions are applicable to the Airbus A380–800 airplane. Should Airbus apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design features, these Special Conditions would apply to that model as well under the provisions of § 21.101.

Conclusion

This action affects only certain novel or unusual design features of the Airbus A380–800 airplane. It is not a rule of general applicability, and it affects only the applicant that applied to the FAA for approval of these features on the airplane.

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 Airbus A380–800 airplane.

1. Dynamic Braking

In addition to the requirements of § 25.493(d), the following Special Conditions apply:

Loads arising from the sudden application of maximum braking effort must be defined, taking into account the behavior of the braking system. Failure conditions of the braking system must be analyzed in accordance with the criteria specified in Special Conditions No. 2, ''Interaction of Systems and Structures.''

2. Interaction of Systems and Structures

In addition to the requirements of part 25, subparts C and D, the following Special Conditions apply:

a. For airplanes equipped with systems that affect structural performance—either directly or as a result of a failure or malfunction—the influence of these systems and their failure conditions must be taken into account when showing compliance with the requirements of part 25, subparts C and D. Paragraph c. below must be used to evaluate the structural performance of airplanes equipped with these systems.

b. Unless shown to be extremely improbable, the airplane must be designed to withstand any forced structural vibration resulting from any failure, malfunction, or adverse condition in the flight control system. These loads must be treated in accordance with the requirements of paragraph a. above.

c. Interaction of Systems and Structures

(1) General: The following criteria must be used for showing compliance with these Special Conditions and with § 25.629 for airplanes equipped with flight control systems, autopilots, stability augmentation systems, load alleviation systems, flutter control systems, and fuel management systems. If this paragraph is used for other systems, it may be necessary to adapt the criteria to the specific system.

(a) The criteria defined herein address only the direct structural consequences of the system responses and performances. They cannot be considered in isolation but should be included in the overall safety evaluation of the airplane. These criteria may, in some instances, duplicate standards already established for this evaluation. These criteria are applicable only to structures whose failure could prevent continued safe flight and landing. Specific criteria that define acceptable limits on handling characteristics or stability requirements when operating in the system degraded or inoperative modes are not provided in this paragraph.

(b) Depending upon the specific characteristics of the airplane, additional studies may be required that go beyond the criteria provided in this paragraph in order to demonstrate the capability of the airplane to meet other realistic conditions, such as alternative gust or maneuver descriptions for an airplane equipped with a load alleviation system.

(c) The following definitions are applicable to this paragraph.

Structural performance: Capability of the airplane to meet the structural requirements of part 25.

Flight limitations: Limitations that can be applied to the airplane flight conditions following an in-flight occurrence and that are included in the flight manual (*e.g.*, speed limitations and avoidance of severe weather conditions).

Operational limitations: Limitations, including flight limitations, that can be applied to the airplane operating conditions before dispatch (*e.g.*, fuel, payload, and Master Minimum Equipment List limitations).

Probabilistic terms: The probabilistic terms (probable, improbable, and extremely improbable) used in this Special Conditions are the same as those used in § 25.1309.

Failure condition: The term failure condition is the same as that used in § 25.1309. However, this Special Conditions applies only to system failure conditions that affect the structural performance of the airplane (*e.g.*, system failure conditions that induce loads, change the response of the airplane to inputs such as gusts or pilot actions, or lower flutter margins).

(2) Effects of Systems on Structures.

(a) *General.* The following criteria will be used in determining the influence of a system and its failure conditions on the airplane structure.

(b) *System fully operative.* With the system fully operative, the following apply:

(1) Limit loads must be derived in all normal operating configurations of the system from all the limit conditions specified in Subpart C, taking into account any special behavior of such a system or associated functions or any effect on the structural performance of the airplane that may occur up to the limit loads. In particular, any significant non-linearity (rate of displacement of control surface, thresholds or any other system non-linearities) must be accounted for in a realistic or conservative way when deriving limit loads from limit conditions.

(2) The airplane must meet the strength requirements of part 25 (Static strength, residual strength), using the specified factors to derive ultimate loads from the limit loads defined above. The effect of non-linearities must be investigated beyond limit conditions to ensure that the behavior of the system presents no anomaly compared to the behavior below limit conditions. However, conditions beyond limit conditions need not be considered, when it can be shown that the airplane has design features that will not allow it to exceed those limit conditions.

(3) The airplane must meet the aeroelastic stability requirements of § 25.629.

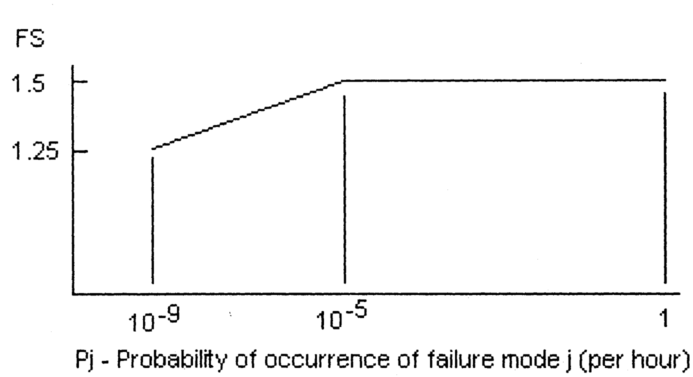
(c) *System in the failure condition.* For any system failure condition not shown to be extremely improbable, the following apply:

(1) At the time of occurrence. Starting from 1g level flight conditions, a realistic scenario, including pilot corrective actions, must be established to determine the loads occurring at the time of failure and immediately after failure.

(i) For static strength substantiation, these loads multiplied by an appropriate factor of safety that is related to the probability of occurrence of the failure are ultimate loads to be considered for design. The factor of safety (FS) is defined in Figure 1.

Figure 1

Factor of safety at the time of occurrence



(ii) For residual strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in Paragraph (c)(1)(i) of this section.

(iii) Freedom from aeroelastic instability must be shown up to the speeds defined in § 25.629(b)(2). For failure conditions that result in speed increases beyond V_C/M_C, freedom from aeroelastic instability must be shown to increased speeds, so that the margins intended by § 25.629(b)(2) are maintained.

(iv) Failures of the system that result in forced structural vibrations (oscillatory failures) must not produce loads that could result in detrimental deformation of primary structure.

(2) For the continuation of the flight. For the airplane in the system failed state and considering any appropriate reconfiguration and flight limitations, the following apply:

(i) The loads derived from the following conditions at speeds up to Vc or the speed limitation prescribed for the remainder of the flight must be determined:

(A) the limit symmetrical maneuvering conditions specified in § 25.331 and in § 25.345.

(B) the limit gust and turbulence conditions specified in § 25.341 and in § 25.345.

(C) the limit rolling conditions specified in § 25.349 and the limit unsymmetrical conditions specified in § 25.367 and § 25.427(b) and (c).

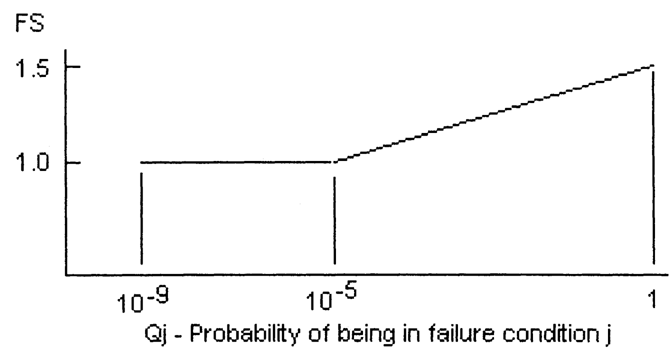
(D) the limit yaw maneuvering conditions specified in § 25.351.

(E) the limit ground loading conditions specified in § 25.473 and § 25.491.

(ii) For static strength substantiation, each part of the structure must be able to withstand the loads in Paragraph (2)(i) of this Special Conditions multiplied by a factor of safety, depending on the probability of being in this failure state. The factor of safety is defined in Figure 2.

Figure 2

Factor of safety for continuation of flight



$Q_j = (T_j)(P_j)$ where:

T_j = Average time spent in failure condition j (in hours)

P_j = Probability of occurrence of failure mode j (per hour)

Note: If P_j is greater than 10^{-3} per flight hour, then a 1.5 factor of safety must be applied to all limit load conditions specified in Subpart C.

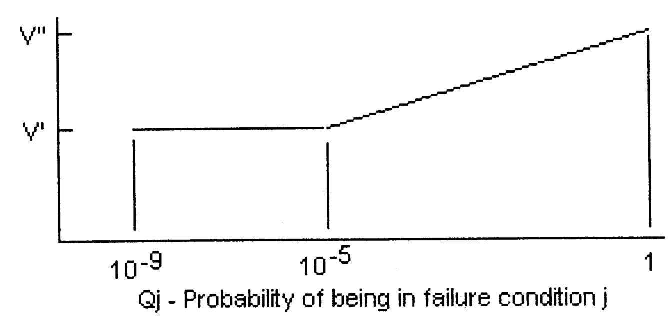
(iii) For residual strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in Paragraph (c)(2)(ii).

(iv) If the loads induced by the failure condition have a significant effect on fatigue or damage tolerance, then their effects must be taken into account.

(v) Freedom from aeroelastic instability must be shown up to a speed determined from Figure 3. Flutter clearance speeds V′ and V″ may be based on the speed limitation specified for the remainder of the flight, using the margins defined by § 25.629(b).

Figure 3

Clearance speed



V′ = Clearance speed as defined by § 25.629(b)(2).
V″ = Clearance speed as defined by § 25.629(b)(1).
$Q_j = (T_j)(P_j)$ where:
T_j = Average time spent in failure condition j (in hours)
P_j = Probability of occurrence of failure mode j (per hour)

Note: If P_j is greater than 10^{-3} per flight hour, then the flutter clearance speed must not be less than V′

(vi) Freedom from aeroelastic instability must also be shown up to V′ in Figure 3 above for any probable system failure condition combined with any damage required or selected for investigation by § 25.571(b).

(3) Consideration of certain failure conditions may be required by other sections of this Part, regardless of calculated system reliability. Where analysis shows the probability of these failure conditions to be less than $10_{-}{}^{9}$, criteria other than those specified in this paragraph may be used for structural substantiation to show continued safe flight and landing.

(d) *Warning considerations.* For system failure detection and warning, the following apply:

(1) The system must be checked for failure conditions, not extremely improbable, that degrade the structural capability below the level required by part 25 or significantly reduce the reliability of the remaining system. As far as reasonably practicable, the flight crew must be made aware of these failures before flight. Certain elements of the control system, such as mechanical and hydraulic components, may use special periodic inspections, and electronic components may use daily checks in lieu of warning systems to achieve the objective of this requirement. These certification maintenance requirements must be limited to components that are not readily detectable by normal warning systems and where service history shows that inspections will provide an adequate level of safety.

(2) The existence of any failure condition, not extremely improbable, during flight that could significantly affect the structural capability of the airplane and for which the associated reduction in airworthiness can be minimized by suitable flight limitations must be signaled to the flightcrew. For example, failure conditions that result in a factor of safety between the airplane strength and the loads of part 25, subpart C, below 1.25 or flutter margins below V″ must be signaled to the crew during flight.

(e) *Dispatch with known failure conditions.* If the airplane is to be dispatched in a known system failure condition that affects structural performance or affects the reliability of the remaining system to maintain structural performance, then the provisions of this Special Conditions must be met, including the provisions of Paragraph (b), for the dispatched condition and Paragraph (c) for subsequent failures. Expected operational limitations may be taken into account in establishing P_j as the probability of failure occurrence for determining the safety margin in Figure 1. Flight limitations and expected operational limitations may be taken into account in establishing Qj as the combined probability of being in the dispatched failure condition and the subsequent failure condition for the safety margins in Figures 2 and 3. These limitations must be such that the probability of being in this combined failure state and then subsequently encountering limit load conditions is extremely improbable. No reduction in these safety margins is allowed, if the subsequent system failure rate is greater than 1E–3 per flight hour.

3. Limit Pilot Forces

In addition to the requirements of § 25.397(c) the following Special Conditions apply: The limit pilot forces are as follows:

a. For all components between and including the handle and its control stops.

Pitch	Roll
Nose up 200 lbf	Nose left 100 lbf.
Nose down 200 lbf	Nose right 100 lbf.

b. For all other components of the side stick control assembly, but excluding the internal components of the electrical sensor assemblies to avoid damage as a result of an in-flight jam.

Pitch	Roll
Nose up 125 lbf	Nose left 50 lbf.
Nose down 125 lbf	Nose right 50 lbf.

4. Side Stick Controllers

In the absence of specific requirements for side stick controllers, the following Special Conditions apply:

a. *Pilot strength:* In lieu of the ‘‘strength of pilots’’ limits shown in § 25.143(c) for pitch and roll and in lieu of the specific pitch force requirements of §§ 25.145(b) and 25.175(d), it must be shown that the temporary and maximum prolonged force levels for the side stick controllers are suitable for all expected operating conditions and configurations, whether normal or non-normal.

b. *Pilot control authority:* The electronic side stick controller coupling design must provide for corrective and/or overriding control inputs by either pilot with no unsafe characteristics. Annunciation of the controller status must be provided and must not be confusing to the flight crew.

c. *Pilot control:* It must be shown by flight tests that the use of side stick controllers does not produce unsuitable pilot-in-the-loop control characteristics when considering precision path control/tasks and turbulence. In addition, pitch and roll control force and displacement sensitivity must be compatible, so that normal inputs on one control axis will not cause significant unintentional inputs on the other.

d. *Autopilot quick-release control location:* In lieu of compliance with 25.1329(d), autopilot quick release (emergency) controls must be on both side stick controllers. The quick release means must be located so that it can readily and easily be used by the flight crew.

5. Dive Speed Definition

In lieu of the requirements of § 25.335(b)(1)—if the flight control system includes functions which act automatically to initiate recovery before the end of the 20 second period specified in § 25.335(b)(1)—the greater of the speeds resulting from the following Special Conditions applies.

a. From an initial condition of stabilized flight at VC/ MC, 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 maintain this new flight path. Twenty seconds after initiating the upset, manual recovery is made at a load factor of 1.5 g (0.5 acceleration increment) or such greater load factor that is automatically applied by the system with the pilot's pitch control neutral. The speed increase occurring in this maneuver may be calculated, if reliable or conservative aerodynamic data is used. Power, as specified in § 25.175(b)(1)(iv), is assumed until recovery is made, 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.

Note: The pilot's controls may be in the neutral position after reaching V_C/M_C and before recovery is initiated.

c. Recovery may be initiated three seconds after operation of 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 one second.

d. The applicant must also demonstrate either that

(1) 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, or

(2) the airplane is protected by the flight control laws from getting into non-symmetric upset conditions.

e. The probability of failure of the protective system that mitigates for the reduced speed margin must be less than 10^{-5} per flight hour, except that the probability of failure may be greater than 10^{-5}, but not greater than 10^{-3}, per flight hour, provided that:

(1) Failures of the system are annunciated to the pilots, and

(2) The flight manual instructions require the pilots to reduce the speed of the airplane to a value that maintains a speed margin between V_{MO} and V_D consistent with showing compliance with 25.335(b) without the benefit of the system, and

(3) no dispatch of the airplane is allowed with the system inoperative.

6. Electronic Flight Control System: Lateral-Directional and Longitudinal Stability and Low Energy Awareness

In lieu of the requirements of §§ 25.171, 25.173, 25.175, and 25.177(c), the following Special Conditions apply:

a. The airplane must be shown to have suitable static lateral, directional, and longitudinal stability in any condition normally encountered in service, including the effects of atmospheric disturbance. The showing of suitable static lateral, directional, and longitudinal stability must be based on the airplane handling qualities, including pilot workload and pilot compensation, for specific test procedures during the flight test evaluations.

b. The airplane must provide adequate awareness to the pilot of a low energy (low speed/low thrust/low height) state when fitted with flight control laws presenting neutral longitudinal stability significantly below the normal operating speeds. ''Adequate awareness'' means warning information must be provided to alert the crew of unsafe operating conditions and to enable them to take appropriate corrective action.

c. The static directional stability—as shown by the tendency to recover from a skid with the rudder free—must be positive for any landing gear and flap position and symmetrical power condition, at speeds from 1.13 V_{S1g} up to V_{FE}, V_{LE}, or V_{FC}/M_{FC} (as appropriate).

d. In straight, steady sideslips (unaccelerated forward slips), the rudder control movements and forces must be substantially proportional to the angle of sideslip, and the factor of proportionality must be between limits found necessary for safe operation throughout the range of sideslip angles appropriate to the operation of the airplane. At greater angles—up to the angle at which full rudder control is used or a rudder pedal force of 180 pounds (81.72 kg) is obtained—the rudder pedal forces may not reverse, and increased rudder deflection must produce increased angles of sideslip. Unless the airplane has a suitable sideslip indication, there must be enough bank and lateral control deflection and force accompanying sideslipping to clearly indicate any departure from steady, unyawed flight.

7. Electronic Flight Control System: Control Surface Awareness

In addition to the requirements of §§ 25.143, 25.671 and 25.672, the following Special Conditions apply:

a. A suitable flight control position annunciation must be provided to the crew in the following situation:

A flight condition exists in which—without being commanded by the crew—control surfaces are coming so close to their limits that return to normal flight and (or) continuation of safe flight requires a specific crew action.

b. In lieu of control position annunciation, existing indications to the crew may be used to prompt crew action, if they are found to be adequate.

Note: The term ''suitable'' also indicates an appropriate balance between nuisance and necessary operation.

8. Electronic Flight Control System: Flight Characteristics Compliance Via the Handling Quantities Rating Method (HQRM)

a. Flight Characteristics Compliance Determination for EFCS Failure Cases:

In lieu of compliance with § 25.672(c), the HQRM contained in Appendix 7 of AC 25–7A must be used for evaluation of EFCS configurations resulting from single and multiple failures not shown to be extremely improbable.

The handling qualities ratings are as follows:

(1) *Satisfactory:* Full performance criteria can be met with routine pilot effort and attention.

(2) *Adequate:* Adequate for continued safe flight and landing; full or specified reduced performance can be met, but with heightened pilot effort and attention.

(3) *Controllable:* Inadequate for continued safe flight and landing, but controllable for return to a safe flight condition, safe flight envelope and/or reconfiguration, so that the handling qualities are at least Adequate.

b. Handling qualities will be allowed to progressively degrade with failure state, atmospheric disturbance level, and flight envelope, as shown in Figure 12 of Appendix 7. Specifically, for probable failure conditions within the normal flight envelope, the pilot-rated handling qualities must be satisfactory in light atmospheric disturbance and adequate in moderate atmospheric disturbance. The handling qualities rating must not be less than adequate in light atmospheric disturbance for improbable failures.

Note: AC 25–7A, Appendix 7 presents a method of compliance and provides guidance for the following:

- Minimum handling qualities rating requirements in conjunction with atmospheric disturbance levels, flight envelopes, and failure conditions (Figure 12),
- Flight Envelope definition (Figures 5A, 6 and 7),
- Atmospheric Disturbance Levels (Figure 5B),
- Flight Control System Failure State (Figure 5C),
- Combination Guidelines (Figures 5D, 9 and 10), and
- General flight task list, from which appropriate specific tasks can be selected or developed (Figure 11).

9. Flight Envelope Protection

(a) *General Limiting Requirements.* (1) Onset characteristics of each envelope protection feature must be smooth, appropriate to the phase of flight and type of maneuver, and not in conflict with the ability of the pilot to satisfactorily change the airplane flight path, speed, or attitude, as needed.

(2) Limit values of protected flight parameters (and if applicable, associated warning thresholds) must be compatible with the following:

(a) Airplane structural limits,

(b) Required safe and controllable maneuvering of the airplane, and

(c) Margins to critical conditions. Dynamic maneuvering, airframe and system tolerances (both manufacturing and in-service), and non-steady atmospheric conditions—in any appropriate combination and phase of flight—must not result in a limited flight parameter beyond the nominal design limit value that would cause unsafe flight characteristics.

(3) The airplane must be responsive to intentional dynamic maneuvering to within a suitable range of the parameter limit. Dynamic characteristics, such as damping and overshoot, must also be appropriate for the flight maneuver and limit parameter in question.

(4) When simultaneous envelope limiting is engaged, adverse coupling or adverse priority must not result.

b. *Failure States:* EFCS failures, including sensor failures, must not result in a condition where a parameter is limited to such a reduced value that safe and controllable maneuvering is no longer available. The crew must be alerted by suitable means, if any change in envelope limiting or maneuverability is produced by single or multiple failures of the EFCS not shown to be extremely improbable.

c. *Abnormal Attitudes:* In case of abnormal attitude or excursion of any other flight parameters outside the protected boundaries, the operation of the EFCS, including the automatic protection functions, must not hinder airplane recovery.

10. Flight Envelope Protection: Normal Load Factor (g) Limiting

In addition to the requirements of 25.143(a)—and in the absence of other limiting factors—the following Special Conditions apply:

a. The positive limiting load factor must not be less than:

(1) 2.5g for the EFCS normal state.

(2) 2.0g for the EFCS normal state with the high lift devices extended.

b. The negative limiting load factor must be equal to or more negative than:

(1) Minus 1.0g for the EFCS normal state.

(2) 0.0g for the EFCS normal state with high lift devices extended.

Note: This Special Condition does not impose an upper bound for the normal load factor limit, nor does it require that the limit exist. If the limit is set at a value beyond the structural design limit maneuvering load factor ''n,'' indicated in § 25.333(b) and 25.337(b) and (c), there should be a very positive tactile feel built into the controller and obvious to the pilot that serves as a deterrent to inadvertently exceeding the structural limit.

11. Flight Envelope Protection: High Speed Limiting

In addition to § 25.143, the following Special Condition applies:

Operation of the high speed limiter during all routine and descent procedure flight must not impede normal attainment of speeds up to the overspeed warning.

12. Flight Envelope Protection: Pitch And Roll Limiting

In addition to § 25.143, the following Special Conditions apply:

a. The pitch limiting function must not impede normal maneuvering for pitch angles up to the maximum required for normal maneuvering—including a normal all-engines operating takeoff plus a suitable margin to allow for satisfactory speed control.

b. The pitch and roll limiting functions must not restrict or prevent attaining roll angles up to 65 degrees or pitch attitudes necessary for emergency maneuvering. Spiral stability, which is introduced above 33 degrees roll angle, must not require excessive pilot strength to achieve roll angles up to 65 degrees.

13. Flight Envelope Protection: High Incidence Protection And Alpha-floor Systems

a. *Definitions.* For the purpose of this Special Condition, the following definitions apply:

High Incidence Protection System A system that operates directly and automatically on the airplane's flying controls to limit the maximum angle of attack that can be attained to a value below that at which an aerodynamic stall would occur.

Alpha-Floor System. A system that automatically increases thrust on the operating engines when the angle of attack increases through a particular value.

Alpha Limit. The maximum angle of attack at which the airplane stabilizes with the high incidence protection system operating and the longitudinal control held on its aft stop.

V_{min}. The minimum steady flight speed is the stabilized, calibrated airspeed obtained when the airplane is decelerated at an entry rate not exceeding 1 knot per second, until the longitudinal pilot control is on its stop with the high incidence protection system operating.

V_{min1g} V_{min} corrected to 1g conditions. It is the minimum calibrated airspeed at which the airplane can develop a lift force normal to the flight path and equal to its weight when at an angle of attack not greater than that determined for V_{min}.

b. *Capability and Reliability of the High Incidence Protection System:* (1) It must not be possible to encounter a stall during pilot induced maneuvers, and handling characteristics must be acceptable, as required by paragraphs e and f below, entitled High Incidence Handling Demonstrations and High Incidence Handling Characteristics respectively.

(2) The airplane must be protected against stalling due to the effects of windshears and gusts at low speeds, as required by paragraph g below, entitled Atmospheric Disturbances.

(3) The ability of the high incidence protection system to accommodate any reduction in stalling incidence resulting from residual ice must be verified.

(4) The reliability of the system and the effects of failures must be acceptable, in accordance with § 25.1309 and Advisory Circular 25.1309–1A, System Design and Analysis.

(5) The high incidence protection system must not impede normal maneuvering for pitch angles up to the maximum required for normal maneuvering, including a normal all-engines operating takeoff plus a suitable margin to allow for satisfactory speed control.

c. *Minimum Steady Flight Speed and Reference Stall Speed:* In lieu of the requirements of § 25.103, the following Special Conditions apply:

(1) V_{min}. The minimum steady flight speed, for the airplane configuration under consideration and with the high incidence protection system operating, is the final stabilized calibrated airspeed obtained when the airplane is decelerated at an entry rate not exceeding 1 knot per second until the longitudinal pilot control is on its stop.

(2) The minimum steady flight speed, V_{min}, must be determined with:

(a) The high incidence protection system operating normally.

(b) Idle thrust.

(c) Alpha-floor system inhibited.

(d) All combinations of flap settings and landing gear positions.

(e) The weight used when V_{SR} is being used as a factor to determine compliance with a required performance standard.

(f) The most unfavorable center of gravity allowable, and

(g) The airplane trimmed for straight flight at a speed achievable by the automatic trim system.

(3) V_{min1g} is V_{min} corrected to 1g conditions. V_{min1g} is the minimum calibrated airspeed at which the airplane can develop a lift force normal to the flight path and equal to its weight when at an angle of attack not greater

than that determined for $V_{min.}$ V_{min1g} is defined as follows:

$$V\ min\ 1g = \frac{V\ min}{\sqrt{n_{zw}}}$$

where n_{zw} = load factor normal to the flight path at V_{min}

(4) The Reference Stall Speed, V_{SR}, is a calibrated airspeed selected by the applicant. V_{SR} may not be less than the 1g stall speed. V_{SR} is expressed as:

$$V_{SR} \geq \frac{V_{CL_{MAX}}}{\sqrt{n_{zw}}}$$

where

V_{CLMAX} = Calibrated airspeed obtained when the load factor-corrected lift coefficient

$$\left(\frac{n_{zw}W}{qS}\right)$$

is first a maximum during the maneuver prescribed in Paragraph (5)(h) of this Special Conditions.

n_{zw} = Load factor normal to the flight path at V_{CLMAX}

W = Airplane gross weight

S = Aerodynamic reference wing area, and

q = Dynamic pressure.

(5) V_{CLMAX} must be determined with the following conditions:

(a) Engines idling or—if that resultant thrust causes an appreciable decrease in stall speed—not more than zero thrust at the stall speed

(b) The airplane in other respects, such as flaps and landing gear, in the condition existing in the test or performance standard in which V_{SR} is being used.

(c) The weight used when V_{SR} is being used as a factor to determine compliance with a required performance standard.

(d) The center of gravity position that results in the highest value of reference stall speed.

(e) The airplane trimmed for straight flight at a speed achievable by the automatic trim system, but not less than 1.13 V_{SR} and not greater than 1.3 V_{SR}.

(f) The alpha-floor system inhibited.

(g) The high incidence protection system adjusted to a high enough incidence to allow full development of the 1g stall.

(h) Starting from the stabilized trim condition, apply the longitudinal control to decelerate the airplane so that the speed reduction does not exceed one knot per second.

(6) The flight characteristics at the angle of attack for C_{LMAX} must be suitable in the traditional sense at FWD and AFT CG in straight and turning flight at IDLE power. Although for a normal production EFCS and steady full aft stick this angle of attack for C_{LMAX} cannot be achieved, the angle of attack can be obtained momentarily under dynamic circumstances and deliberately in a steady state sense with some EFCS failure conditions.

d. *Stall Warning.* (1) *Normal Operation.* If the conditions of Paragraph b, Capability and Reliability of the High Incidence Protection System, are satisfied, a level of safety equivalent to that intended by § 25.207, Stall Warning, must be considered to have been met without provision of an additional, unique warning device.

(2) *Failure Cases.* Following failures of the high incidence protection system not shown to be extremely improbable, if the system no longer satisfies Paragraph b, Capability and Reliability of the High Incidence Protection System, parts (1), (2), and (3), stall warning must be provided in accordance with § 25.207. The stall warning should prevent inadvertent stall under the following conditions:

(a) Power off straight stall approaches to a speed 5 percent below the warning onset.

(b) Turning flight stall approaches at entry rates up to 3 knots per second when recovery is initiated not less than one second after the warning onset.

Note: ''Unless angle of attack (AOA) protection system (high incidence protection system, stall warning and stall identification) production tolerances are acceptably small, so as to produce insignificant changes in performance determinations, the flight test settings for the high incidence protection system, stall warning and stall identification should be set at the low AOA tolerance limit. High AOA tolerance limits should be used for characteristics evaluations.''

e. *High Incidence Handling Demonstrations.* In lieu of the requirements of § 25.201, the following Special Conditions apply:

Maneuvers to the limit of the longitudinal control in the nose up direction must be demonstrated in straight flight and in 30 degree banked turns under the following conditions:

(1) The high incidence protection system operating normally.

(2) Initial power condition of:

(a) Power off.

(b) The power necessary to maintain level flight at 1.5 V_{SR1}, where V_{SR1} is the reference stall speed with the flaps in the approach position, the landing gear retracted, and the maximum landing weight. The flap position to be used to determine this power setting is that position in which the stall speed, V_{SR1}, does not exceed 110% of the stall speed, V_{SR0}, with the flaps in the most extended landing position.

(3) Alpha-floor system operating normally, unless more severe conditions are achieved with alpha-floor inhibited.

(4) Flaps, landing gear and deceleration devices in any likely combination of positions.

(5) Representative weights within the range for which certification is requested, and

(6) The airplane trimmed for straight flight at a speed achievable by the automatic trim system.

f. *High Incidence Handling Characteristics.* In lieu of the requirements of § 25.203, the following Special Conditions apply:

(1) In demonstrating the handling characteristics specified in paragraphs (2), (3), (4), and (5) below, the following procedures must be used:

(a) Starting at a speed sufficiently above the minimum steady flight speed to ensure that a steady rate of speed reduction can be established, apply the longitudinal control so that the speed reduction does not exceed one knot per second until the control reaches the stop.

(b) The longitudinal control must be maintained at the stop until the airplane has reached a stabilized flight condition and must then be recovered by normal recovery techniques.

(c) The requirements for turning flight maneuver demonstrations must also be met with accelerated rates of entry to the incidence limit, up to the maximum rate achievable.

(2) Throughout maneuvers with a rate of deceleration of not more than 1 knot per second, both in straight flight and in 30 degree banked turns, the airplane's characteristics must be as follows:

(a) There must not be any abnormal airplane nose-up pitching.

(b) There must not be any uncommanded nose-down pitching that would be indicative of stall. However, reasonable attitude changes associated with stabilizing the incidence at alpha limit as the longitudinal control reaches the stop would be acceptable. Any reduction of pitch attitude associated with stabilizing the incidence at the alpha limit should be achieved smoothly and at a low pitch rate, such that it is not likely to be mistaken for natural stall identification.

(c) There must not be any uncommanded lateral or directional motion, and the pilot must retain good lateral and directional control by conventional use of the cockpit controllers throughout the maneuver.

(d) The airplane must not exhibit buffeting of a magnitude and severity that would act as a deterrent to completing the maneuver.

(3) In maneuvers with increased rates of deceleration, some degradation of characteristics is acceptable, associated with a transient excursion beyond the stabilized alpha-limit. However, the airplane must not exhibit dangerous characteristics or characteristics that would deter the pilot from holding the longitudinal controller on the stop for a period of time appropriate to the maneuvers.

(4) It must always be possible to reduce incidence by conventional use of the controller.

(5) The rate at which the airplane can be maneuvered from trim speeds associated with scheduled operating speeds, such as V_2 and V_{REF}, up to alpha-limit must not be unduly damped or significantly slower than can be achieved on conventionally controlled transport airplanes.

g. *Atmospheric Disturbances.* Operation of the high incidence protection system and the alpha-floor system must not adversely affect aircraft control during expected levels of atmospheric disturbances or impede the application of recovery procedures in case of windshear. Simulator tests and analysis may be used to evaluate such conditions but must be validated by limited flight testing to confirm handling qualities at critical loading conditions.

h. *Alpha-floor.* The alpha-floor setting must be such that the aircraft can be flown at normal landing operational speed and maneuvered up to bank angles consistent with the flight phase, including the maneuver capabilities specified in 25.143(g), without triggering alpha-floor. In addition, there must be no alpha-floor triggering, unless appropriate, when the airplane is flown in usual operational maneuvers and in turbulence.

i. *Proof of Compliance:* In addition to the requirements of § 25.21, the following Special Conditions apply:

The flying qualities must be evaluated at the most unfavorable center of gravity position.

j. *Longitudinal Control:* (1) In lieu of the requirements of § 25.145(a) and 25.145(a)(1), the following Special Conditions apply:

It must be possible—at any point between the trim speed for straight flight and V_{min}—to pitch the nose downward, so that the acceleration to this selected trim speed is prompt, with:

The airplane trimmed for straight flight at the speed achievable by the automatic trim system and at the most unfavorable center of gravity;

(2) In lieu of the requirements of § 25.145(b)(6), the following Special Conditions apply:

With power off, flaps extended and the airplane trimmed at 1.3 V_{SR1}, obtain and maintain airspeeds between V_{min} and either 1.6 V_{SR1} or V_{FE}, whichever is lower.

k. *Airspeed Indicating System:* (1) In lieu of the requirements of subsection 25.1323(c)(1), the following Special Conditions apply:

V_{MO} to V_{min} with the flaps retracted.

(2) In lieu of the requirements of subsection 25.1323(c)(2), the following Special Conditions apply:

V_{min} to V_{FE} with flaps in the landing position.

14. High Intensity Radiated Fields (HIRF) Protection

a. *Protection from Unwanted Effects of High-intensity Radiated Fields.* Each electrical and electronic system which performs critical functions must be designed and installed to ensure that the operation and operational capabilities of these systems to perform critical functions are not adversely affected when the airplane is exposed to high intensity radiated fields external to the airplane.

b. *For the purposes of this Special Conditions, the following definition applies: Critical Functions:* Functions whose failure would contribute to or cause a failure condition which would prevent the continued safe flight and landing of the airplane.

15. Operation Without Normal Electrical Power

In lieu of the requirements of § 25.1351(d), the following Special Condition applies:

It must be demonstrated by test or combination of test and analysis that the airplane can continue safe flight and landing with inoperative normal engine and APU generator electrical power (*i.e.*, electrical power sources, excluding the battery and any other standby electrical sources). The airplane operation should be considered at the critical phase of flight and include the ability to restart the engines and maintain flight for the maximum diversion time capability being certified.

Issued in Renton, Washington, on March 30, 2006.

Ali Bahrami,

Manager, Transport Airplane Directorate, Aircraft Certification Service.

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No.: FAA–2004–18775; Amendment No. 25–119]

RIN 2120–AI41

Safety Standards for Flight Guidance Systems

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This action amends the airworthiness standards for new designs and significant product changes for transport category airplanes concerning flight guidance systems. The standards address the performance, safety, failure protection, alerting, and basic annunciation of these systems. This rule is necessary to address flight guidance system vulnerabilities and to consolidate and standardize regulations for functions within those systems. In addition, this rule updates the current regulations regarding the latest technology and functionality. Adopting this rule eliminates significant regulatory differences between the U.S. and European airworthiness standards.

DATES: Effective Date: This amendment becomes effective May 11, 2006.

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SUPPLEMENTARY INFORMATION:

Availability of Rulemaking Documents

You can get an electronic copy using the Internet by:

(1) Searching the Department of Transportation's electronic Docket Management System (DMS) web page (*http://dms.dot.gov/search*);

(2) Visiting the FAA's Regulations and Policies Web page at *http://www.faa.gov/regulations_policies*; or

(3) Accessing the Government Printing Office's Web page at *http://www.gpoaccess.gov/fr/index.html.*

You can also get a copy by sending a request to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267–9680. Make sure to identify the amendment number or docket number of this rulemaking.