DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. 28312; Notice No. 95–14]

RIN 2120–AF70

Revised Structural Loads Requirements for Transport Category Airplanes

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: This notice proposes to revise 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 is necessary because differences between current U.S. and European requirements impose unnecessary costs on airplane manufacturers. This action would make some of the requirements more rational and eliminate differences between current U.S. and European requirements that impose unnecessary costs on airplane manufacturers. These proposals are intended to achieve common requirements 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.

DATES: Comments must be received on or before November 27, 1995.

ADDRESSES: Comments on this notice may be mailed in triplicate to: Federal Aviation Administration (FAA), Office of the Chief Counsel, Attention: Rules Docket (AGC–200), Docket No. 28312, 800 Independence Avenue SW., Washington, DC 20591; or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, DC 20591. Comments delivered must be marked Docket No. 28312. Comments may be examined in Room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5 p.m. In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM–100), FAA, 1601 Lind Avenue SW., Renton, WA 98055–4056. Comments in the information docket may be examined weekdays, except Federal holidays, between 7:30 a.m. and 4 p.m.

FOR FURTHER INFORMATION CONTACT: James Haynes, Airframe and Propulsion Branch, ANM–112, Transport Airplane Directorate, Aircraft Certification Service, FAA, 1601 Lind Avenue SW., Renton, WA 98055–4056; telephone (206) 227–2131.

SUPPLEMENTARY INFORMATION

Comments Invited

Interested persons are invited to participate in this proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to any environmental, energy, or economic impact that might result from adopting the proposals contained in this notice are invited. Substantive comments should be accompanied by cost estimates. Commenters should identify the regulatory docket or notice number and submit comments in triplicate to the Rules Docket address above. All comments received on or before the closing date for comments will be considered by the Administrator before taking action on this proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments received will be available in the Rules Docket, both before and after the comment period closing date, for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Persons wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped postcard on which the following statement is made: ''Comments to Docket No. 28312.'' The postcard will be date/time stamped and returned to the commenter.

Availability of NPRM

Any person may obtain a copy of this notice by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Inquiry Center, APA–230, 800 Independence Avenue SW., Washington, DC 20591; or by calling (202) 267–3484. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future rulemaking documents should also request a copy of Advisory Circular No. 11–2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

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.

The European countries have developed a common airworthiness code for transport category airplanes that is administered by the JAA of Europe. 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 a variety of 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 with the airworthiness requirements of 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. 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). By notice in the **Federal Register** (58 FR 13819, March 15, 1993), the FAA chartered a working group of industry and government structural loads specialists from Europe, the United States, and Canada. The harmonization effort has now progressed to a point where some specific proposals have been developed by the working group for the structural loads requirements of Subpart C of part 25, ''Structure,'' and these proposals have been recommended to FAA by letter dated February 2, 1995. This notice contains some of the proposals necessary to achieve harmonization for

the loads requirements of part 25. The ARAC working group is also considering other changes to the loads requirements that may become proposals for future rulemaking.

Certain technical differences in the part 25 and JAR–25 structural requirements have resulted in extensive revision or redevelopment of the criteria and methodology for specific requirements and some of those issues will be made the subject of separate proposals. In addition, some standards were already in the process of revision and improvement by the FAA when the harmonization effort was initiated. These changes have also been subjected to the harmonization process and will be proposed in separate notices.

This notice provides many of the proposals necessary for harmonizing the loads requirements of Subpart C of part 25. Many of the sections of part 25 that would be changed by this notice are also affected by an earlier related proposal ''Revised Discrete Gust Load Design Requirements,'' Notice No. 94–29 (59 FR 47756, September 15, 1994), and the proposals presented here were developed under the presumption that proposal would be adopted. The final rule text of Notice No. 94–29, if adopted, will be taken into account in the drafting of the final rule resulting from the proposals presented in this NPRM.

A comparison of the proposals in this NPRM with the current version of JAR–25 may not show identical wording between the proposed part 25 sections and the equivalent JAR–25 sections since, in many cases, proposals are being made to change both the FAR and the JAR versions at the same time. However, the proposals in this notice, when taken in context with the Notices of Proposed Amendment (NPA) currently proposed by the JAA and FAA Notice No. 94–29, will harmonize the bulk of the requirements of Subpart C of part 25 and Subpart C of JAR–25.

Discussion

The pitching maneuver resulting from the maximum deflection of the control surface is specified in § 25.331(c)(1). This maneuver is commonly known as the ''unchecked'' pitching maneuver since it is not arrested by an opposite control input. Differences in the terminology used in part 25 and JAR–25 have led to differences in the way the rule has been applied. The FAA has interpreted this as a maneuver that applies to the entire airplane and that must be carried out until the normal load factor is reached. Consequently, this maneuver could result in high pitching rates that may be important in determining gyroscopic loads resulting from rotating machinery such as propellers and large fans. The equivalent JAR paragraph, however, allows the maneuver to be terminated when the maximum tail load is reached, and the JAR rule has been interpreted as primarily applying to the determination of empennage loads.

It is proposed that § 25.331(c)(1) be revised to specifically allow the ''unchecked maneuver'' to be terminated when the tail load reaches a maximum. The maneuver and resulting loads would still be considered to apply to the entire airplane but, for the purposes of determining these airplane loads, the maneuver could be terminated when the maximum tail load is reached. However, for the purpose of determining the pitching rate used in calculating the gyroscopic loads of § 25.371, the rule would require the maneuver to be carried out until the maximum limit load factor on the airplane is reached. In this regard, another revision to § 25.371 is proposed as discussed below. These changes would have no impact on safe flight of the airplane, but would reduce the extent of calculations needed for determining the critical design loads.

Section 25.335(a)(2) would be revised by replacing the 43 knot speed margin between the design speed for maximum gust intensity (V_B) and the design cruising speed (V_C) with a variable margin based on the variation of gust speeds with altitude. This new margin would be approximately equal to 43 knots at sea level and would vary proportionally to the gust velocities specified in § 25.34(a)(4) of Notice No. 94–29, Revised Discrete Gust Load Design Requirements (59 FR 47756 at 47760, September 16, 1994). An alternative margin established by a rational investigation, provided for in the current rule, would no longer be allowed since the proposed criteria are considered to provide the minimum acceptable margin between V_B and V_C. Since this proposal provides specific speed margins equivalent to those currently accepted by rational analyses, there would be no impact on safety.

Section § 25.335(b)(2) would be revised by increasing the minimum speed margin for atmospheric variations from 0.05 Mach to 0.07 Mach. Studies by industry have shown that for a conventional aircraft, a margin of approximately 0.07 Mach is necessary to account for atmospheric disturbances. However, it is recognized that some aircraft may have aerodynamic characteristics that would allow a lower margin, provided a rational analysis of the effects of atmospheric disturbances is carried out for the airplane. The ARAC believes the 0.07 Mach margin to be the minimum safe margin unless a rational analysis of the response of the airplane to atmospheric disturbances justifies a lower value. The change is intended to provide a harmonized requirement since a parallel change is being proposed by the JAA in NPA 25C–260. This proposal would allow the minimum margin to be reduced to the level of the current rule (0.05 Mach) if a rational analysis warrants such reduction. Since margins as low as the current margins would still be allowed, if justified, this proposal would not have a significant impact on design. In addition to the amendments to part 25 proposed in this notice, an advisory circular (AC 25.335–1) is being proposed to ensure that the harmonized standards would be interpreted and applied consistently. This proposed AC would provide a means of demonstrating compliance with the provisions of part 25 related to the minimum speed margin between design cruise speed and design dive speed for transport category airplanes. Public comments concerning the proposed AC are invited by separate notice published elsewhere in this issue of the **Federal Register**.

Section 25.345(d) would be revised to specify more clearly the design conditions for wing flaps and similar high lift devices in the landing configuration. It would be revised to make it clear that this is a maneuvering flight condition and not an actual ground landing condition.

In Notice No. 94–29, Revised Discrete Gust Load Design Requirements (59 FR 47756 at 47760, September 16, 1994), the FAA proposed to remove the gust conditions from the yawing conditions specified in § 25.351. This notice proposes to further revise § 25.351, by allowing the 300-pound pilot effort load to be reduced linearly between the design maneuvering speed (V_A) and V_C to 200 pounds at V_C. The current § 25.351 requires 300 pounds to be withstood up to the design dive speed, V_D. Further clarifying changes are also proposed to eliminate confusion concerning the specific design cases required by this section. These proposals would make § 25.351 of part 25 equivalent to § 25.351 of JAR–25 as proposed by the NPA 25C–260. The change would have little effect on most transport category airplanes since they usually have devices that limit the effect of rudder control force on surface deflection. The control pedals and affected systems would still be designed to comply with the 300 pound condition at V_A. In any case, the requirement to

withstand 300 pounds at all speeds up to the maximum design dive speed is considered by the ARAC to be excessive and unrealistic for modern transport category airplanes. As reflected in the NPRM, the FAA agrees.

Seciton 25.363 concerning side loads on engine mounts would be revised to clarify that it applies to auxiliary power units as well as engines. This clarifying proposal would have no impact on safety because it is consistent with current design practice for transport category airplanes.

Section 25.371 concerning gyroscopic loads would be revised as noted above in the discussion of the pitching maneuver of § 25.331(c)(1). In addition, this notice proposes to require that the highest pitching rates derived from all rational flight and landing conditions be used to determine the gyroscopic loads. This proposal would provide some improvement in safety since the pitching rates required for calculating the gyroscopic loads would include landing conditions. Furthermore, to harmonize with the current § 25.371 of JAR–25, this section would be revised to clarify that it applies to auxiliary power units as well as engines.

Although § 25.415 ''Ground gust conditions'' is currently identical in part 25 and JAR–25, this notice proposes to increase the ground gust velocity from the current maximum of 88 feet per second (about 52 knots) to 65 knots. JAR–25 currently has a requirement (§ 25.519) that covers ground loads during jacking and tie-down. Section 25.519 of JAR–25 establishes a 65-knot wind speed for ground gusts during jacking and tie-down and specifically requires these gusts to be applied to the control surfaces, rendering the current § 25.415 of part 25 and JAR–25 ''Ground gust conditions'' inconsistent with § 25.519 of JAR–25 and inconsequential for design. The FAA has a new requirement similar to § 25.519 of JAR–25. This requirement, § 25.519 (59 FR 22100, April 28, 1994), is equivalent to the § 25.519 of JAR–25 except that the control surfaces are not specified in § 25.519. The FAA has determined that control surfaces should continue to be addressed only under § 25.415 so this section is being revised to achieve the same effect as the § 25.519 of JAR–25 by incorporating the 65-knot wind speed into § 25.415. The formula presented in § 25.415 would also be simplified in that the 65-knot wind speed would be contained within the numerical constant (14.3) for the formula used to calculate the ground gust load. These changes are made for the purpose of clarity and harmonization and would have not impact on safety.

This notice proposes to revise and reorganize §§ 25.473, 25.479 and 25.481 and 25.485 in order to clarify the requirement that structural dynamic effects in the landing conditions be considered and to clarify which requirements are full airplane rational design conditions and which are static design loading cases. These proposals would provide identical language for these sections of part 25 and JAR–25. The requirement for consideration of dynamic landing conditions is currently expressed in § 25.473(e) of JAR–25 by specific language, and in § 25.305(c) of the FAR by general language. The change proposed in this notice would make it a specific requirement in part 25.

This notice proposes to add a new requirement in § 25.479 to consider lateral drift in the landing condition. The current JAR requirement (§ 25.479(c)(4)), which covers this subject, would be incorporated into paragraph (d)(2) of the proposed § 25.479. This is a rational airplane load requirement that would be in addition to the requirements of § 25.485 that include specified side loads on the landing gear. These proposed requirements would have no impact on safety since they are equivalent to existing requirements and are consistent with the current design practice for transport airplanes.

Although the language for § 25.483 of part 25 and § 25.483 of JAR–25 are currently identical, differences in interpretation have occurred. This notice proposes to clarify the language to define the requirement as a ''one gear'' landing condition instead of a ''one wheel'' condition in order to resolve confusion that arises in treating multi-wheeled landing gear units. The rule would be retitled ''One gear landing'' and the language in the rule would be revised to reflect this terminology. An identical change to JAR–25 will be proposed.

Section 25.491 would be revised to eliminate differences in interpretation and to clarify that it applies equally to takeoff, taxi and landing roll by changing the title to ''Taxi, takeoff and landing roll.'' In addition, the reference to § 25.235 would be eliminated and the language of § 25.235 would be incorporated directly into the rule.

The requirements concerning nose-gear steering are different between part 25 and JAR–25 in that § 25.499(e) of JAR–25 requires a factor of 1.33 on the maximum steering torque and also for the vertical ground reaction that is combined with the steering torque. This factor is applied in addition to the 1.5 safety factor normally applied to limit loads. Part 25 provides the same requirement without the additional 1.33 factor.There is merit in considering the maximum steering torque in combination with a ground reaction that is greater than the static one, however there is insufficient justification for an additional factor on the maximum steering torque. Therefore the rule would be revised to include a 1.33 factor for the static ground reaction. A related JAA proposal would remove the 1.33 factor from the maximum steering torque in § 25.499(e) of JAR–25, resulting in an identical requirement. This proposal would result in an increase in the level of safety provided by part 25.

Section 25.561(c) would be revised to be equivalent with § 25.561(c) of JAR–25. This would require the application of a 1.33 factor to the loads used to design the restraints of items of mass if the failure of those items could injure occupants in an emergency landing. This would also incorporate a provision that the 1.33 factor applies only to items of mass that are frequently removed during normal operation. This change would provide an increase in the level of safety provided by part 25.

Regulatory Evaluation Summary

Preliminary Regulatory Evaluation, Initial Regulatory Flexibility Determination, and Trade Impact Assessment

Proposed 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) Would 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 the Department of Transportation's (DOT) Regulatory Policies and Procedures; (3) would not have a significant impact on a substantial number of small entities; and (4) would not constitute a barrier to international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

Depending on airplane design, the proposed rule could result in additional compliance costs for some manufacturers. If manufacturers choose to design to and justify a V_D–V_C margin of 0.05 Mach, there would be an increase in analysis costs of approximately $145,000 per certification. The proposed requirement in § 25.473 to consider structural flexibility in the analysis of landing loads and the proposed 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 would be negligible.

The proposed rule would also result in cost savings. Proposed 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 proposed 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 proposed § 25.351. The FAA solicits information from manufacturers and other interested parties concerning these and other benefits of the proposed rule.

The primary benefit of the proposed rule would be cost savings associated with harmonization of part 25 with JAR–25. In order to sell airplanes in a global marketplace, manufacturers usually certify their products under part 25 and JAR–25. Harmonizing design load requirements would outweigh any incremental costs of the proposal, resulting in a net cost savings. These savings would 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 United States.

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

The FAA solicits information from manufacturers and other interested parties concerning these and other benefits of the proposed rule.

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 agencies to determine whether rules would have ''a significant economic impact on a substantial number of small entities,'' and, in cases where they would, to conduct a regulatory flexibility analysis. Based on FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, the FAA has determined that the proposed revisions would not have a significant economic impact on a substantial number of small entities because there are no small manufacturers of transport category airplanes.

International Trade Impact Assessment

The proposed rule would 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 United States. Because the proposed rule would harmonize with the JAR, it would, in fact, lessen restraints on trade.

Federalism Implications

The regulations proposed herein would not have substantial direct effects on the states, on 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 proposal does not have sufficient federalism implications to warrant the preparation of a Federalism Asssessment.

Conclusion

Because the proposed changes to the structural loads requirements are not expected to result in any substantial economic costs, the FAA has determined that this proposed regulation would not be significant under Executive Order 12866. Because there has not been significant public interest in this issue, 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, if promulgated, would 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 would 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 Proposed Amendments

Accordingly, the Federal Aviation Administration (FAA) proposes to amend 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. App. 1347, 1348, 1354(a), 1357(d)(2), 1372, 1421 through 1430, 1432, 1442, 1443, 1472, 1510, 1522, 1652(e), 1655(c), 1657(f), 49 U.S.C. 106(g).

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

§ 25.331 General.

* * * * *

(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 § 25.333(b)), or the resulting tailplane normal load reaches its maximum, whichever occurs first, need not be considered.

* * * * *

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.

(3) * * *

(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 be 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.

* * * * *

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 1.5g 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 or 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 overwing 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 title 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 a 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) * * *

(1) * * *

(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,

$H=14.3\ KcS$,

where—

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 25% 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 § 25.25.473(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 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—

* * * * *

12. Section 25.483 is amended by revising the title, 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 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) 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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