DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. 28312; Amdt. No. 25–91]

RIN 2120–AF70

Revised Structural Loads Requirements for Transport Category Airplanes

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This amendment revises the structural loads design requirements of the Federal Aviation Regulations (FAR) for transport category airplanes by incorporating changes developed in cooperation with the Joint Aviation Authorities (JAA) of Europe and the Aviation Rulemaking Advisory Committee (ARAC). This action makes some of the requirements more rational and eliminates differences between current U.S. and European requirements that impose unnecessary costs on airplane manufacturers. These changes are intended to achieve common airworthiness standards and language between the requirements of the U.S. regulations and the Joint Aviation Requirements (JAR) of Europe while maintaining at least the level of safety provided by the current regulations and industry practices.

EFFECTIVE DATE: August 28, 1997.

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SUPPLEMENTARY INFORMATION:

Background

The manufacturing, marketing and certification of transport airplanes is increasingly an international endeavor. In order for U.S. manufacturers to export transport airplanes to other countries the airplane must be designed to comply, not only with the U.S. airworthiness requirements for transport airplanes (14 CFR part 25), but also with the transport airworthiness requirements of the countries to which the airplane is to be exported, unless the importing country accepts the aircraft without findings of compliance with specified regulations.

The European countries have developed a common airworthiness code for transport category airplanes that is administered by the JAA. This code is the result of a European effort to harmonize the various airworthiness codes of the European countries and is called the Joint Aviation Requirements (JAR)–25. It was developed in a format similar to 14 CFR part 25. Many other countries have airworthiness codes that are aligned closely to part 25 or to JAR–25, or they use these codes directly for their own certification purposes.

Although JAR–25 is very similar to part 25, there are differences in methodologies and criteria that often result in the need to address the same design objective with more than one kind of analysis or test in order to satisfy both part 25 and JAR airworthiness codes. These differences result in additional costs to the transport airplane manufacturers and additional costs to the U.S. and foreign authorities that must continue to monitor compliance with different airworthiness codes.

In 1988, the FAA, in cooperation with the JAA and other organizations representing the U.S. and European aerospace industries, began a process to harmonize the airworthiness requirements of the United States and the European authorities. The objective was to achieve common requirements for the certification of transport category airplanes without a substantive change in the level of safety provided by the regulations and industry practices. Other airworthiness authorities such as Transport Canada have also participated in this process.

In 1992, the harmonization effort was undertaken by the Aviation Rulemaking Advisory Committee (ARAC). A working group of industry and government structural loads specialists of Europe, the United States, and Canada was chartered by notice in the **Federal Register** (58 FR 13819, March 15, 1993) to harmonize the design loads sections of Subpart C of part 25. The bulk of the harmonization tasks for Subpart C were completed by the working group and recommendations were submitted to FAA by letter dated February 2, 1995. The FAA concurred with the recommendations and proposed them in Notice of Proposed Rulemaking (NPRM) No. 95–14; which was published in the **Federal Register** on August 29, 1995 (60 FR 44998).

In establishing a design requirement for the nose gear, its attaching structure and the forward fuselage structure, § 25.499(e) continues to require consideration of positioning the nose gear in any steerable position. The term ‘‘any’’ is continued from the current regulation. The term, and the requirements of the section, are understood in the engineering and regulated communities to require demonstration that the nose gear and associated structures will sustain the applicable loads throughout the full range of nose gear positions.

Discussion of Comments

Comments were received from transport airplane manufacturers, industry associations and foreign airworthiness authorities. All of the commenters express support for the proposals in Notice No. 95–14 although a few make some recommendations for changes. One comment believes the changes proposed for § 25.415 could be a burden to some applicants with airplanes that are derived from models that were certified to earlier amendment levels of the FAR and JAR. To provide relief for these derivative airplanes, the commenter proposes a change to paragraph (b) of § 25.415 which would allow the use of ‘‘realistic’’ aerodynamic hinge moment coefficients for control surfaces in lieu of the prescribed coefficients of paragraph (b). The FAA does not agree that there is likely to be a burden for derivative airplanes since the proposed rule applies to new designs. In addition, the design gust speed does not create an increased requirement over existing design requirements. Part 24 and JAR–25 were identical in using 88 feet per second (about 52 knots) in defining hinge moment for ground gust conditions. However, JAR § 25.519 prescribes a 65 knot wind speed for ground gusts during jacking and tie-down, and specifically requires application of those gusts to control surfaces. As a result, aircraft designs already have to meet the 65 knot rather than the 52 knot requirement. The ARAC recommends, with FAA and JAA concurrence, that ground gusts on control surfaces be addressed in just one section, § 25.415, so Notice No. 95–14 proposes to revise this section to achieve the same effect as the § 25.519 of JAR–25 by incorporating the 65-knot wind speed into § 25.415. The net effect is that there is no change in the ground gust speed requirement for control surfaces over that already required by JAR–25.

Furthermore, the use of rational aerodynamic hinge moment coefficients would necessitate a rational ground gust speed as well, and the 65 knot design gust speed is not necessarily a rational design speed for ground gusts. Jet blasts in airport operations and normal storm conditions often exceed 65 knots but service history has shown that the 65 knot design speed when combined with the conservative prescribed hinge moments of paragraph (b) provides a satisfactory design.

One commenter recommends that the formulation of the requirement for hinge moments in § 25.415 be changed to show the 65 knot wind speed explicitly rather than embedding this value into the multiplying constant. The FAA agrees that this has merit since the connection between the 65 knot wind speed of §§ 25.415 and 25.519 could otherwise be missed in any future rulemaking actions. The rule is adopted with a change to show the 65 knot wind speed explicitly in the formula for control surface hinge moments.

One commenter points out that the proposed revision to paragraph (a) of § 25.481 references paragraphs 25.479(c)(1) and (2) for vertical and drag load conditions and that these latter paragraphs, as proposed, no longer specify those conditions. Notice 95–14 proposes to express the substance of § 25.479(c)(1) and (2) in more general terms in § 25.473(c). The commenter is correct. The rule is adopted with a change to delete the incorrect references.

Regulatory Evaluation Summaries

Regulatory Evaluation, Regulatory Flexibility Determination, and Trade Impact Assessment

Changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic effect of regulatory changes on small entities. Third, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these analyses, the FAA has determined that this rule:

(1) Will generate benefits that justify its costs and is not a ''significant regulatory action'' as defined in the Executive Order; (2) is not significant as defined in DOT's Regulatory Policies and Procedures; (3) will not have a significant impact on a substantial number of small entities; and (4) will not constitute a barrier to international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

Depending on airplane design, the rule could result in additional compliance costs for some manufacturers. If manufacturers choose to design to and justify a V_D–V_C magin of 0.05 Mach, there will be an increase in analysis costs of approximately $145,000 per certification. The requirement in § 25.473 to consider structural flexibility in the analysis of landing loads and the increase in the factor on the maximum static reaction on the nose gear vertical force in § 25.499 could add compliance costs, but the FAA estimates that these will be negligible.

The rule will also result in cost savings. Revisions in the conditions in which unchecked pitch maneuvers are investigated could reduce certification costs by as much as $10,000 per certification. The FAA estimates that the change in the speed margin between V_B and V_C from a fixed margin to a margin variable with altitude could result in substantial, though unquantified, cost savings to some manufacturers. Manufacturers that design small transport category airplanes with direct mechanical rudder control systems could realize a savings as a result of the modification in the rudder control force limit in § 25.351. No comments were received on the costs or cost savings resulting from these changes.

The primary benefit of the rule will be the cost savings associated with harmonization of the FAR with the JAR. In order to sell airplanes in a global marketplace, manufacturers usually certify their products under the FAR and the JAR. The cost savings from reducing the resources necessary to demonstrate compliance with non-harmonized design load requirements will outweigh any incremental costs of the rule, resulting in a net cost savings. These savings will be realized by U.S. manufacturers that market airplanes in JAA countries as well as by manufacturers in JAA countries that market airplanes in the U.S.

The change to § 25.335(b)(2) in the minimum speed margin for atmospheric conditions from 0.05 Mach to 0.07 Mach could produce safety benefits. The increase in the margin between V_D/M_D and V_C/M_C is more conservative and will standardize training across international lines. Crews could cross-train and cross-fly and this standardization will enhance safety as well as result in more efficient training.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionally burdened by Federal regulations. The RFA requires a Regulatory Flexibility Analysis if a proposed or final rule would have a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, establishes threshold cost values and small entity standards for complying with RFA review requirements in FAA rulemaking actions. The Order defines ''small entities'' in terms of size threshold, ''significant economic impact'' in terms of annualized cost thresholds, and ''substantial number'' as a number which is not less than eleven and which is more than one-third of the small entities subject to the proposed or final rule.

Order 2100.14A specifies a size threshold for classification as a small manufacturer as 75 or fewer employees. Since none of the manufacturers affected by this rule has 75 or fewer employees and any costs of the rule will be negligible, the rule will not have a significant economic impact on a substantial number of small manufacturers.

International Trade Impact Assessment

The rule will not constitute a barrier to international trade, including the export of U.S. airplanes to foreign markets and the import of foreign airplanes into the U.S. Because the rule will harmonize with the JAR, it would, in fact, lessen restraints on trade.

Federalism Implications

The regulations amended herein do not have a substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Thus, in accordance with Executive Order 12612, it is determined that this rule does not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

International Compatibility

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with International Civil Aviation Organization (ICAO) standards and recommended practices to the maximum extent practicable. The FAA has determined that this rule does not conflict with any international agreement of the United States.

Paperwork Reduction Act

In accordance with the Paperwork Reduction Act of 1980 (Pub. L. 96–511), there are no requirements for information collection associated with this rule.

Conclusion

Because these changes to the structural loads requirements do not result in any substantial economic costs, the FAA has determined that this rule will not be significant under Executive Order 12866. Because there has not been significant public interest in this issue, the FAA has determined that this action is not significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 25, 1979). In addition, since there are no small entities affected by this rulemaking, the FAA certifies that the rule will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act, since none will be affected. A copy of the regulatory evaluation prepared for this project may be examined in the Rules Docket or obtained from the person identified under the caption **FOR FURTHER INFORMATION CONTACT**.

List of Subjects in 14 CFR Part 25

Air transportation, Aircraft, Aviation safety, Safety.

The Amendments

Accordingly, the Federal Aviation Administration (FAA) amends 14 CFR part 25 of the Federal Aviation Regulations as follows:

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation for part 25 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701–44702, 44704.

2. Section 25.331 is amended by revising the introductory text of paragraph (c) and paragraph (c)(1) to read as follows:

§ 25.331 Symmetric maneuvering conditions.

* * * * *

(c) *Pitch maneuver conditions.* The conditions specified in paragraphs (c)(1) and (2) of this section must be investigated. The movement of the pitch control surfaces may be adjusted to take into account limitations imposed by the maximum pilot effort specified by § 25.397(b), control system stops and any indirect effect imposed by limitations in the output side of the control system (for example, stalling torque or maximum rate obtainable by a power control system.)

(1) *Maximum pitch control displacement at V_A.* The airplane is assumed to be flying in steady level flight (point A_1, § 25.333(b)) and the cockpit pitch control is suddenly moved to obtain extreme nose up pitching acceleration. In defining the tail load, the response of the airplane must be taken into account. Airplane loads that occur subsequent to the time when normal acceleration at the c.g. exceeds the positive limit maneuvering load factor (at point A_2 in § 25.333(b)), or the resulting tailplane normal load reaches its maximum, whichever occurs first, need not be considered.

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3. Section 25.335 is amended by revising paragraphs (a)(2) and (b)(2) to read as follows:

§ 25.335 Design airspeeds.

* * * * *

(a) * * *

(2) Except as provided in § 25.335(d)(2), V_C may not be less than V_B + 1.32 U_{REF} (with U_{REF} as specified in § 25.341(a)(5)(i)). However V_C need not exceed the maximum speed in level flight at maximum continuous power for the corresponding altitude.

* * * * *

(b) * * *

(2) The minimum speed margin must be enough to provide for atmospheric variations (such as horizontal gusts, and penetration of jet streams and cold fronts) and for instrument errors and airframe production variations. These factors may be considered on a probability basis. The margin at altitude where M_C is limited by compressibility effects must not less than 0.07M unless a lower margin is determined using a rational analysis that includes the effects of any automatic systems. In any case, the margin may not be reduced to less than 0.05M.

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4. Section 25.345 is amended by revising paragraph (d) to read as follows:

§ 25.345 High lift devices.

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(d) The airplane must be designed for a maneuvering load factor of 1.5 g at the maximum take-off weight with the wing-flaps and similar high lift devices in the landing configurations.

5. Section 25.351 is revised to read as follows:

§ 25.351 Yaw maneuver conditions.

The airplane must be designed for loads resulting from the yaw maneuver conditions specified in paragraphs (a) through (d) of this section at speeds from V_{MC} to V_D. Unbalanced aerodynamic moments about the center of gravity must be reacted in a rational or conservative manner considering the airplane inertia forces. In computing the tail loads the yawing velocity may be assumed to be zero.

(a) With the airplane in unaccelerated flight at zero yaw, it is assumed that the cockpit rudder control is suddenly displaced to achieve the resulting rudder deflection, as limited by:

(1) The control system on control surface stops; or

(2) A limit pilot force of 300 pounds from V_{MC} to V_A and 200 pounds from V_C/M_C to V_D/M_D, with a linear variation between V_A and V_C/M_C.

(b) With the cockpit rudder control deflected so as always to maintain the maximum rudder deflection available within the limitations specified in paragraph (a) of this section, it is assumed that the airplane yaws to the overswing sideslip angle.

(c) With the airplane yawed to the static equilibrium sideslip angle, it is assumed that the cockpit rudder control is held so as to achieve the maximum rudder deflection available within the limitations specified in paragraph (a) of this section.

(d) With the airplane yawed to the static equilibrium sideslip angle of paragraph (c) of this section, it is assumed that the cockpit rudder control is suddenly returned to neutral.

6. Section 25.363 is amended by revising the heading and paragraph (a) to read as follows:

§ 25.363 Side load on engine and auxiliary power unit mounts.

(a) Each engine and auxiliary power unit mount and its supporting structure must be designed for a limit load factor in lateral direction, for the side load on the engine and auxiliary power unit mount, at least equal to the maximum load factor obtained in the yawing conditions but not less than—

(1) 1.33; or

(2) One-third of the limit load factor for flight condition A as prescribed in § 25.333(b).

* * * * *

7. Section 25.371 is revised to read as follows:

§ 25.371 Gyroscopic loads.

The structure supporting any engine or auxiliary power unit must be designed for the loads including the gyroscopic loads arising from the conditions specified in §§ 25.331, 25.341(a), 25.349, 25.351, 25.473, 25.479, and 25.481, with the engine or auxiliary power unit at the maximum rpm appropriate to the condition. For the purposes of compliance with this section, the pitch maneuver in § 25.331(c)(1) must be carried out until the positive limit maneuvering load factor (point A_2 in § 25.333(b)) is reached.

8. Section 25.415 is amended by revising paragraph (a)(2) to read as follows:

§ 25.415 Ground gust conditions.

(a) * * *

(2) The control system stops nearest the surfaces, the control system locks, and the parts of the systems (if any) between these stops and locks and the control surface horns, must be designed for limit hinge moments H, in foot pounds, obtained from the formula, $H=.0034KV^2cS$, where—

V=65 (wind speed in knots)
K=limit hinge moment factor for ground gusts derived in paragraph (b) of this section.
c=mean chord of the control surface aft of the hinge line (ft);
S=area of the control surface aft of the hinge line (sq ft);

* * * * *

9. Section 25.473 is revised to read as follows:

§ 25.473 Landing load conditions and assumptions.

(a) For the landing conditions specified in § 25.479 to § 25.485 the airplane is assumed to contact the ground—

(1) In the attitudes defined in § 25.479 and § 25.481;

(2) With a limit descent velocity of 10 fps at the design landing weight (the maximum weight for landing conditions at maximum descent velocity); and

(3) With a limit descent velocity of 6 fps at the design take-off weight (the maximum weight for landing conditions at a reduced descent velocity).

(4) The prescribed descent velocities may be modified if it is shown that the airplane has design features that make it impossible to develop these velocities.

(b) Airplane lift, not exceeding airplane weight, may be assumed unless the presence of systems or procedures significantly affects the lift.

(c) The method of analysis of airplane and landing gear loads must take into account at least the following elements:

(1) Landing gear dynamic characteristics.

(2) Spin-up and springback.

(3) Rigid body response.

(4) Structural dynamic response of the airframe, if significant.

(d) The limit inertia load factors corresponding to the required limit descent velocities must be validated by tests as defined in § 25.723(a)

(e) The coefficient of friction between the tires and the ground may be established by considering the effects of skidding velocity and tire pressure. However, this coefficient of friction need not be more than 0.8.

10. Section 25.479 is revised to read as follows:

§ 25.479 Level landing conditions.

(a) In the level attitude, the airplane is assumed to contact the ground at forward velocity components, ranging from V_{L1} to 1.25 V_{L2} parallel to the ground under the conditions prescribed in § 25.473 with—

(1) V_{L1} equal to V_{S0} (TAS) at the appropriate landing weight and in standard sea level conditions; and

(2) V_{L2} equal to V_{S0} (TAS) at the appropriate landing weight and altitudes in a hot day temperature of 41 degrees F. above standard.

(3) The effects of increased contact speed must be investigated if approval of downwind landings exceeding 10 knots is requested.

(b) For the level landing attitude for airplanes with tail wheels, the conditions specified in this section must be investigated with the airplane horizontal reference line horizontal in accordance with Figure 2 of Appendix A of this part.

(c) For the level landing attitude for airplanes with nose wheels, shown in Figure 2 of Appendix A of this part, the conditions specified in this section must be investigated assuming the following attitudes:

(1) An attitude in which the main wheels are assumed to contact the ground with the nose wheel just clear of the ground; and

(2) If reasonably attainable at the specified descent and forward velocities, an attitude in which the nose and main wheels are assumed to contact the ground simultaneously.

(d) In addition to the loading conditions prescribed in paragraph (a) of this section, but with maximum vertical ground reactions calculated from paragraph (a), the following apply:

(1) The landing gear and directly affected attaching structure must be designed for the maximum vertical ground reaction combined with an aft acting drag component of not less than 25% of this maximum vertical ground reaction.

(2) The most severe combination of loads that are likely to arise during a lateral drift landing must be taken into account. In absence of a more rational analysis of this condition, the following must be investigated:

(i) A vertical load equal to 75% of the maximum ground reaction of § 25.473 must be considered in combination with a drag and side load of 40% and 35% respectively of that vertical load.

(ii) The shock absorber and tire deflections must be assumed to be 75% of the deflection corresponding to the maximum ground reaction of § 25.473(a)(2). This load case need not be considered in combination with flat tires.

(3) The combination of vertical and drag components is considered to be acting at the wheel axle centerline.

11. Section 25.481 is amended by revising paragraph (a) introductory text and by designating the undesignated text following paragraph (a)(2) as paragraph (a)(3) and revising it to read as follows:

§ 25.481 Tail down landing conditions.

(a) In the tail-down attitude, the airplane is assumed to contact the ground at forward velocity components, ranging from V_{L1} to V_{L2} parallel to the ground under the conditions prescribed in § 25.473 with—

(1) * * *

(2) * * *

(3) The combination of vertical and drag components is considered to be acting at the main wheel axle centerline.

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12. Section 25.483 is amended by revising the heading, introductory text, and paragraph (a) to read as follows:

§ 25.483 One-gear landing conditions.

For the one-gear landing conditions, the airplane is assumed to be in the level attitude and to contact the ground on one main landing gear, in accordance with Figure 4 of Appendix A of this part. In this attitude—

(a) The ground reactions must be the same as those obtained on that side under § 25.479(d)(1), and

* * * * *

13. Section 25.485 is amended by adding the introductory text to read as follows:

§ 25.485 Side load conditions.

In addition to § 25.479(d)(2) the following conditions must be considered:

* * * * *

14. Section 25.491 is revised to read as follows:

§ 25.491 Taxi, takeoff and landing roll.

Within the range of appropriate ground speeds and approved weights, the airplane structure and landing gear are assumed to be subjected to loads not less than those obtained when the aircraft is operating over the roughest ground that may reasonably be expected in normal operation.

15. Section 25.499 is amended by revising the heading and paragraph (e) to read as follows:

§ 25.499 Nose-wheel yaw and steering.

* * * * *

(e) With the airplane at design ramp weight, and the nose gear in any steerable position, the combined application of full normal steering torque and vertical force equal to 1.33 times the maximum static reaction on the nose gear must be considered in designing the nose gear, its attaching structure, and the forward fuselage structure.

16. Section 25.561 is amended by revising paragraph (c) to read as follows:

§ 25.561 General.

* * * * *

(c) For equipment, cargo in the passenger compartments and any other large masses, the following apply:

(1) Except as provided in paragraph (c)(2) of this section, these items must be positioned so that if they break loose they will be unlikely to:

(i) Cause direct injury to occupants;

(ii) Penetrate fuel tanks or lines or cause fire or explosion hazard by damage to adjacent systems; or

(iii) Nullify any of the escape facilities provided for use after an emergency landing.

(2) When such positioning is not practical (e.g. fuselage mounted engines or auxiliary power units) each such item of mass shall be restrained under all loads up to those specified in paragraph (b)(3) of this section. The local attachments for these items should be designed to withstand 1.33 times the specified loads if these items are subject to severe wear and tear through frequent removal (e.g. quick change interior items).

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Issued in Washington D.C. on July 14, 1997.

Barry L. Valentine,

Acting Administrator.

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