Done at Washington, DC, on February 20, 2007.

Bryce Quick,

Acting Administrator.

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. NM370; Notice No. 25–07–06–SC]

Special Conditions: Dassault Aviation Model Falcon 7X Airplane; Side Stick Controllers, Electronic Flight Control System: Lateral-Directional and Longitudinal Stability, Low Energy Awareness, Flight Control Surface Position Awareness, and Flight Characteristics Compliance via the Handling Qualities Rating Method; Flight Envelope Protection: General Limiting Requirements, High Incidence Protection Function, Normal Load Factor (g) Limiting, and Pitch, Roll, and High Speed Limiting Functions

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed special conditions.

SUMMARY: This action proposes special conditions for the Dassault Aviation Model Falcon 7X 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, electronic flight control systems, and flight envelope protections. These special conditions pertain to control and handling qualities of the airplane and protection limits within the normal flight envelope. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for these design features. These proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards. Additional special conditions will be issued for other novel or unusual design features of the Dassault Model Falcon 7X airplanes.

DATES: We must receive your comments by March 28, 2007.

ADDRESSES: You must mail two copies of your comments to: Federal Aviation Administration, Transport Airplane Directorate, Attn: Rules Docket (ANM–113), Docket No. NM370, 1601 Lind Avenue, SW., Renton, Washington, 98057–3356. You may deliver two copies to the Transport Airplane Directorate at the above address. *You must mark your comments:* Docket No. NM370. You can inspect comments in the Rules Docket weekdays, except Federal holidays, between 7:30 a.m. and 4 p.m.

FOR FURTHER INFORMATION CONTACT: Joe Jacobsen, FAA, Airplane and Flight Crew Interface Branch, ANM–111, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue, SW., Renton, Washington 98057–3356; telephone (425) 227–2011; facsimile (425) 227–1149.

SUPPLEMENTARY INFORMATION:

Comments Invited

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

We will file in the docket all comments we receive, as well as a report summarizing each substantive public contact with FAA personnel concerning these special conditions. You can inspect the docket before and after the comment closing date. If you wish to review the docket in person, go to the address in the **ADDRESSES** section of this preamble between 7:30 a.m. and 4 p.m., Monday through Friday, except Federal holidays.

We will consider all comments we receive on or before the closing date for comments. We will consider comments filed late if it is possible to do so without incurring expense or delay. We may change these special conditions based on the comments we receive.

If you want the FAA to acknowledge receipt of your comments on this proposal, include with your comments a pre-addressed, stamped postcard on which the docket number appears. We will stamp the date on the postcard and mail it back to you.

Background

On June 4, 2002, Dassault Aviation, 9 rond Point des Champs Elysees, 75008, Paris, France, applied for FAA type certificate for its new Model Falcon 7X airplane. The Dassault Model Falcon 7X airplane is a 19 passenger transport category airplane powered by three aft mounted Pratt & Whitney PW307A high bypass ratio turbofan engines. Maximum takeoff weight will be 63,700 pounds, and maximum certified altitude will be 51,000 feet with a range of 5,700 nautical miles. The airplane is operated using a fly-by-wire (FBW) primary flight control system. This will be the first application of a FBW primary flight control system in an airplane primarily intended for private/corporate use.

The Dassault Aviation Model Falcon 7X design incorporates equipment that was not envisioned when part 25 was created. This equipment includes side stick controllers, and an electronic flight control system that provides flight envelope protection. Therefore, special conditions are required that provide the level of safety equivalent to that established by the regulations.

Type Certification Basis

Under the provisions of 14 CFR 21.17, Dassault Aviation must show that the Model Falcon 7X airplane meets the applicable provisions of 14 CFR part 25, as amended by Amendments 25–1 through 25–108.

If the Administrator finds that the applicable airworthiness regulations do not contain adequate or appropriate safety standards for the Model Falcon 7X airplane because of novel or unusual design features, special conditions are prescribed under the provisions of § 21.16.

In addition to the applicable airworthiness regulations and special conditions, the Dassault Model Falcon 7X 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 under § 611 of Public Law 93–574, the ''Noise Control Act of 1972.''

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

Novel or Unusual Design Features

The Dassault Falcon 7X airplane will incorporate the following novel or unusual design features:

- Side stick controllers;
- *Electronic flight control system:* lateral-directional and longitudinal stability, low energy awareness,

• *Electronic flight control system:* flight control surface position awareness,
• *Electronic flight control system:* flight characteristics compliance via the handling qualities rating method (HQRM);
• *Flight envelope protection:* general limiting requirements,
• *Flight envelope protection:* high incidence protection function,
• *Flight envelope protection:* normal load factor (g) limiting,
• *Flight envelope protection:* pitch, roll, and high speed limiting functions.

Because of these rapid improvements in airplane technology, the applicable airworthiness regulations do not contain adequate or appropriate safety standards for these design features. These proposed special conditions address equipment which may affect the airplane's structural performance, either directly or as a result of failure or malfunction. These proposed special conditions are identical or nearly identical to those previously required for type certification of other airplane models. Additional special conditions will be issued for other novel or unusual design features of the Dassault Model Falcon 7X airplane. Those additional special conditions will pertain to the following topics:

• Dive speed definition with speed protection system,
• Sudden engine stoppage, and
• Operation without normal electrical power.

Final special conditions have been issued for the Model Falcon 7X with the novel or unusual design feature pertaining to Pilot Compartment View-Hydrophobic Coatings in Lieu of Windshield Wipers (January 10, 2007; 72 FR 1135). Special conditions have been proposed for the Model Falcon 7X with the novel or unusual design features pertaining to Interaction of Systems and Structures, Limit Pilot Forces, and High Intensity Radiated Fields (HIRF) (October 18, 2006; 71 FR 61427).

Discussion

Because of these rapid improvements in airplane technology, the applicable airworthiness regulations do not contain adequate or appropriate safety standards for these design features. Therefore, in addition to the requirement of part 25, subparts C and D, the following special conditions are proposed.

Proposed Special Condition No. 1. Side Stick Controllers

The Falcon 7X 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. Certain ergonomic considerations such as armrest support, freedom of arm movement, controller displacement, handgrip size and accommodations for a range of pilot sizes are not addressed in the regulations. In addition, pilot control authority may be uncertain, because the side sticks are not mechanically interconnected as with conventional wheel and column controls. 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.

These proposed special conditions require that the unique features of the side stick must be demonstrated through flight and simulator tests to have suitable handling and control characteristics.

Proposed Special Condition No. 2. 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 Falcon 7X will have suitable airplane handling qualities throughout the normal flight envelope.

The unique features of the Model Falcon 7X flight control system and side-stick controllers, when compared with conventional airplanes with wheel and column controllers, do not provide conventional awareness to the flightcrew of a change in speed or a change in the direction of flight. These special conditions require 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 electronic flight control system (EFCS) on the Falcon 7X contains fly-by-wire control laws that result in neutral lateral-directional static stability. Therefore, the conventional requirements of the regulations are not met.

The Model Falcon 7X 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.

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. These proposed special conditions 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 Falcon 7X provide neutral static stability within the normal operational envelope. Therefore, it is inappropriate to require the airplane design to 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 required 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 the speed at the angle of attack protection limit to initiation of the angle of attack protection limit. 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 Falcon 7X does not meet the part 25 requirements for static longitudinal stability. It would not be appropriate to apply the conventional part 25 requirements for static longitudinal stability to the unconventional control systems of the Falcon 7X. These proposed special conditions would require that the airplane be shown to have suitable static longitudinal stability in any condition normally encountered in service.

c. *Low Energy Awareness:* Static longitudinal stability provides an awareness to the flightcrew 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.

Because § 25.173 requires that the pilot receive speed change cues through increased or decreased forces on the controller, it would be inappropriate to apply those requirements for feedback cues to the Falcon Model 7X systems. These proposed special conditions would require that the airplane provide adequate awareness of a low energy state to the pilot.

Proposed Special Condition No. 3. Electronic Flight Control System: Flight Control Surface Position Awareness

With a response-command type of flight control system and no direct mechanical coupling from cockpit controller to control surface, the controller does not provide the Falcon 7X pilot with an awareness 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 flightcrew is made aware of excessive deflection or impending control surface deflection limiting, the pilot or auto-flight system may encounter situations where loss of control or other unsafe handling or performance characteristics occur.

These special conditions would require that suitable annunciation be provided to the flightcrew 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 nuisance warnings.

Proposed Special Condition No. 4. Electronic Flight Control System: Flight Characteristics Compliance Via the Handling Qualities Rating Method (HQRM)

The Model Falcon 7X 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, FAA Handling Qualities Rating Method, of AC 25–7A, Flight Test Guide Certification of Transport Category Airplanes, would provide a means to evaluate flight characteristics—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.
- Any other flight condition or characteristic where 14 CFR part 25 proves to be inadequate for proper assessment of unique Falcon Model 7X flight characteristics.

The Handling Qualities Rating Method 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 on the flying qualities of highly augmented/relaxed static stability airplanes in relation to regulatory and flight test guide requirements is reported in DOT/FAA/CT–82/130, Flying Qualities of Relaxed Static Stability Aircraft, Volumes I and II.

Proposed Special Condition No. 5. Flight Envelope Protection: General Limiting Requirements

These special conditions and the following ones—pertaining to flight envelope protection—would present general limiting requirements for all the unique flight envelope protection features of the basic Model Falcon 7X 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, 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 that follow.

Proposed Special Condition No. 6. Flight Envelope Protection—High Incidence Protection Function

The Falcon 7X is equipped with a high incidence protection function 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 flightcrew. This function prevents the airplane from stalling and therefore, the stall warning system is not needed during normal flight conditions. If there is a failure of the high incidence protection function 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. This special condition would address these and other unique features of this function on the Model Falcon 7X.

The special conditions define a $_{MIN}$imum steady flight speed, V_{MIN}, to be demonstrated during flight test, at which the airplane can develop lift normal to the flight path and equal to its weight at the angle of attack limit of the protection function. It further defines procedures for establishing the reference stall speed, V_{SR}, to be used for defining reference speeds during takeoff and landing.

In the absence of specific regulations in 14 CFR Part 25, these special conditions present High Incidence Protection Function requirements for the capability and reliability of the function, stall warning with a failure condition, handling qualities and characteristics at high incidence or angle of attack flight maneuvers, and specific applications of the newly defined V_{MIN} in lieu of current regulations.

Proposed Special Condition No. 7. Flight Envelope Protection: Normal Load Factor (G) Limiting

The Falcon 7X flight control system design incorporates a normal load factor limiting function 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 the normal flight control mode and cannot be overridden by the pilot. There is no requirement in the regulations for this limiting feature.

This 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.

Because Dassault has chosen to include this optional design feature on the Falcon 7X, for which part 25 does not contain adequate or appropriate safety standards, special conditions pertaining to this feature are included. These special conditions would establish $_{MIN}$imum 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 conditions 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.

Proposed Special Condition No. 8. Flight Envelope Protection: Pitch, Roll, and High Speed Limiting Functions

The Model Falcon 7X will incorporate pitch attitude and high speed limiting functions via the Electronic Flight Control System (EFCS) normal operating mode. In addition, positive spiral stability and partial pitch compensation will be introduced in the lateral and pitch axes through the control laws for bank angles greater than 35 degrees.

The purpose of the pitch attitude limiting function, in conjunction with the high incidence protection function, is to prevent airplane stall during low speed, high angle of attack excursions.

The high speed limiting protection function prevents the pilot from inadvertently or intentionally exceeding the airplane maximum design speeds, V_D/M_D. Part 25 does not address such a function that would limit or modify flying qualities in the high speed region.

There are no specific hard limits on the Falcon 7X for bank angle. At bank angles up to 35 degrees, side movement of the controller commands roll rate depending on the amount of deflection. Bank angle is immediately accomplished by the control law function and deflection of the control surfaces. With the stick released to its neutral point, the airplane will maintain the commanded bank angle (neutral spiral stability). Positive spiral stability is introduced at and above 35 degrees band angle such that a stick force is required to maintain bank angle, and releasing the stick will return the airplane to 35 degrees.

In addition to the requirements of § 25.143, this special condition would establish requirements to ensure that pitch and high speed limiting functions do not impede normal maneuvering and that pitch and roll limiting functions do not restrict or prevent attaining bank angles necessary for emergency maneuvering.

Applicability

As discussed above, these special conditions are applicable to the Dassault Model Falcon 7X. Should Dassault Aviation 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.

Conclusion

This action affects only certain novel or unusual design features of the Dassault Model Falcon 7X airplane. It is not a rule of general applicability, and it affects only the applicant which 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 Proposed Special Conditions

Accordingly, pursuant to the authority delegated to me by the Ad_{MIN}istrator, the following special conditions are issued as part of the type certification basis for the Dassault Aviation Model Falcon 7X airplane.

1. 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 flightcrew.

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 flightcrew.

2. 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_{SR1} 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.

3. Electronic Flight Control System: Flight Control Surface Position 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.

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

a. Flight characteristics compliance determination for electronic flight control system (EFCS) Failure Cases:

In lieu of compliance with § 25.672(c), the HQRM contained in Appendix 7, FAA Handling Qualities Rating Method, of the Flight Test Guide for Certification of Transport Category Airplanes, AC 25–7A, (or an equivalent method of compliance found acceptable to the FAA), 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:

(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, ''Minimum HQ Requirements,'' 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).

5. Flight Envelope Protection: General Limiting Requirements

a. *General Requirements*

(1) Onset characteristics of each envelope protection function 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.

6. Flight Envelope Protection: High Incidence Protection Function

a. *Definitions.* For the purpose of this special condition, the following definitions apply:

Electronic Flight Control System (EFCS) The electronic and software command and control elements of the flight control system.

High Incidence Protection Function An airplane level function that automatically limits the maximum angle of attack that can be attained to a value below that at which an aerodynamic stall would occur.

Alpha Limit The maximum angle of attack at which the airplane stabilizes with the high incidence protection function 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 function 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 Function.*

(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, titled High Incidence Handling Demonstrations and High Incidence Handling Characteristics respectively.

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

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

(4) The reliability of the function 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 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.

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 function 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 function operating normally.

(b) Idle thrust.

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

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

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

(f) 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:

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

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:

$$V_{SR} \geq Vs\,1g = \frac{V_{CL_{MAX}}}{\sqrt{n_{zw}}}$$

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 condition.

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) [Reserved]

(g) The high incidence protection function 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 center of gravity 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.

(7) The reference stall speed, V_{SR}, is a calibrated airspeed defined by the applicant. If V_{SR} is chosen equal to V_{MIN1g}, an equivalent safety finding to the intent of § 25.103 may be considered to have been met. The applicant may choose V_{SR} to be less than V_{MIN1g} but not less than VS1g if compensating factors are provided to ensure safe characteristics.

d. *Stall Warning.*

(1) *Normal Operation* If the conditions of paragraph b, Capability and Reliability of the High Incidence Protection Function, of this special conditions 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 function not shown to be extremely improbable, if the function no longer satisfies paragraph b, Capability and Reliability of the High Incidence Protection Function, paragraphs b(1), (2), and (3) of this special condition, 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 with at least 1.5g load factor normal to the flight path at entry rate of at least 2 knots per second when recovery is initiated not less than one second after warning onset.

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 function 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) [Reserved]

(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 function 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. *[Reserved].*

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 (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 § 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 § 25.1323(c)(2), the following special conditions apply:

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

7. 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 Electronic Flight Control System (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.

8. Flight Envelope Protection: Pitch, Roll, and High Speed Limiting Functions

In addition to § 25.143, the following special conditions apply:

a. 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.

b. The pitch limiting function must not impede airplane maneuvering, including an all-engines operating takeoff, for pitch angles up to the maximum required for normal operations plus a suitable margin in the pitch axis to allow for satisfactory speed control.

c. The high speed limiting function must not impede normal attainment of speeds up to V_{MO}/M_{MO} during all routine and descent procedure flight conditions.

d. The pitch and roll limiting functions must not restrict nor prevent attaining bank angles up to 65 degrees and pitch attitudes necessary for emergency maneuvering. Positive spiral stability, which is introduced above 35 degrees bank angle, must not require excessive pilot strength on the side stick controller to achieve bank angles up to 65 degrees. Stick force at bank angles greater than 35 degrees must not be so light that over-control would lead to pilot-induced oscillations.

Issued in Renton, Washington, on February 15, 2007.

Stephen Boyd,

Acting Manager, Transport Airplane Directorate, Aircraft Certification Service.

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

[Docket No. FAA–2007–27338; Directorate Identifier 2006–NM–148–AD]

RIN 2120–AA64

Airworthiness Directives; McDonnell Douglas Model 717–200 Airplanes

AGENCY: Federal Aviation Administration (FAA), Department of Transportation (DOT).

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: The FAA proposes to supersede an existing airworthiness directive (AD) that applies to all McDonnell Douglas Model 717–200 airplanes. The existing AD currently requires revising the Airworthiness Limitations Section (ALS) of the Instructions for Continued Airworthiness to incorporate new removal limits for certain components of the flap system and to reduce the interval of inspections for fatigue cracking of certain principal structural elements (PSEs). This proposed AD would require revising the ALS of the Instructions for Continued Airworthiness to incorporate reduced initial inspection and repeat inspection intervals for certain PSEs. This proposed AD results from a revised damage tolerance analysis. We are proposing this AD to detect and correct fatigue cracking of certain PSEs, which could adversely affect the structural integrity of the airplane.

DATES: We must receive comments on this proposed AD by April 12, 2007.

ADDRESSES: Use one of the following addresses to submit comments on this proposed AD.

- *DOT Docket Web site:* Go to *http://dms.dot.gov* and follow the instructions for sending your comments electronically.
- *Government-wide rulemaking Web site:* Go to *http://www.regulations.gov* and follow the instructions for sending your comments electronically.
- *Mail:* Docket Management Facility; U.S. Department of Transportation, 400 Seventh Street, SW., Nassif Building, Room PL–401, Washington, DC 20590.
- *Fax:* (202) 493–2251.
- *Hand Delivery:* Room PL–401 on the plaza level of the Nassif Building, 400 Seventh Street, SW., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

Contact Boeing Commercial Airplanes, Long Beach Division, 3855 Lakewood Boulevard, Long Beach, California 90846, Attention: Data and Service Management, Dept. C1–L5A (D800–0024), for the service information identified in this proposed AD.

FOR FURTHER INFORMATION CONTACT: David Rathfelder, Aerospace Engineer, Airframe Branch, ANM–120L, FAA, Los Angeles Aircraft Certification Office, 3960 Paramount Boulevard, Lakewood, California 90712–4137; telephone (562) 627–5229; fax (562) 627–5210.

SUPPLEMENTARY INFORMATION:

Comments Invited

We invite you to submit any relevant written data, views, or arguments regarding this proposed AD. Send your comments to an address listed in the **ADDRESSES** section. Include the docket number ''FAA–2007–27338; Directorate Identifier 2006–NM–148–AD'' at the beginning of your comments. We specifically invite comments on the overall regulatory, economic, environmental, and energy aspects of the proposed AD. We will consider all comments received by the closing date and may amend the proposed AD in light of those comments.

We will post all comments we receive, without change, to *http://dms.dot.gov,* including any personal information you provide. We will also post a report summarizing each substantive verbal contact with FAA personnel concerning this proposed AD. Using the search function of that web site, anyone can find and read the comments in any of our dockets, including the name of the individual who sent the comment (or signed the comment on behalf of an association, business, labor union, etc.). You may review the DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (65 FR 19477–78), or may can visit *http://dms.dot.gov.*

Examining the Docket

You may examine the AD docket on the Internet at *http://dms.dot.gov,* or in