Part Binder
4/1/70

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Changes to FAR Parts 1 and 25

Title 14—AERONAUTICS AND SPACE

Chapter I—Federal Aviation Administration, Department of Transportation

[Docket No. 9079; Amdt. Nos. 1–16, 25–23]

PART 1—DEFINITIONS AND ABBREVIATIONS

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

Transport Category Airplane Type Certification Standards

The purpose of these amendments is to improve the airworthiness requirements applicable to the type certification of transport category airplanes.

These amendments are based on, and reflect comments from interested persons concerning the notice of proposed rule making published in the FEDERAL REGISTER (33 F.R. 11913) on August 22, 1968, and circulated as Notice 68–18.

Notice 68–18 contained over 100 proposed amendments to Parts 1 and 25, and approximately 300 comments were received in response to the notice. Based upon these comments and upon further review within the FAA, a number of substantive changes have been made to the proposed rules and these changes are discussed hereinafter. In addition, a number of the proposals have been withdrawn for further study and future rulemaking action. Editorial revisions have also been made to more clearly state the intent of the requirements as expressed in the explanation. A number of comments recommended changes which went beyond the scope of Notice 68–18. These comments are appreciated and consideration will be given to them in connection with future rulemaking actions. Interested persons have been afforded an opportunity to participate in the making of these amendments, and due consideration has been given to all matters presented; however, in view of the number of comments received only the most pertinent ones are discussed herein. Except as modified by the following discussion; the reasons for these amendments are those contained in the notice.

The notice proposed to amend the control system requirements set forth in §§ 25.21, 25.671, 25.677, 25.695, and 25.701. One comment suggested that the proposed amendment to § 25.21(e) should be revised to delete the introductory clause so that compliance with the proposed requirements would be required whether or not a stability augmentation device is needed in showing compliance with the flight requirements. While this appears to have merit, it goes beyond the scope of the notice and requires further evaluation. However, it will be considered in future rulemaking action. On the other hand, the FAA agrees that the detailed and complex design requirements proposed in § 25.21(e) (1) through (3) should be transferred to a new section in Subpart D which deals specifically with matters concerning design and construction, and these requirements have been set forth in a new § 25.672. Several comments pointed out that the pilot alerting type of warning proposed in § 25.21(e)(1) would be needed only for those failures of the stability augmentation system or any other automatic or power-operated system that could result in an unsafe condition if the pilot were not aware of this failure. The FAA agrees and the proposal as now set forth in new § 25.672 has been revised accordingly. The proposal would have required that the pilot be able to deactivate or override the stability augmentation device or any other automatic or power-operated device by means of normal movement of the flight controls without exerting excessive strength. However, as noted by commentators, the proposal does not take into consideration the new airplanes with fully power operated redundant systems in which it is not feasible to deactivate or override the entire system. Therefore, the proposal has been changed to require the deactivation of the system, or the failed portion thereof, or the overriding of the failure by movement of the flight controls. In addition, the FAA agrees with a further comment that it should be possible to deactivate the system, or to override the system by movement of the flight controls in the normal sense, without requiring exceptional piloting skill or strength, and the proposal has been changed accordingly. In response to several comments, the FAA agrees that the proposed change to § 25.701 is not necessary in its entirety since the requirements set forth in § 25.671(c), as amended herein, are appropriate to cover the lift and drag control systems other than flaps. Therefore, the current provisions of § 25.701 are retained with the exception of the requirements of current paragraph (b) which have been deleted and a new paragraph has been added based on paragraph (b)(3) of the proposal to provide for unsymmetrical load conditions resulting from jamming of the flap surfaces on one side of the airplane.

The notice proposed to amend the requirements of § 25.145(c) concerning longitudinal control during flap retraction. Several comments stated that the proposal to limit the application of power to "maximum continuous power" is unduly restrictive and that there is no need to reserve the additional power between maximum continuous power and takeoff power for contingencies since the proposal requires compliance at critical combination of weights and altitudes. The FAA agrees and the proposal has been changed to provide for the application of takeoff power, taking into account the critical engine operating conditions. In this connection, it should be noted that from a controllability standpoint (i.e., pitch-up) takeoff power could be more critical. Other comments point out that the proposal would allow partial retraction of high-lift devices to be any amount of retraction that could be normally controlled by the pilot regardless of gate or detent position. This was not the intent of the proposal and it has been changed to make it clear that partial retraction of the high-lift devices is to the gated control position which has a design feature to prevent inadvertent operation beyond that position. In this connection the word "detent(s)" has been deleted since it could be interpreted to permit a simple notch in the control quadrant rather than a more sophisticated control (generally referred to as a gated position) having a rather complex notching or channeling provision through which the control lever must move. The word "pilot" has also been deleted so that the design motion criteria of the gated control position will be applicable to all high-lift device controls. Another comment expressed concern that the explanation in Notice 68–18 implies that the speed $1.2V_S$ would become a new lower limit speed for go-around. No such implication was intended. The intent of the rule is to assure that the minimum inflight go-around speed for turbojet powered airplanes is related to realistic landing touchdown speeds.

The proposed amendment to § 25.161 (c)(2) to require the longitudinal trim requirements of that subparagraph to be met at the "most critical" center of gravity has been changed to the "most unfavorable" center of gravity since the latter term is generally used in other flight requirements with respect to the center of gravity position. It should also be noted that while Notice 68–18 referred to § 25.161(c)(2)(ii), the requirement applies to all of paragraph (c)(2).

One commentator objected to the proposed amendment to § 25.251(c) stating that the term "perceptible" was not discussed in the explanation in Notice 68–18 and that it is a meaningless term. The FAA does not agree. Perceptible buffeting means any buffeting which comes within the range of human senses. The FAA considers that continuous perceptible buffeting should not be permitted for cruise flight since pilots use buffeting as a warning means. The proposal has been changed, however, in view of other comments received and upon further consideration by the FAA, to limit the proposed requirement to the cruise configuration. The requirements of current paragraph (c) for normal flight conditions other than for straight flight in the cruise configuration are retained. Proposed paragraph (d) is renumbered as paragraph (e) and the phrase "except that load factors greater than the structural limitation need not be investigated" has been deleted as superfluous and to eliminate any suggestion that it is necessary to investigate aircraft characteristics up to limit load factors to determine buffet boundaries.

The notice proposed to amend § 25.253 to cover upsets caused by activation of the longitudinal trim surfaces due to a malfunction in the trim control system or to improper use of the trim control by the pilot in turbulence. A number of comments were received on this proposal, including comments which raised issues which are beyond the scope of the notice. Upon further consideration of the proposal and in view of the comments

(As published in the Federal Register [35 F.R. 5665] on April 8, 1970)

received, it is withdrawn for further study and future rulemaking action.

One comment stated that the proposed amendment to § 25.301(b) should be withdrawn and that the need for flight load measurements on a particular airplane design be established by special requirements during the type board meetings. In response to these comments it should be noted that the proposed amendment permits this procedure to be used to determine when flight load measurements are necessary. The amendment is adopted as proposed.

One comment suggested that the words "external loads" in proposed § 25.303 should be replaced with the words "internal loads" to be consistent with § 25.301(a). The FAA disagrees since § 25.301 as well as all of the other structural requirements are expressed in terms of external loads. The amendment is adopted as proposed.

With respect to proposed § 25.305(b), one commentator stated that to include the effects of ultimate deformations in static tests to ultimate loads is not consistent with industry practice and that this requirement should be deleted. The FAA disagrees, since it would be unrealistic to hold the structure to its limit deformation while the load is increased from limit load up to ultimate load. The commentator also stated that proposed § 25.305(b)(2) is covered by paragraph (b)(3), and that paragraph (b)(2) should be deleted because it involves complex analysis procedures. However, since paragraph (b)(2) is merely one of three alternative procedures available to the applicant, it is being retained for those who may choose to employ precise in lieu of conservative procedures. Another commentator questioned whether the continuous turbulence analysis proposed under § 25.305 (d) applies only to flight structure. The proposal applies not only to flight structure, but also to seat strength or to mass items which could cause injury to occupants. Several additional commentators contend that the method for evaluating dynamic response of an aircraft to continuous gusts is well known, while the continuous gust model of turbulence is not. It was also contended that the gust model is probably not reliable enough to make positive design decisions. Thus, these commentators consider it premature to make the continuous turbulence method a mandatory requirement. The FAA disagrees. The addition of a continuous turbulence analysis to the already required static discrete gust analysis is a necessary step forward in flight structure safety. Although this type of analysis is still developing, the technique has been and is presently being applied to the design of transport airplanes. As more knowledge becomes available, the analysis techniques can be refined, but in the meantime, the maximum degree of safety available within the state-of-the-art should be designed into airplanes. Accordingly, § 25.305(d) is adopted as proposed.

The notice proposed to add a new paragraph (d) to § 25.307 to require that appropriate material correction factors be applied to test results when static or dynamic tests are used to show compliance with § 25.305(b). However, these factors do not have to be applied if the structure or part thereof has fail-safe features. One commentator noted that the term "fail-safe" has a special meaning within the context of structural fatigue and is directly related to the crack propagation and residual strength characteristics of a structure. Thus, with the use of particular materials, a single element could constitute a "fail-safe" structure. The FAA agrees with this comment and has clarified the final rule accordingly.

It was suggested that the proposed amendment to § 25.331(a)(3) does not cover manually operated control systems and does not consider that pilot effort governs the rate of control displacement. The intent of the revision to § 25.331(a)(3) is to consider in the design of the aircraft the maximum rate of control displacement which is consistent with normal pilot effort and normal control system function. The limits of pilot effort are contained in § 25.397. The proposed requirement applies to all types of control systems (from manual to fully powered) and is consistent with the present industry practice of designing to the actually available rates of control surface displacement. This has been made clear in the final rule. In addition, the FAA has withdrawn its proposed amendment to paragraph (a)(4) concerning maneuvers for out-of-trim conditions since the related proposal set forth in § 25.253 has been withdrawn.

The proposed amendment to § 25.351 (a)(1) has been changed to make it clear that the control stop is the stop located at the control surface and that the maximum rudder deflection is limited by the control surface stop or by a 300-pound rudder pedal force, whichever is less, as specified in the explanation in the notice.

The notice proposed to transfer the same design dive speed requirements now contained in § 25.1505 (b) and (c) to § 25.335(b) in order that these requirements would be set forth in the appropriate subpart of the regulations. However, a number of comments recommended substantive changes to the proposal. Since these changes are outside the scope of the notice, they will be considered in connection with future rulemaking. The amendment is adopted as proposed.

The proposed amendment to § 25.427 has been revised, in response to a comment, to make it clear that it is necessary to design the specified empennage arrangements to both the lateral and vertical gust flight conditions, not in combination, but considered separately. Moreover, this also applies to the prescribed maneuver conditions.

It was proposed to amend paragraph (b) of § 25.471 by adding a new sentence to provide that lateral displacements of the c.g. from the airplane centerline resulting from passenger or cargo disposition which would not cause more than a 3 percent increase of the ground loads under symmetrical loading conditions need not be considered in determining the data required by this section. However, § 25.471(b) has been changed consistent with the explanation in the notice to make it clear that the 3 percent increase may be allowed only in those cases where the increase is the result of variations in lateral c.g. locations resulting from random type loadings.

The notice proposed to amend the hull and main float landing conditions specified in § 25.529(a)(1) to require only a single step limit water reaction, and to amend the related provisions of § 37.192 (TSO C27). Upon further consideration of the proposal and in view of comments received it appears that the manner of applying the load to the hull bottom was not completely defined in the proposal and could produce step load locations unreasonably forward of the step location. The proposal is therefore withdrawn for further study and future rulemaking action.

The notice proposed to amend § 25.571 to provide an adequate margin for the fatigue evaluation of flight structures. One commentator stated it assumed that the 1.15 factor would also apply to pressurized structures and that it considered this to be too severe an overall factor and should be applied only to discrete load members. The FAA does not agree that the 1.15 factor is excessive for dynamic effects, especially as the manufacturer has the option to make a dynamic test in lieu of using the 1.15 factor. The proposal has been changed to make it clear that the 1.15 factor applies to pressurized as well as unpressurized structures. The FAA does not agree with the statement of other commentators that the 1.33 factor is too high or that proposed § 25.571 (e)(2) is inconsistent with the ultimate static strength requirement in § 25.365 (d). A factor of 1.33 applied to the normal operating (internal plus external) pressure (not maximum relief valve setting) is necessary to account for variation in cabin pressure and strength, and to provide a margin over the normal operating loads in the partially failed condition. The FAA never intended that fail-safe loads would be the normal operating loads as reflected by the current requirements of § 25.571(c). Furthermore, the FAA does not agree that the proposed additional residual static strength margin would have no effect on failure of the pressure shell or that proposed § 25.571 (e)(2) is inconsistent with current § 25.-365(d). Proposed § 25.571(e)(2) covers ultimate loads in the damaged condition while § 25.365(d) covers limit loads in the undamaged conditions and proposed § 25.571(e) has been changed to make this clear.

The notice proposed to add a new § 25.581 to require lightning protection of the airplane structures. The suggestion of one commentator that the rule should require compliance with both subparagraphs (1) and (2) of paragraph (b) in all cases cannot be adopted since, for some purposes, it is necessary to electrically isolate some exposed parts to enable them to function. One commentator

expressed concern as to the adequacy of the proposed protection against high induced current from a lightning strike causing arcing within the airplane which could result in loss of essential systems, and also suggested the word "catastrophic" be changed to "hazardous". On the other hand another commentator suggested that the proposal was too strict in that it did not take into account lesser protection requirements for components located in areas with low probability of strike attachment such as classification zone three in Advisory Circular 20–53. AC 20–53 is concerned with fuel system lightning protection and the zone classifications in that Advisory Circular are not considered generally applicable to airframe components when the hazard may be due to a high current flow in a zone even though the point of stroke attachment may be in another zone. The FAA believes that the proposed rule will provide the desired protection insofar as it is possible within the present state-of-the-art. The rule is adopted as proposed, except that the title has been changed to read "Lightning Protection" since the requirement covers more than structures.

The proposal to amend § 25.607 has been changed to make it clear that it applies only to "removable" fasteners; that the "primary control system" is the "yaw, pitch, and roll control systems"; and that the control capability requirement is limited to those fasteners whose failure could result in a reduction in control capability below that required by Subpart B of Part 25. The FAA does not agree with the statement of one commentator that the proposal is redundant with the proposed amendment to § 25.671, since a reduction in control capability would be permitted under § 25.671.

The notice proposed to amend § 25.611 to require accessibility for the inspections and maintenance necessary for continued airworthiness. Commentators recommended that the proposal be changed to make it clear that the inspections are not limited to visual means, that nondestructive inspection aids should be permitted, and that accessibility should be further defined. The intent of the proposal is to require means (primarily access) adequate to insure that it will be practical to carry out the necessary inspections. Furthermore, the inspection means or access provided should be practical for the inspection interval required for the particular item involved, and easy access for direct visual inspections of critical structures is necessary for an adequate inspection program. The use of nondestructive inspection aids such as X-ray, eddy current, and ultrasonic is considered acceptable where it is impractical to provide means for direct visual inspection if adequate procedures are developed, and it is shown that the inspection is effective. The proposal has been changed accordingly.

A suggestion was made that proposed § 25.615 should cover materials other than those listed in MIL–HDBK–5. However, it should be pointed out that this is unnecessary, since § 25.613 (a) and (b) cover the strength properties and design values for materials other than those listed in the military specifications. The amendment is adopted as proposed.

With respect to the proposed change to § 25.629, one commentator expressed concern that the proposal would omit the effects of Mach numbers greater than one when M_D is less than one. However, the proposed flutter instability margin is based on damping criteria when M_D is less than one and when 1.2 M_D is greater than one as set forth in proposed paragraphs (b) (1) (i) and (ii). The FAA considers that this criteria ensures an adequate level of safety and the added burden of considering the effects of supersonic flight Mach numbers is not justified for airplanes which fly at subsonic speeds. It was also recommended that V_D/M_D in proposed paragraph (a) of § 25.629 should be changed to "V_{DF}/M_{DF}" to make it consistent with the speed definition and to require flight flutter tests up to the maximum demonstrated flight speed. The FAA agrees, since V_{DF}/M_{DF} can be less than V_DM_D and by definition it is the highest demonstrated flight speed for the type design. This change has been incorporated into the final rule. Another comment concluded that while the proposed revision to § 25.629 is an improvement, it is more arbitrary than the current rule. The FAA does not agree that this proposal is more arbitrary than the current rule. Under the proposal, airplanes which have an M_D near Mach one are treated as a special case based on compliance with damping criteria, instead of a specified speed margin. In addition, § 25.629(a)(3) has been revised to make it clear that full scale flight flutter tests are required for a modification to the type design on the same basis as for a new type design.

One of the comments recommended that both the windshield and the wing should be included in the bird strike damage criteria of § 25.631. Moreover, it was suggested that the use of an 8-pound bird in this requirement may not be realistic and that a larger sized bird should be considered. Other comments suggested that only smaller sized birds be considered. The FAA does not agree that the wing and windshield should be included in this proposal. Service experience has not shown that the current windshield strength requirements for bird strikes in § 25.775 are inadequate or that a special investigation of wing structures for resistence to bird strikes is necessary. Moreover, the bird strike records indicate that encounters with birds weighing more than 8 pounds are a rarity and that on the basis of probability, 8 pounds is a reasonable value. In response to another comment, however, § 25.631 has been changed to make it clear that compliance with this requirement by providing redundant structure and protected location of control system elements or protective devices is acceptable. Moreover, the use of data on airplanes having similar structural design is permitted in showing compliance with this requirement.

One of the comments noted that the proposed change to § 25.683 does not indicate whether the 80 percent of the limit load on the control system is a dynamic load or takes into account the additional control system loads due to structural deflection or whether this includes the powered portion of a powered control system. However, other provisions in Part 25, namely, §§ 25.301 and 25.305, do require that the determination of design limit loads include consideration of dynamic effects and structural deflections. Moreover, the amendment to § 25.671 requires that adequate proof be provided to show that the control system can be operated sufficiently for continued safe flight and landing after any single failure in the control system. This will include the effects of the loads resulting from the failure. An additional comment stated that the wings and empenage should be subject to limit loads during the control system operation tests. The FAA does not agree that such a requirement is necessary because under § 25.305 (a) it must be shown that the structure deflections under limit loads will not interfere with safe operation of the airplane. The amendment is adopted as proposed.

The notice proposed to amend § 25.699 (a) to require a means to indicate to the pilots the positions of the lift or drag devices on each side of the airplane or to indicate any unsymmetrical system operation to the pilots. Numerous comments were received questioning the intent of the proposal and as to when position indicators for the left or drag devices are required. The rule as adopted requires an indicator for each lift or drag device having a separate control in the cockpit. An indication of unsymmetrical operation or other malfunction in the lift or drag device systems must be provided when such indication is necessary to enable the pilots to prevent or counteract an unsafe flight or ground condition.

It was recommended that the proposed § 25.721 be revised to cover failure modes of the landing gear in all directions and ground operating conditions as well as takeoff and landings. This rule is based on the operating history of transport category airplanes which shows that the predominant failure modes act vertically or fore and aft. Insofar as the recommendation covers other failure modes it is beyond the scope of this notice. However, the FAA will study the matter further in connection with Notice 69–33 and the amendment is adopted as proposed.

In response to a comment, proposed § 25.723(b) now refers to "airplane lift" rather than "wing lift".

Concerning proposed § 25.729, it was asserted that there are no gyroscopic loads induced when the wheels stop rotating prior to gear retraction; consequently, the commentator suggested that the proposal include a statement that gyroscopic loads need not be considered when the design incorporates devices to stop wheel rotation prior to gear retraction. While the FAA agrees with this statement, the proposal need not be changed since it is inherent in the proposal that any particular load which

becomes zero or insignificant during any portion of the retraction or extension cycle need not be considered during that portion.

It was recommended that the proposed amendment to § 25.733(a) should be changed to delete the words "critical condition" to avoid the interpretation that the tire placard speed could not be exceeded for an emergency condition such as a high weight, flaps-up landing. The FAA does not agree. A tire speed rating should not be exceeded under any conditions considered critical regardless of operational envelope. Another comment recommended that in addition to tire speed rating, the design skid depth must also be met to provide proper tire installation. The addition of a skid depth requirement in § 25.733 would require further study and is beyond the scope of this notice. However, it will be evaluated in future rulemaking actions. After further consideration, the FAA considers that reference to the "Tire and Rim Association" in § 25.733(a) is not appropriate since it implies that no further tire qualification beyond assignment by the "Tire and Rim Association" is required. This, of course, is not the case and the proposal has been changed to refer only to approval by the Administrator. In addition, the proposal has been changed to make it clear that a "suitable tire" means a tire of "proper fit".

The notice proposed to add a new § 25.773(c) to require a means to prevent internal windshield fogging in the pilot compartment. One comment pointed out that the use of the words "windshield fogging" in the proposal could be interpreted as requiring only forward visibility, whereas "paragraph (a)" provides for pilot compartment visibility. The FAA agrees and the proposal has been changed to make it clear that it includes windows as well as windshields and covers fogging from all internal and external ambient conditions, including precipitation conditions, in which the airplane is intended to be operated. Another commentator urged that the proposed rule should not require defogging means for inherently fog-free panes or for transparent areas not needed in the conduct of certain operations. Areas which are shown to be inherently fog-free comply with the proposed rule. Furthermore, the FAA does not consider it practical to establish boundaries of visibility for the different stages of flight and ground operations.

In response to numerous comments, the proposed amendment to § 25.863 has been substantially revised. A number of comments objected to the proposed paragraph (a) which would require fire or overheat detectors and fire extinguishing means in specified areas of the airplane. A study of the research conducted on this matter and subsequent service experience has shown that other methods of fire protection may be equally or more effective and that each area should be carefully examined with respect to the potential sources of combustible materials and ignition and appropriate fire protection means provided to prevent the occurrence of a catastrophic fire. Therefore, the proposal has been relaxed by withdrawing paragraph (a). However, proposed paragraph (b) of the notice has been retained as the new paragraph (a); stating the basic objectives of (1) preventing the ignition of flammable fluids and (2), minimizing the hazards in the event an ignition does occur. In addition, a new paragraph has been added which lists those factors (among others) that the applicant must consider in showing compliance with these objectives. A requirement for a means to alert the crew when an action by the crew is necessary to counteract or prevent a fire has been incorporated in a new paragraph (c) in view of the withdrawal of the proposed paragraph (a). A comment was also received stating that the proposal to require fire detectors and extinguishers be extended to include Class "D" cargo compartments. The FAA is not in a position to respond to this comment since the research program referred to in Notice 68-18 is still being evaluated. However, it should be noted that Notice 69-33 includes a proposal to require cargo compartment linings to have improved fire resistance characteristics.

In response to comments received, the proposed requirement of § 25.865 has been changed to make it clear that it is only those flight controls, engine mounts, and other flight structures which would be damaged by the "effects of fire" that need be constructed of fireproof material or shielded. In response to another comment, § 25.865 has been changed to make it clear that it is the "essential" flight controls with which the regulation is concerned.

One comment objected to the proposal to add a new § 25.901(c) to require a powerplant installation fault analysis on the basis that the requirement is covered in the proposed amendment to § 25.1309. The FAA agrees that the requirement is adequately covered in § 25.1309 and the proposal has been changed to make it clear that compliance with § 25.1309 is required.

The purpose of the proposed amendment to § 25.903(d) is to ensure that, for turbine engine installations, design precautions are taken to minimize the hazards to the airplane in the event of an engine rotor failure or of a fire originating in the engine which burns through the engine case. Comments were received objecting to the proposed words "design precautions to minimize hazards to the airplane" in that they would be subject to interpretation. However, this wording is contained in the current regulations and no change to these words or their meaning is intended. Another comment stated that containment precautions and engine integrity should be the engine manufacturer's responsibility and covered under Part 33. The FAA does not agree. Service experience has shown that additional safeguards in the installation of the engine is necessary over and above those provided by Part 33 to minimize hazards resulting from engine rotor failure or engine case burn through. The amendment is adopted as proposed.

The notice proposed to amend § 25.951 (b) to require the fuel system to be arranged so that hazardous amounts of air cannot be introduced into the system by any fuel pump. Several comments were received questioning the meaning of the word "hazardous". The FAA agrees that the word "hazardous" with respect to air in the fuel system is not sufficiently clear. In order to provide the necessary clarification, the word "hazardous" has been deleted and the rule now specifies that any air which is introduced into the system may not result in engine flameout or power interruption for more than 20 seconds.

The notice proposed to amend § 25.959 to require that a determination be made of the unusable fuel quantity for each fuel tank and its fuel system components at which the first evidence of engine malfunction occurs under certain conditions. One comment suggested that the proposal should be based on system malfunctioning rather than engine malfunctioning. The FAA disagrees. The important factor in determining unusable fuel is the time at which the engine malfunctions and present day aircraft have been type certificated on this basis. The amendment is adopted as proposed.

The notice proposed to amend the fuel system hot weather test requirements of § 25.961(a)(5) to require the fuel temperature for the climb test to be accomplished at the highest temperature selected by the applicant for the operation of the airplane, but not less than 110° F. Upon further consideration of the proposal in the light of comments received, the FAA has determined that the current requirement that the fuel temperature may not be less than 110° F. is adequate and the proposal is withdrawn. Furthermore, the proposed amendment to clarify the requirement of § 25.961(a) concerning the critical pump inoperative condition has been withdrawn for further study and future rulemaking action.

There was an objection to proposed new § 25.994 which would require fuel system components in an engine nacelle or in the fuselage to be protected from damage which could cause the release of fuel as a result of a wheels-up landing. One commentator stated that the proposal is unreasonable for airplanes that do not have aft mounted engines and that the proper use of the fuel shutoff valves required by § 25.1189 would be a more rational method of achieving the intent of the proposal. The FAA disagrees. The criteria in § 25.1189, applicable to a fuel shutoff valve is inadequate to achieve the purpose intended by proposed § 25.994. Furthermore, the use of fuel shutoff valves in lieu of protective structural design would not provide an adequate level of safety. The amendment is adopted as proposed.

The notice proposed to amend § 25.997 (a)(1) to require a fuel strainer or filter only between the tank outlet and the engine-driven positive displacement pump inlet when an engine-driven positive displacement pump is used. One commentator stated that a requirement for a strainer to protect all types of positive displacement pumps appears to be

extreme. The FAA does not agree. The proposal merely relaxes the present requirement by eliminating the requirement for a filter between the tank and the pump when the pump is other than a positive displacement type. Service experience has not shown that further relaxation is warranted and the amendment is adopted as proposed.

It was proposed to amend § 25.1091 (d) (2) to require in part that airplanes be designed to prevent water or slush on the runway and any other airport operating surface from being directed into the engine air inlet ducts in hazardous quantities. One comment stated that the proposal could have a restrictive effect on the designer's freedom of choice of aircraft layout without increasing safety. Another comment suggested that the proposal be revised to give the applicant the alternative of establishing operating limitations setting forth the depth of water or slush in which the airplane could be operated and a limitation on the speed range in which it would be permissible to operate thrust reversers. The FAA considers that in this case the suggested operating procedures or limitations would not compensate for a lack of the proposed design requirements. Experience has shown that it is possible to design and prevent such ingestion and the amendment is adopted as proposed.

The notice proposed to amend § 25.1093 to cover turbine engine ice protection. Upon further consideration of the proposal and in view of comments received, the FAA has determined that the proposal should be withdrawn for further study.

The notice proposed to add a new § 25.1103(d) applicable to induction system ducts. The proposal would require that, for turbine engine bleed air systems, no hazard may result if a duct rupture or failure occurs at any point between the engine port and the airplane unit served by the bleed air. One comment considered the use of the words "no hazard" as unrealistic and an oversimplification of a complex situation. Commentator suggested that the proposal should be revised to specify acceptable limits on heat exposure in the various areas of the airplane where duct rupture or leakage could occur. The FAA does not consider it practicable to establish numerical limits or a specific number for temperature and pressure because of the numerous variable factors involved. Each airplane must be evaluated on an individual basis. Furthermore, the proposal has been applied as a special condition with no apparent difficulty. The amendment is adopted as proposed.

The notice proposed to amend § 25.1143(e) to require each power or thrust control to have a means to prevent inadvertent movement of that control into any position that will reduce the fuel flow to the engine(s) below the fuel flow necessary for normal flight idle operations. The proposal would also require a positive lock or stop at the flight idle position. Several commentators objected to the use of the words "flight idle" and contended that they are improper in that they could lead persons to believe that any position below the flight idle position results in a fuel cutoff. The FAA agrees. The intent of the proposal is to preclude inadvertent movement of the control into the cutoff position and to require a separate and distinct motion on the part of the crew to shut down the engine, which may be accomplished by means of shutoff levers. The proposal has been revised accordingly.

Proposed § 25.1189(a)(2) has been changed to make it clear that a shutoff means is not required for oil systems for turbine engine installations in which all external components of the oil system, including the oil tanks, are fireproof.

The notice proposed to add a new § 25.1189(g) to require each flammable fluid shutoff valve and control to be fireproof or to be located so that exposure to fire will not affect its operation. In response to comments received and consistent with the intent of the notice, the proposal has been changed to make it clear that it applies only to flammable fluid shutoff means and controls located in a fire zone or that would affected by a fire in a fire zone. The proposal as revised is adopted as an amendment to current paragraph (d).

The notice proposed to add a new § 25.1192 to require an engine accessory section diaphragm for reciprocating engines. As a result of this amendment, § 25.1181(a)(3) is amended to except reciprocating engines from the requirements of § 25.1181(a)(3).

The proposed amendment to § 25.1195 (b) has been changed to make it clear that each of the two discharges of the fire extinguisher system must produce adequate agent concentrations to extinguish fires.

The amendment to § 25.1203 changes the words "fire detector" to "fire or overheat detector". It should be noted that while TSO C-11(d) is titled "fire detectors", it is equally applicable to overheat detectors.

The notice proposed to amend the flight and navigation instruments requirements of § 25.1303. Upon further consideration, the FAA considers that proposed paragraph (b)(1) should refer to an "airspeed indicator" rather than an "airspeed indicating system" as proposed. Since this requirement is concerned with flight and navigation instruments, the FAA agrees that the term "airspeed indicator" is more appropriate here. One comment contended that the requirement in proposed paragraph (b)(4) for a rate-of-turn indicator should be deleted because the state-of-the-art in modern aircraft instrument systems has negated the need for a rate-of-turn indicator. The FAA agrees that the rate-of-turn indicator may be omitted if the airplane has a third attitude indicator. This change has been incorporated by a recent amendment to Part 25 (Amendment 25-22, 35 F.R. 304). It was also recommended that if the rate-of-turn is not deleted, the requirement should be transferred to proposed paragraph (a) so that it need only be visible from each pilot station but not installed at each pilot station. The FAA does not agree. Gyroscopic rate-of-turn instruments are still used occasionally as direct flight instruments in the sense that information displayed is used in a positive feedback manner by whichever pilot is manipulating the controls. For this reason, this instrument should be installed at each pilot station. The amendment is adopted as proposed except that subparagraph (b)(1) has been changed to refer to an "airspeed indicator".

A number of comments suggested that several of the required powerplant instruments set forth in the proposal to amend § 25.1305 be specified in more detail. However, the instruments are defined in objective terms in order to avoid unnecessary restrictions on design, and the amendment is adopted as proposed.

With respect to the proposed amendment to § 25.1307, it was recommended that certain items listed in the proposal should be deleted on the basis that they are covered in other sections of Part 25. The FAA does not agree with this comment. While equipment listed in § 25.1307 may be referred to in other sections of Part 25, the listing of such equipment in § 25.1307 is necessary since it is only there that the equipment is required. The other sections generally treat the equipment from the standpoint of performance, reliability, and installation. It was contended by one commentator that the duplication of communication and navigation radio equipment required by § 25.1307 imposes type certification rules more stringent than § 91.33 or § 121.345. While the FAA agrees that under Parts 91 and 121 there are situations in which an airplane can be operated without two communication and navigation systems, there are always operations in which a transport category airplane would be involved which do require dual systems. Therefore, the FAA considers it necessary to make this a design requirement for all future transport category airplanes. In response to another comment, § 25.1307 has been amended to make it clear that some interconnection or component sharing is permissible if system reliability is not impaired. In this connection, the word "independent" has been removed and the regulation now requires that there be two systems for two-way radio communications designed and installed so that failure of one system will not preclude operation of the other system. In addition, the use of a common antenna is acceptable if adequate reliability is shown.

The notice also proposed to amend the equipment systems and installation requirements of § 25.1309. In response to a comment, the words "and installed" have been deleted from paragraph (a) of § 25.1309 to make it consistent with the remaining provisions of that section. Numerous and detailed changes have been made to paragraph (b) of § 25.1309 in response to various comments received. Several comments concerned the flush paragraph following proposed paragraph (b)(2) which states that failure condition means a single

failure or malfunction or damage from external sources, and any combination of failures, malfunctions and damage from external sources. The commentators contended that this provision would require protection against any number of improbable conditions involving any combination of system failure and damage from external sources. This was not the intent, since other provisions of the proposal would limit the failure combinations to those that would preclude safe flight and are not extremely improbable. The proposal has been clarified in this respect by deleting the paragraph in question, and adding another requirement which states that the failure analysis must include consideration of the probability of multiple failures and undetected failures. However, the FAA does not agree that the proposal should be changed to require that multiple failures of airplane systems and associated components be considered only when the first malfunction would not be detected during normal operation of the system or when the first failure would inevitably lead to other failures. Existing transports exceed such a requirement in critical systems, and service experience has shown that these additional backup provisions are necessary for safety. With further reference to paragraph (b) the FAA has determined that the phrase "without exceptional skill or strength on the part of the crew" is redundant and that the word "minimized" should be replaced by the word "improbable". Moreover, while the term "marginal physiological condition" would generally include oxygen depletion, depressurization, and other similar conditions, it was the intent of the proposal to cover only these occurrences that could cause injury to an occupant. For this reason, the final rule has been changed to require that airplane systems and components be designed so that the occurrence of a failure condition which would result in injury to the occupants is improbable. Finally, the FAA does not agree that the requirements of proposed § 25.1309 (c) and (d) are repetitious or too detailed. The provisions of paragraphs (c) and (d) were proposed to introduce monitoring and failure warning requirements and failure analysis criteria which do not exist in the current regulations.

In response to a comment received, proposed § 25.1309(e)(4) has been clarified by replacing the words "two sources of power" with the words an "alternate source of power." This is necessary to remove the implication that "two sources of power" referred to systems which require two different forms of power such as AC and DC at different voltages.

The notice proposed to add a new § 25.1322 to standardize the color of warning, caution, and advisory lights. In view of the comments received, and the difference between the current standardization requirements in the corresponding provisions of Parts 27 and 29 and of those proposed in Notice 67–14 for Part 23 airplanes which were withdrawn for further study (34 F.R. 13085), this proposal is also withdrawn for further evaluation with a view to future rulemaking action designed to standardize the color of such lights for all aircraft.

The introductory statement to § 25.1333 has been revised to replace the words "at the first and second pilot's station" with the words at "each pilot's station." This is appropriate since not all airplanes have two pilot stations. In addition, paragraph (b) of § 25.1333 has been substantially changed in response to numerous comments. In this connection, paragraph (b) now refers to the "equipment, systems and installations" rather than systems only to make it consistent with other parts of the regulation. The FAA also agrees that the intent of § 25.1333(b) is that if one pilot's instrument fails, the failure should not cause failure of the other pilot's instrument. Moreover, the FAA agrees that to require information to be available separately to each pilot after multiple failures would not be reasonable. The final rule has been changed to make this clear. The FAA, however, does not agree with one commentator that the system may be designed based on the criteria that one display of information essential to the safety of flight which is provided by the instruments, must be available after only a single failure. The FAA considers the single failure criteria alone to be inadequate for airplanes currently being developed and anticipated in the future. Therefore, the final rule retains the requirement that combinations of failures that are not shown to be extremely remote must be considered. In connection with § 25.1333(c), one comment noted that the proposal is more severe than the current rule. It is the intent of the FAA to prohibit the connection of additional instruments to required instruments unless the continued operation of those required instruments can be assured following failure of the additional instruments. The proposal accomplishes this objective. Finally, § 25.1333 has been changed to assure that essential information will remain available to the pilots after certain failures without additional crewmember action.

In response to a comment, the proposed amendment to § 25.1355 has been changed by retaining current paragraph (c) of § 25.1355. However, the FAA does not agree that retention of current paragraph (b) is necessary since this material is adequately covered in the amendment to § 25.1309(e)(4).

The notice proposed to amend the ditching equipment requirements of § 25.1415(b) to permit airplanes certificated for the carriage of cargo only to either be equipped with enough rafts of sufficient buoyancy to accommodate the minimum flight crew, or to meet the current rule which requires all transport category airplanes to be equipped with rafts of sufficient buoyancy to accommodate all occupants of the airplane in event of loss of one raft of the largest rated capacity. One comment objected to the proposal on the grounds that it is not consistent with the fail-safe principle of transport category airplane design and discriminates against the flight crews of cargo only airplanes. The FAA agrees and the proposal has been withdrawn.

In a comment concerning the ice protection requirements of proposed § 25.1419, it was asserted that demonstration of the effectiveness of the airplane ice protection system by flight tests in natural icing conditions would deter the development of icing tanker airplanes for system testing and also will delay the large-scale use of anti-icing systems on general aviation airplanes. However, notwithstanding this comment, the proposed rule does provide for the use of icing tankers; thus, recognizing their usefulness and encouraging their development. Experience has shown that there is no means at hand to evaluate the complete airplane anti-icing system other than by exposing it to natural icing conditions. However, the proposed rule does not require the total anti-icing compliance to be substantiated solely by natural icing flight tests, and icing tankers are a primary means of obtaining data to enable the analytical substantiation. The amendment is adopted as proposed.

One comment indicated that the proposed change to § 25.1435(a)(4) could dictate design unrealistically for it does not allow for expected pressure transients that have been accounted for in the design of systems. The intent of the proposal is to limit transient pressures to relatively low specific values because service experience has shown that the current general requirements are too broad to ensure the necessary reliability in modern complex hydraulic systems. The change recommended by the foregoing comment would provide a level of safety below the current rule because it would permit transients of any magnitude and frequency based on structural analysis alone, without regard to system performance capability. Another comment indicated that § 25.1435 was inadequate in that it did not cover "pump ripple pressure." The FAA disagrees. The ±10 percent tolerance in the proposal is intended to take into account "pump ripple pressure" amplitude either at the outlet of the pump or at the pump transient pressure dampening device, if provided. A final comment regarding § 25.1435 stated that there is no reason to place arbitrary limits on transient pressures and stated that the manufacturer should be entitled to provide the necessary static and fatigue strength. The FAA does not agree. The reason for the limits, as confirmed by service experience, is that a dynamic system, such as a hydraulic power application system, is adversely affected by pulse loads which may fall within the static and fatigue "strength of materials" criteria of the components. This comment overlooks the synergism which is characteristic of any complex dynamic powered control system. The amendment is adopted as proposed.

Although the proposals to establish turbulence criteria for turbine-engine-powered airplanes in new § 25.255 and to define turbine penetration speed in § 1.1

have been withdrawn for further study, the FAA considers it appropriate, pending the adoption of such criteria, that the Airplane Flight Manual contain the applicant's recommended information regarding operating procedures in turbulence. New § 25.1585(a)(8) has been revised accordingly.

The notice proposed a clarifying amendment to the definition of "accelerate-stop distance" in § 1.1. However, in view of comments received, it appears that the definition should not be changed until consideration is given to the effect that changing the meaning of the term might have on the requirements of the other Federal Aviation Regulations in which this term is used. The proposal is therefore withdrawn for further study and future rulemaking action.

In consideration of the foregoing, Parts 1 and 25 of the Federal Aviation Regulations are amended effective May 8, 1970, as follows:

1. Section 1.1 is amended by amending the definitions of "fireproof," "fire resistant," and "standard atmosphere" to read as follows:

§ 1.1 General definitions.

* * * * *

"Fireproof"—

(1) With respect to materials and parts used to confine fire in a designated fire zone, means the capacity to withstand at least as well as steel in dimensions appropriate for the purpose for which they are used, the heat produced when there is a severe fire of extended duration in that zone; and

(2) With respect to other materials and parts, means the capacity to withstand the heat associated with fire at least as well as steel in dimensions appropriate for the purpose for which they are used.

"Fire resistant"—

(1) With respect to sheet or structural members means the capacity to withstand the heat associated with fire at least as well as aluminum alloy in dimensions appropriate for the purpose for which they are used; and

(2) With respect to fluid-carrying lines, fluid system parts, wiring, air ducts, fittings, and powerplant controls, means the capacity to perform the intended functions under the heat and other conditions likely to occur when there is a fire at the place concerned.

* * * * *

"Standard atmosphere" means the atmosphere defined in U.S. Standard Atmosphere, 1962 (Geopotential altitude tables).

* * * * *

2. Section 25.21 is amended by amending paragraph (e) to read as follows:

§ 25.21 Proof of compliance.

* * * * *

(e) If compliance with the flight characteristics requirements is dependent upon a stability augmentation system or upon any other automatic or power-operated system, compliance must be shown with §§ 25.671 and 25.672.

3. Section 25.25 is amended by amending paragraph (a) to read as follows:

§ 25.25 Weight limits.

(a) *Maximum weights.* Maximum weights corresponding to the airplane operating conditions (such as ramp, ground or water taxi, takeoff, en route, and landing), environmental conditions (such as altitude and temperature), and loading conditions (such as zero fuel weight, center of gravity position and weight distribution) must be established so that they are not more than—

(1) The highest weight selected by the applicant for the particular conditions; or

(2) The highest weight at which compliance with each applicable structural loading and flight requirement is shown, except that for airplanes equipped with standby power rocket engines the maximum weight must not be more than the highest weight established in accordance with Appendix E of this part.

* * * * *

§ 25.113 [Amended]

4. Section 25.113 is amended by amending paragraphs (a)(2) and (b)(2) by striking out the words "with the engines" and inserting the words "with all engines" in place thereof.

5. Section 25.145 is amended by amending paragraphs (b)(6) and (c) to read as follows:

§ 25.145 Longitudinal control.

* * * * *

(b) * * *

(6) With power off, flaps extended, and the airplane trimmed at 1.4 V_{S1}, obtain and maintain airspeeds between 1.1 V_{S1}, and either 1.7 V_{S1}, or V_{FE}, whichever is lower.

(c) It must be possible, without exceptional piloting skill, to prevent loss of altitude when complete retraction of the high lift devices from any position is begun during steady, straight, level flight at 1.1 V_{S1} for propeller powered airplanes or 1.2 V_{S1} for turbojet powered airplanes, with—

(1) Simultaneous application of not more than takeoff power taking into account the critical engine operating conditions;

(2) The landing gear extended; and

(3) The critical combinations of landing weights and altitudes.

If gated high-lift device control positions are provided, retraction must be shown from any position from the maximum landing position to the first gated position, between gated positions, and from the last gated position to the full retraction position. In addition, the first gated control position from the landing position must correspond with the high-lift devices configuration used to establish the go-around procedure from the landing configuration. Each gated control position must require a separate and distinct motion of the control to pass through the gated position and must have features to prevent inadvertent movement of the control through the gated position.

§ 25.161 [Amended]

6. Section 25.161 is amended by amending paragraph (c)(2) by striking out the words "most forward" and inserting the words "most unfavorable" in place thereof wherever they appear.

§ 25.233 [Amended]

7. Section 25.233 is amended by amending paragraph (a) by striking out the words "cross wind component" in the second sentence and inserting the words "90° cross component of wind" in place thereof.

8. Section 25.237 is amended by amending paragraphs (a) and (b)(1) to read as follows:

§ 25.237 Wind velocities.

(a) For landplanes, a 90° cross component of wind velocity, shown to be safe for takeoff and landing, must be established.

(b) * * *

(1) A 90° cross component of wind velocity, not less than 0.2 V_{S0}, up to which takeoff and landing is safe under any water condition that may reasonably be expected in normal operation.

* * * * *

9. Section 25.251 is amended by amending paragraph (c) and adding new paragraphs (d) and (e) to read as follows:

§ 25.251 Vibration and buffeting.

* * * * *

(c) Except as provided in paragraph (d) of this section, there may be no buffeting condition, in normal flight, including configuration changes during cruise, severe enough to interfere with the control of the airplane, to cause excessive fatigue to the crew, or to cause structural damage. Stall warning buffeting within these limits is allowable.

(d) There may be no perceptible buffeting condition in the cruise configuration in straight flight at any speed up to V_{MO}/M_{MO}, except that stall warning buffeting is allowable.

(e) With the airplane in the cruise configuration, the positive maneuvering load factors at which the onset of perceptible buffeting occurs must be determined for the ranges of airspeed or Mach Number, weight, and altitude for which the airplane is to be certificated. The envelopes of load factor, speed, altitude, and weight must provide a sufficient range of speeds and load factors for normal operations. Probable inadvertent excursions beyond the boundaries of the buffet onset envelopes may not result in unsafe conditions.

§ 25.253 [Amended]

10. Section 25.253 is amended by amending paragraph (a)(2) by striking out the word "altitude" and inserting the word "attitude" in place thereof.

11. Section 25.301 is amended by amending paragraph (b) by inserting at the end thereof a new sentence reading as follows:

§ 25.301 Loads.

* * * * *

(b) * * * Methods used to determine load intensities and distribution must be validated by flight load measurement unless the methods used for determining those loading conditions are shown to be reliable.

* * * * *

12. Section 25.303 is amended to read as follows:

§ 25.303 Factor of safety.

Unless otherwise specified, a factor of safety of 1.5 must be applied to the prescribed limit load which are considered external loads on the structure. When a loading condition is prescribed in terms of ultimate loads, a factor of safety need not be applied unless otherwise specified.

13. Section 25.305 is amended by amending paragraph (b) and adding a new paragraph (d) to read as follows:

§ 25.305 *Strength and deformation.*

* * * * *

(b) The structure must be able to support ultimate loads without failure for at least 3 seconds. However, when proof of strength is shown by dynamic tests simulating actual load conditions, the 3-second limit does not apply. Static tests conducted to ultimate load must include the ultimate deflections and ultimate deformation induced by the loading. When analytical methods are used to show compliance with the ultimate load strength requirements, it must be shown that—

(1) The effects of deformation are not significant;

(2) The deformations involved are fully accounted for in the analysis; or

(3) The methods and assumptions used are sufficient to cover the effects of these deformations.

* * * * *

(d) The dynamic response of the airplane to vertical and lateral continuous turbulence must be taken into account.

14. Section 25.307 is amended by adding a new paragraph (d) to read as follows:

§ 25.307 Proof of structure.

* * * * *

(d) When static or dynamic tests are used to show compliance with the requirements of § 25.305(b) for flight structures, appropriate material correction factors must be applied to the test results, unless the structure, or part thereof, being tested has features such that a number of elements contribute to the total strength of the structure and the failure of one element results in the redistribution of the load through alternate load paths.

§ 25.321 [Amended]

15. Section 25.321 is amended by amending paragraph (b)(2) by striking out the words "; and" and by inserting the words "appropriate to each particular flight load condition; and" in place thereof.

16. Section 25.331 is amended by amending paragraph (a) (2) and (3) to read as follows:

§ 25.331 General.

(a) *Procedure.* * * *

(2) The significant forces acting on the airplane must be placed in equilibrium in a rational or conservative manner. The linear inertia forces must be considered in equilibrium with thrust and all aerodynamic loads, while the angular (pitching) inertia forces must be considered in equilibrium with thrust and all aerodynamic moments, including moments due to loads on components such as tail surfaces and nacelles. Critical thrust values in the range from zero to maximum continuous thrust must be considered.

(3) Where sudden displacement of a control is specified, the assumed rate of control surface displacement may not be less than the rate that could be applied by the pilot through the control system.

* * * * *

17. Section 25.335 is amended by amending paragraph (b) and by adding a new paragraph (f) to read as follows:

§ 25.335 Design airspeeds.

* * * * *

(b) *Design dive speed,* V_D. V_D must be selected so that V_C/M_C is not greater than $0.8\ V_D/M_D$, or so that the minimum speed margin between V_C/M_C and V_D/M_D is the greater of the following values:

(1) From an initial condition of stabilized flight at V_C/M_C, the airplane is upset, flown for 20 seconds along a flight path 7.5° below the initial path, and then pulled up at a load factor of 1.5 *g* (0.5 *g* acceleration increment). The speed increase occurring in this maneuver may be calculated if reliable or conservative aerodynamic data is used. Power as specified in § 25.175(b)(1)(iv) is assumed until the pullup is initiated, at which time power reduction and the use of pilot controlled drag devices may be assumed;

(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. However, the margin at altitude where M_C is limited by compressibility effects may not be less than 0.05 *M*.

* * * * *

(f) *Design drag device speeds,* V_{DD}. The selected design speed for each drag device must be sufficiently greater than the speed recommended for the operation of the device to allow for probable variations in speed control. For drag devices intended for use in high speed descents, V_{DD} may not be less than V_D. When an automatic drag device positioning or load limiting means is used, the speeds and corresponding drag device positions programmed or allowed by the automatic means must be used for design.

18. Section 25.337 is amended by amending paragraph (b) to read as follows:

§ 25.337 Limit maneuvering load factors.

* * * * *

(b) The positive limit maneuvering load factor "*n*" for any speed up to V_D may not be less than $2.1+\left(\frac{24{,}000}{W+10{,}000}\right)$ except that "*n*" may not be less than 2.5 and need not be greater than 3.8—where "*W*" is the design maximum takeoff weight.

* * * * *

§ 25.349 [Amended]

19. Section 25.349 is amended by amending paragraph (b) by striking out the words "greater load factor" and inserting the words "critical load" in place thereof.

20. Section 25.351 is amended by amending paragraph (a)(1) to read as follows:

§ 25.351 Yawing conditions.

(a) * * *

(1) With the airplane in unaccelerated flight at zero yaw, it is assumed that the rudder control is suddenly displaced to the maximum deflection, as limited by the control surface stops, or by a 300-pound rudder pedal force, whichever is less.

* * * * *

21. Section 25.361 is amended by amending paragraph (a)(3) to read as follows:

§ 25.361 Engine torque.

(a) * * *

(3) For turbopropeller installations, in addition to the conditions specified in subparagraphs (1) and (2) of this paragraph, the limit engine torque corresponding to takeoff power and propeller speed, multiplied by a factor accounting for propeller control system malfunction, including quick feathering, acting simultaneously with 1 *g* level flight loads. In the absence of a rational analysis, a factor of 1.6 must be used.

* * * * *

§ 25.363 [Amended]

22. Section 25.363 is amended by amending paragraph (a)(2) by inserting the words and reference "as prescribed in § 25.333(b)" at the end of the subparagraph.

23. Section 25.395 is amended by amending paragraph (a) by striking out the words "Elevator, aileron, and rudder" and inserting the words "Longitudinal, lateral, directional, and drag" in place thereof, and by amending paragraph (b) to read as follows:

§ 25.395 Control system.

* * * * *

(b) The system limit loads, except the loads resulting from ground gusts, need not exceed the loads that can be produced by the pilot (or pilots) and by automatic or power devices operating the controls. The loads must be great enough to provide a rugged system for service use.

24. Section 25.427 is amended by amending paragraph (b)(2) to read as follows:

§ 25.427 Unsymmetrical loads.

* * * * *

(b) * * *

(2) For empennage arrangements where the horizontal tail surfaces have appreciable dihedral or are supported by the vertical tail surfaces, the surfaces and supporting structure must be designed for the combined vertical and horizontal surface loads resulting from each prescribed flight load condition considered separately.

25. Section 25.471 is amended to read as follows:

§ 25.471 General.

(a) *Loads and equilibrium.* For limit ground loads—

(1) Limit ground loads obtained under this subpart are considered to be external forces applied to the airplane structure; and

(2) In each specified ground load condition, the external loads must be placed in equilibrium with the linear and angular inertia loads in a rational or conservative manner.

(b) *Critical centers of gravity.* The critical centers of gravity within the range for which certification is requested must be selected so that the maximum design loads are obtained in each landing gear element. Fore and aft, vertical, and lateral airplane centers of gravity must be considered. Lateral displacements of the c.g. from the airplane centerline which would result in main gear loads not greater than 103 percent of the critical design load for symmetrical loading conditions may be selected without considering the effects of these lateral c.g. displacements on the loading of the main gear elements, or on the airplane structure provided—

(1) The lateral displacement of the c.g. results from random passenger or cargo disposition within the fuselage or from random unsymmetrical fuel loading or fuel usage; and

(2) Appropriate loading instructions for random disposable loads are included under the provisions of § 25.1583(c)(1) to ensure that the lateral displacement of the center of gravity is maintained within these limits.

(c) *Landing gear dimension data.* Figure 1 of Appendix A contains the basic landing gear dimension data.

§ 25.473 [Amended]

26. Section 25.473 is amended by amending paragraph (a)(1)(iii) striking out the words "taxiing conditions and".

27. Section 25.473 is amended by amending paragraph (a)(2) by striking out the words "A wing" and inserting the word "Airplane" in place thereof.

§ 25.479 [Amended]

28. Section 25.479 is amended by amending paragraph (d) by striking out the reference "paragraph (a)" and inserting the reference "paragraphs (a) through (c)" in place thereof.

§ 25.489 [Amended]

29. Section 25.489 is amended by striking out the words "design takeoff weight" in the first sentence and inserting the words "design ramp weight (the maximum weight for ground handling conditions)" in place thereof.

§ 25.493 [Amended]

30. Section 25.493 is amended by amending paragraphs (a) and (b) by striking out the words "design takeoff weight" in the first sentence of each paragraph and inserting the words "design ramp weight" in place thereof.

§ 25.499 [Amended]

31. Section 25.499 is amended as follows:

a. By amending the lead-in sentence in paragraph (b) by inserting after the words "fuselage structure" the words "forward of the center of gravity".

b. By amending paragraph (c) by striking out the reference "paragraph (a)", and inserting the reference "paragraph (b)" in place thereof.

c. By amending paragraph (d) by striking out the phrase "for the landing gear and airplane structure" and inserting the phrase "For other than the nose gear, its attaching structure, and the forward fuselage structure" in place thereof.

§ 25.509 [Amended]

32. Section 25.509 is amended by amending paragraph (a)(3) by striking out the words "design maximum takeoff weight" in the lead-in sentence and inserting the words "design ramp weight" in place thereof.

§ 25.523 [Amended]

33. Section 25.523 is amended by amending paragraph (a) by striking out the words "the design takeoff weight" and inserting the words "the design water takeoff weight (the maximum weight for water taxi and takeoff run)" in place thereof.

§ 25.527 [Amended]

34. Section 25.527 is amended by amending paragraph (b)(3) by amending the value of "V_{ss}" by adding the words "in knots" after the word "speed".

§ 25.531 [Amended]

35. Section 25.531 is amended by amending paragraph (b) by amending the definition of "V_{s1}" by adding the unit of measure "(knots)" after the word "speed"; and by amending the definition of "W" to read "design water takeoff weight in pounds".

§ 25.533 [Amended]

36. Section 25.533 is amended as follows:

a. By amending the definition of "P_k" in paragraph (b)(1) by inserting the unit of measure "(p.s.i.)" after the word "pressure";

b. By amending the definition of "V_{s1}" in paragraph (b) (1) and (2) by inserting the unit of measure "(Knots)" after the word "speed" and inserting the word "water" between the word "design" and the word "takeoff" in each of the definitions;

c. By amending the definition of "*Pch*" in paragraph (b)(2) by inserting the unit of measure "(p.s.i.)" after the word "pressure";

d. By amending the definition of "P" in paragraph (c)(1) by inserting the unit of measure "(p.s.i.)" after the word "pressure"; and

e. By amending the definition of "V_{s_0}" in paragraph (c)(1) by inserting the unit of measure "(Knots)" after the word "speed".

§ 25.535 [Amended]

37. Section 25.535 is amended as follows:

a. By amending the definition of "L" in paragraph (b) by adding the unit of measure "(lbs.)" after the word "load";

b. By amending the definition of "V_{s_0}" in paragraphs (b) and (f) by adding the unit of measure "(knots)" after the word "speed";

c. By amending the definition of "ρ" in paragraph (f) by adding the unit of measure "(slugs/ft.^{3})" after the word "water"; and

d. By amending the definition of "V" in paragraph (f) by adding the unit of measure "(ft.^{3})" after the word "float".

§ 25.535 [Amended]

38. Section 25.535 is amended by amending paragraph (g) by striking out the period at the end of the first sentence and inserting the phrase ", except that the value of K_2 in the formulae may be taken as 1.0."

§ 25.561 [Amended]

39. Section 25.561 is amended by amending paragraph (b)(3) by inserting the words "acting separately", after the word "forces" in the lead-in sentence.

40. Section 25.571 is amended by striking out the flush paragraph following paragraph (c) and by adding a new paragraph (e) to read as follows:

§ 25.571 Fatigue evaluation of flight structure.

* * * * *

(e) The loads prescribed in this paragraph and paragraph (c) of this section must be multiplied by a factor of 1.15 unless the dynamic effects of failure under static load are otherwise considered. In addition, the following apply as ultimate loading conditions:

(1) For a pressurized cabin, the normal operating pressures combined with the expected external aerodynamic pressures must be applied simultaneously with the flight loading conditions specified in paragraph (c) of this section; and

(2) The combined pressures set forth in subparagraph (1) of this paragraph multiplied by a factor of 1.33 must be applied to the pressurized cabin without any other load.

41. A new center heading entitled "Lightning Protection" is added following § 25.573.

42. A new § 25.581, following the above new center heading is added to read as follows:

§ 25.581 Lightning protection.

(a) The airplane must be protected against catastrophic effects from lightning.

(b) For metallic components, compliance with paragraph (a) of this section may be shown by—

(1) Bonding the components properly to the airframe; or

(2) Designing the components so that a strike will not endanger the airplane.

(c) For nonmetallic components, compliance with paragraph (a) of this section may be shown by—

(1) Designing the components to minimize the effect of a strike; or

(2) Incorporating acceptable means of diverting the resulting electrical current so as not to endanger the airplane.

43. Section 25.607 is amended to read as follows:

§ 25.607 Fasteners.

(a) Each removable bolt, screw, nut, pin, or other removable fastener must incorporate two separate locking devices if—

(1) Its loss could preclude continued flight and landing within the design limitations of the airplane using normal pilot skill and strength; or

(2) Its loss could result in reduction in pitch, yaw, or roll control capability or response below that required by Subpart B of this chapter.

(b) The fasteners specified in paragraph (a) of this section and their locking devices may not be adversely affected by the environmental conditions associated with the particular installation.

(c) No self-locking nut may be used on any bolt subject to rotation in operation unless a nonfriction locking device is used in addition to the self-locking device.

44. Section 25.611 is amended to read as follows:

§ 25.611 Accessibility provisions.

Means must be provided to allow inspection (including inspection of principal structural elements and control systems), replacement of parts normally requiring replacement, adjustment, and lubrication as necessary for continued airworthiness. The inspection means for each item must be practicable for the inspection interval for the item. Nondestructive inspection aids may be used to inspect structural elements where it is impracticable to provide means for direct visual inspection if it is shown that the inspection is effective and the inspection procedures are specified in the maintenance manual required by § 25.1529.

§ 25.615 [Amended]

45. Section 25.615 is amended by amending paragraph (a) by inserting the word "when" before the word "listed" in subparagraphs (1) and (2), respectively.

46. Section 25.619 is amended by amending the lead-in sentence to read as follows:

§ 25.619 Special factors.

The factor of safety prescribed in § 25.303 must be multiplied by the highest pertinent special factor of safety prescribed in §§ 25.621 through 25.625 for each part of the structure whose strength is—

* * * * *

47. Section 25.625 is amended by adding a new paragraph (d) to read as follows:

§ 25.625 Fitting factors.

* * * * *

(d) For each seat, berth, safety belt, and harness, the fitting factors specified in §§ 25.785(i)(3) and 25.1413(c) apply.

48. Section 25.629 is amended by amending paragraphs (a) and (b) to read as follows:

§ 25.629 Flutter, deformation, and fail-safe criteria.

(a) *General.* Compliance with this section must be shown by calculations, resonance tests, or other tests found necessary by the Administrator. Full scale flight flutter tests at speeds up to V_{DF}/M_{DF} for the critical airplane flutter modes must be conducted when—

(1) M_D is equal to or greater than $0.8M$;

(2) The adequacy of flutter analysis and wind tunnel tests have not been established by previous experience with aircraft having similar design features; or

(3) The conditions specified in subparagraph (1) or (2) of this paragraph exist, and modifications to the type design have a significant effect on the critical flutter modes.

(b) *Flutter and divergence prevention.* The dynamic evaluation of the airplane must include an investigation of the significant elastic, inertia, and aerodynamic forces associated with the rotations and displacements of the plane of the propeller. In addition, the following apply:

(1) The airplane must be designed to be free from flutter and divergence (unstable structural distortion due to aerodynamic loading) for all combinations of altitude and speed encompassed by the V_D/D versus altitude envelope enlarged at all points by an increase of 20 percent in equivalent airspeed at both constant Mach number and constant altitude, except that Mach effects for Mach numbers greater than 1.0 need not be included when M_D is less than 1.0 at all design altitudes and the following is established—

(i) A proper margin of damping exists at all speeds up to M_D; and

(ii) There is no large and rapid reduction in damping as M_D is approached.

(2) If concentrated balance weights are used on control surfaces, their effectiveness and strength, including supporting structure, must be substantiated.

* * * * *

49. A new § 25.631 is added to read as follows:

§ 25.631 *Bird strike damage.*

The empennage structure must be designed to assure capability of continued safe flight and landing of the airplane after impact with an 8-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to V_C at sea level, selected under § 25.335(a). Compliance with this section by provision of redundant structure and protected location of control system elements or protective devices such as splitter plates or energy absorbing material is acceptable. Where compliance is shown by analysis, tests, or both, use of data on airplanes having similar structural design is acceptable.

50. Section 25.657 is amended to read as follows:

§ 25.657 Hinges.

(a) For control surface hinges, including ball, roller, and self-lubricated bearing hinges, the approved rating of the bearing may not be exceeded. For nonstandard bearing hinge configurations, the rating must be established on the basis of experience or tests and, in the absence of a rational investigation, a factor of safety of not less than 6.67 must be used with respect to the ultimate bearing strength of the softest material used as a bearing.

(b) Hinges must have enough strength and rigidity for loads parallel to the hinge line.

51. Section 25.671 is amended by amending paragraphs (c) and (d) to read as follows:

§ 25.671 General.

* * * * *

(c) The airplane must be shown by analysis, tests, or both, to be capable of continued safe flight and landing after any of the following failures or jamming in the flight control system and surfaces (including trim, lift, drag, and feel systems), within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable malfunctions must have only minor effects on control system operation and must be capable of being readily counteracted by the pilot.

(1) Any single failure, excluding jamming (for example, disconnection or failure of mechanical elements, or structural failure of hydraulic components, such as actuators, control spool housing, and valves).

(2) Any combination of failures not shown to be extremely improbable, excluding jamming (for example, dual electrical or hydraulic system failures, or any single failure in combination with any probable hydraulic or electrical failure).

(3) Any jam in a control position normally encountered during takeoff, climb, cruise, normal turns, descent, and landing unless the jam is shown to be extremely improbable, or can be alleviated. A runaway of a flight control to an adverse position and jam must be accounted for if such runaway and subsequent jamming is not extremely improbable.

(d) The airplane must be designed so that it is controllable if all engines fail. Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.

52. A new § 25.672 is added to read as follows:

§ 25.672 Stability augmentation and automatic and power-operated systems.

If the functioning of stability augmentation or other automatic or power-operated systems is necessary to show compliance with the flight characteristics requirements of this part, such systems must comply with § 25.671 and the following:

(a) A warning which is clearly distinguishable to the pilot under expected flight conditions without requiring his attention must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system which could result in an unsafe condition if the pilot were not aware of the failure. Warning systems must not activate the control systems.

(b) The design of the stability augmentation system or of any other automatic or power-operated system must permit initial counteraction of failures of the type specified in § 25.671(c) without requiring exceptional pilot skill or strength, by either the deactivation of the system, or a failed portion thereof, or by overriding the failure by movement of the flight controls in the normal sense.

(c) It must be shown that after any single failure of the stability augmentation system or any other automatic or power-operated system—

(1) The airplane is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations that is critical for the type of failure being considered;

(2) The controllability and maneuverability requirements of this part are met within a practical operational flight envelope (for example, speed, altitude, normal acceleration, and airplane configurations) which is described in the Airplane Flight Manual; and

(3) The trim, stability, and stall characteristics are not impaired below a level needed to permit continued safe flight and landing.

§ 25.677 [Amended]

53. Section 25.677 is amended by striking out the first sentence of paragraph (c).

54. Section 25.683 is amended by amending the lead-in sentence to read as follows:

§ 25.683 Operation tests.

It must be shown by operation tests that when portions of the control system subject to pilot effort loads are loaded to 80 percent of the limit load specified for the system and the powered portions of the control system are loaded to the maximum load expected in normal operation, the system is free from—

* * * * *

§ 25.695 [Revoked]

55. Section 25.695 is revoked.

56. Section 25.697 is amended to read as follows:

§ 25.697 Lift and drag devices, controls.

(a) Each lift device control must be designed so that the pilots can place the device in any takeoff, en route, approach, or landing position established under § 25.47. Lift and drag devices must maintain the selected positions, except for movement produced by an automatic positioning or load limiting device, without further attention by the pilots.

(b) The lift and drag device controls must be designed and located to make inadvertent operation improbable.

(c) The rate of motion of the surfaces in response to the operation of the control and the characteristics of the automatic positioning or load limiting device must give satisfactory flight and performance characteristics under steady or changing conditions or airspeed, engine power, and airplane attitude.

(d) The lift device control must be designed to retract the surfaces from the fully extended position, during steady flight at maximum continuous engine power at any speed below $V_F+9.0$ (knots).

57. Section 25.699 is amended to read as follows:

§ 25.699 Lift and drag device indicator.

(a) There must be means to indicate to the pilots the position of each lift or drag device having a separate control in the cockpit to adjust its position. In addition, an indication of unsymmetrical operation or other malfunction in the lift or drag device systems must be provided when such indication is necessary to enable the pilots to prevent or counteract an unsafe flight or ground condition, considering the effects on flight characteristics and performance.

(b) There must be means to indicate to the pilots the takeoff, en route, approach, and landing lift device positions.

(c) If any extension of the lift and drag devices beyond the landing position is possible, the controls must be clearly marked to identify this range of extension.

58. Section 25.701 is amended to read as follows:

§ 25.701 Flap interconnection.

(a) The motion of flaps on opposite sides of the plane of symmetry must be synchronized by a mechanical interconnection unless the airplane has safe flight characteristics with the flaps retracted on one side and extended on the other.

(b) If a wing flap interconnection is used, it must be designed to account for the applicable unsymmetrical loads, including those resulting from flight with the engines on one side of the plane of symmetry inoperative and the remaining engines at takeoff power.

(c) For airplanes with flaps that are not subjected to slipstream conditions, the structure must be designed for the loads imposed when the wing flaps on one side are carrying the most severe load occurring in the prescribed symmetrical conditions and those on the other side are carrying not more than 80 percent of that load.

(d) The flap interconnection must be designed for the loads resulting when the flap surfaces on one side of the plane symmetry are jammed and immovable while the surfaces on the other side are free to move and the full power of the surface actuating system is applied.

59. Section 25.721 is amended to read as follows:

§ 25.721 General.

The main landing gear system must be designed so that if it fails due to overloads during takeoff and landing (assuming the overloads are in the vertical plane parallel to the longitudinal axis of the airplane), the failure mode is not likely to puncture any part of the fuel system in the fuselage.

60. Section 25.723 is amended to read as follows:

§ 25.723 Shock absorption tests.

(a) It must be shown by energy absorption tests that the limit load factors selected for design in accordance with § 25.473 for takeoff and landing weights, respectively, will not be exceeded.

(b) The landing gear may not fail in a test, demonstrating its reserve energy absorption capacity, simulating a descent velocity of 12 f.p.s. at design landing weight, assuming airplane lift not greater than the airplane weight acting during the landing impact.

61. Section 25.725 is amended by amending the lead-in sentence of paragraph (b), the definition of "L", and by amending paragraph (c) to read as follows:

§ 25.725 Limit drop tests.

* * * * *

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used for the drop must be equal to W. If the effect of airplane lift is represented in free drop tests by an equivalent reduced mass, the landing gear must be dropped with an effective mass equal to $W_e=W\left(\frac{h+(1-L)d}{h+d}\right)$ where—

L = The ratio of the assumed airplane lift to the airplane weight, but not more than 1.0.

(c) The drop test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airplane landing conditions in a manner consistent with the development of a rational or conservative limit load factor value.

* * * * *

62. Section 25.727 is amended by amending paragraph (b) to read as follows:

§ 25.727 Reserve energy absorption drop tests.

* * * * *

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used for the drop must be equal to W. If the effect of airplane lift is represented in free drop tests by an equivalent reduced mass, the landing

gear must be dropped with an effective mass, $W_e = W\left(\frac{h}{h+d}\right)$ where the symbols and other details are the same as in § 25.725(b).

63. Section 25.729 is amended by amending paragraph (a)(1) (ii) and (iii) to read as follows:

§ 25.729 Retracting mechanism.

(a) *General.* * * *

(1) * * *

(ii) The combination of friction loads, inertia loads, brake torque loads, air loads, and gyroscopic loads resulting from the wheels rotating at a peripheral speed equal to 1.3 V_s (with the flaps in takeoff position at design takeoff weight), occurring during retraction and extension at any airspeed up to 1.6 V_{s1} (with the flaps in the approach position at design landing weight), and

(iii) Any load factor up to those specified in § 25.345(a) for the flaps extended condition.

* * * * *

64. Section 25.733 is amended by amending paragraph (a) to read as follows:

§ 25.733 Tires.

(a) Each landing gear wheel must be fitted with a suitable tire of proper fit whose speed rating approved by the Administrator is not exceeded under critical conditions, and whose load rating approved by the Administrator is not exceeded under—

(1) Equal static loads, corresponding to the most critical combination of maximum takeoff weight and center of gravity position, on each main wheel tire; and

(2) Equal loads corresponding to the ground reactions in paragraph (b) of this section, on each nose wheel tire.

* * * * *

§ 25.735 [Amended]

65. Section 25.735 is amended by striking out the last sentence of paragraph (e).

66. Section 25.735 is amended by amending the definition of "V_w" in paragraph (f)(2) by inserting the word "(knots)" after the words "stalling speed."

67. Section 25.773 is amended by adding a new paragraph (c) to read as follows:

§ 25.773 Pilot compartment view.

* * * * *

(c) *Internal windshield and window fogging.* The airplane must have a means to prevent fogging of the internal portions of the windshield and window panels over an area which would provide the visibility specified in paragraph (a) of this section under all internal and external ambient conditions, including precipitation conditions, in which the airplane is intended to be operated.

§ 25.775 [Amended]

68. Section 25.775 is amended by amending paragraph (a) to read as follows:

(a) Internal panes must be made of nonsplintering material.

69. Section 25.775 is amended by amending the second sentence of paragraph (d) to read as follows: "The windshield and window panels must be capable of withstanding the maximum cabin pressure differential loads combined with critical aerodynamic pressure and temperature effects after any single failure in the installation or associated systems."

§ 25.783 [Amended]

70. Section 25.783 is amended by inserting the words "or failure of a single structural element" after the words "mechanical failure" in paragraphs (b) and (f).

71. Section 25.853 is amended by amending paragraph (e) to read as follows:

§ 25.853 Compartment interiors.

* * * * *

(e) There must be at least one hand fire extinguisher conveniently located in the pilot compartment.

* * * * *

72. Section 25.859 is amended by amending paragraph (e)(2) and the lead-in sentence of paragraph (g) to read as follows:

§ 25.859 Combustion heater fire protection.

* * * * *

(e) * * *

(2) The means of complying with subparagraph (1) of this paragraph for any individual heater must—

(i) Be independent of components serving any other heater whose heat output is essential for safe operation; and

(ii) Keep the heater off until restarted by the crew.

* * * * *

(g) *Heater exhaust.* Heater exhaust systems must meet the provisions of §§ 25.1121 and 25.1123. In addition, there must be provisions in the design of the heater exhaust system to safely expel the products of combustion to prevent the occurrence of—

* * * * *

73. Section 25.863 is amended to read as follows:

§ 25.863 Flammable fluid fire protection.

(a) In any area where flammable fluids or vapors might be liberated by the leakage of fluid systems, there must be means to prevent the ignition of those fluids or vapors, and means to minimize the hazards in the event ignition does occur.

(b) Compliance with paragraph (a) of this section must be shown by analysis or tests, and the following factors must be considered:

(1) Possible sources and paths of fluid leakage, and means of detecting leakage.

(2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials.

(3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices.

(4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents.

(5) Ability of airplane components that are critical to safety of flight to withstand fire and heat.

(c) If action by the flight crew is required to prevent or counteract a fluid fire (e.g. equipment shutdown or actuation of a fire extinguisher) quick acting means must be provided to alert the crew.

74. A new § 25.865 is added to read as follows:

§ 25.865 Fire protection of flight controls, engine mounts, and other flight structure.

Essential flight controls, engine mounts, and other flight structures located in designated fire zones or in adjacent areas which would be subjected to the effects of fire in the fire zone must be constructed of fireproof material or shielded so that they are capable of withstanding the effects of fire.

75. A new § 25.867 is added to read as follows:

§ 25.867 Fire protection: other components.

(a) Surfaces to the rear of the nacelles, within one nacelle diameter of the nacelle centerline, must be at least fire-resistant.

(b) Paragraph (a) of this section does not apply to tail surfaces to the rear of the nacelles that could not be readily affected by heat, flames, or sparks coming from a designated fire zone or engine compartment of any nacelle.

76. Section 25.871 is amended to read as follows:

§ 25.871 Leveling means.

There must be means for determining when the airplane is in a level position on the ground.

77. Section 25.901 is amended by adding a new paragraph (c) to read as follows:

§ 25.901 Installation.

* * * * *

(c) The powerplant installation must comply with § 25.1309.

78. Section 25.903 is amended by amending paragraph (c) and (d) to read as follows:

§ 25.903 Engines.

* * * * *

(c) *Control of engine rotation and restart capability.* There must be means for stopping the rotation of any engine individually in flight, except that, for turbine engine installations, the means for stopping the rotation of any engine need be provided only where continued rotation could jeopardize the safety of the airplane. Each component of the stopping and restarting system on the engine side of the firewall that might be exposed to fire must be at least fire-resistent. Means to restart any engine in flight must be provided. If hydraulic propeller feathering systems are used for this purpose, the feathering lines must be at least

fire resistent under the operating conditions that may be expected to exist during feathering.

(d) *Turbine engine installations.* For turbine engine installations—

(1) Design precautions must be taken to minimize the hazards to the airplane in the event of an engine rotor failure or of a fire originating within the engine which burns through the engine case.

(2) The powerplant systems associated with engine control devices, systems, and instrumentation, must be designed to give reasonable assurance that those engine operating limitations that adversely affect turbine rotor structural integrity will not be exceeded in service.

79. A new § 25.934 is added to read as follows:

§ 25.934 Turbojet engine thrust reverser system tests.

Thrust reversers installed on turbojet engines must meet the requirements of § 33.97 of this chapter.

80. Section 25.951 is amended by amending paragraph (b) to read as follows:

§ 25.951 General.

* * * * *

(b) Each fuel system must be arranged so that any air which is introduced into the system will not result in—

(1) Power interruption for more than 20 seconds for reciprocating engines; or

(2) Flameout for turbine engines.

81. Section 25.959 is amended to read as follows:

§ 25.959 Unusable fuel supply.

The unusable fuel quantity for each fuel tank and its fuel system components must be established at not less than the quantity at which the first evidence of engine malfunction occurs under the most adverse fuel feed condition for all intended operations and flight maneuvers involving fuel feeding from that tank.

82. A new § 25.994 is added to read as follows:

§ 25.994 Fuel system components.

Fuel system components in an engine nacelle or in the fuselage must be protected from damage which could cause the release of fuel as a result of a wheels-up landing.

83. Section 25.997 is amended by amending paragraph (a)(1) to read as follows:

§ 25.997 Fuel strainer or filter.

(a) * * *

(1) Between the tank outlet and the engine-driven positive displacement pump inlet when an engine-driven positive displacement pump is used.

* * * * *

§ 25.1013 [Amended]

84. Section 25.1013 is amended by amending paragraph (c)(2) by striking out the reference to "§ 25.1557(c)" and inserting the reference "§ 25.1557(b)(2)" in place thereof.

85. Section 25.1015 is amended by amending paragraph (b)(1) to read as follows:

§ 25.1015 Oil tank tests.

* * * * *

(b) * * *

(1) The test pressure must be at least 5 p.s.i. instead of the pressure specified in § 25.965(a), except that for pressurized tanks, the test pressure may not be less than 5 p.s.i. plus the maximum operating pressure of the tank; and

* * * * *

86. Section 25.1091 is amended by amending paragraph (d)(2) to read as follows:

§ 25.1091 Air induction.

* * * * *

(d) * * *

(2) The airplane must be designed to prevent water or slush on the runway, taxiway, or other airport operating surfaces from being directed into the engine air inlet ducts in hazardous quantities, and the air inlet ducts must be located or protected so as to minimize the ingestion of foreign matter during takeoff, landing, and taxiing.

87. Section 25.1103 is amended by adding a new paragraph (d) to read as follows:

§ 25.1103 Induction system ducts.

* * * * *

(d) For turbine engine bleed air systems no hazard may result if a duct rupture or failure occurs at any point between the engine port and the airplane unit served by the bleed air.

88. Section 25.1143 is amended to read as follows:

§ 25.1143 Engine power and thrust, and antidetonant injection system controls.

(a) There must be a separate power or thrust control for each engine.

(b) Power and thrsut controls must be arranged to allow—

(1) Separate control of each engine; and

(2) Simultaneous control of all engines.

(c) Each power and thrust control must provide a positive and immediately responsive means of controlling its engine.

(d) If there is an antidetonant injection system, the flow of A.D.I. fluid must be automatically controlled with relation to the amount of power produced by the engine. In addition to the automatic control, there must be a separate control for the A.D.I. pumps.

(e) If the power or thrust control incorporates a fuel shutoff feature, then each power or thrust control must have a means to prevent inadvertent movement of the control into the cutoff position. The means must have a positive lock or stop at the idle position and must require a separate and distinct operation by the crew to displace the control from the idle position.

89. Section 25.1165 is amended by amending paragraph (f) to read as follows:

§ 25.1165 Engine ignition systems.

* * * * *

(f) Each ignition system must be independent of any electrical circuit not used for assisting, controlling, or analyzing the operation of that system.

* * * * *

90. Section 25.1181 is amended by amending paragraph (a)(3) to read as follows:

§ 25.1181 Designed fire zones; regions included.

(a) * * *

(3) Except for reciprocating engines, any complete powerplant compartment in which no isolation is provided between the engine power section and the engine accessory section;

* * * * *

91. Section 25.1183 is amended by amending the title and paragraph (a) to read as follows:

§ 25.1183 Lines, fittings, and components.

(a) Except as provided in paragraph (b) of this section, each line, fitting, and other component carrying flammable fluids in any area subject to engine fire conditions, and each fuel line, fitting, and other flammable fluid system component in a designated fire zone, must meet the following requirement:

(1) Each line, fitting, and component must be at least fire resistant.

(2) Each flexible hose assembly (hose and end fitting) must be approved.

* * * * *

92. Section 25.1189 is amended by amending paragraphs (a) and (d) and by adding new paragraphs (g) and (h) to read as follows:

§ 25.1189 Shutoff means.

(a) Each engine and each fire zone specified in § 25.1181(a) (4) and (5) must have a means to shut off or otherwise prevent hazardous quantities of fuel, oil, deicer, and other flammable fluids, from flowing into, within, or through any designated fire zone, except that shutoff means are not required for—

(1) Lines forming an integral part of an engine; and

(2) Oil systems for turbine engine installations in which all external components of the oil system, including the oil tanks, are fireproof.

* * * * *

(d) Each flammable fluid shutoff means and control must be fireproof or must be located and protected so that any fire in a fire zone will not affect its operation.

* * * * *

(g) Each tank-to-engine shutoff valve must be located so that the operation of the valve will not be affected by powerplant or engine mount structural failure.

(h) Each shutoff valve must have a means to relieve excessive pressure accumulation unless a means for pressure relief is otherwise provided in the system.

93. A new § 25.1192 is added to read as follows:

§ 25.1192 Engine accessory section diaphragm.

For reciprocating engines, the engine power section and all portions of the exhaust system must be isolated from the engine accessory compartment by a diaphragm that complies with the firewall requirements of § 25.1191.

94. Section 25.1195 is amended by amending paragraph (b) to read as follows:

§ 25.1195 Fire extinguisher systems.

* * * * *

(b) The fire extinguishing system, the quantity of the extinguishing agent, the rate of discharge, and the discharge distribution must be adequate to extinguish fires. An individual "one shot" system may be used for auxiliary power units, fuel burning heaters, and other combustion equipment. For other designated fire zones, two discharges must be provided each of which produce adequate agent concentrations. It must be possible to direct each of these discharges to any main engine installation.

* * * * *

95. Section 25.1199 is amended by adding a new paragraph (e) to read as follows:

§ 25.1199 Extinguishing agent containers.

* * * * *

(e) If a pyrotechnic capsule is used to discharge the extinguishing agent, each container must be installed so that temperature conditions will not cause hazardous deterioration of the pyrotechnic capsule.

§ 25.1203 [Amended]

96. Section 25.1203 is amended by striking out the words "fire detector" or "fire-detectors" wherever they appear in paragraphs (b) through (f) and inserting the words "fire or overheat detector" in place thereof.

§ 25.1205 [Revoked]

97. Section 25.1205 is revoked.

98. Section 25.1303 is amended to read as follows:

§ 25.1303 Flight and navigation instruments.

(a) The following flight and navigation instruments must be installed so that the instrument is visible from each pilot station:

(1) A free air temperature indicator or an air-temperature indicator which provides indications that are convertible to free-air temperature.

(2) A clock (sweep-second pointer).

(3) A direction indicator (nonstabilized magnetic compass).

(b) The following flight and navigation instruments must be installed at each pilot station:

(1) An airspeed indicator. If airspeed limitations vary with altitude, the indicator must have a maximum allowable airspeed indicator showing the variation of V_{MO} with altitude.

(2) An altimeter (sensitive).

(3) A rate-of-climb indicator (vertical speed).

(4) A gyroscopic rate-of-turn indicator combined with an integral slip-skid indicator (turn and bank indicator) except that only a slip-skid indicator is required on large airplanes with a third attitude instrument system installed in accordance with § 121.305(j) of this chapter.

(5) A bank and pitch indicator (gyroscopically stabilized).

(6) A direction indicator (gyroscopically stabilized, magnetic or nonmagnetic).

(c) The following flight and navigation instruments are required as prescribed in this paragraph:

(1) A speed warning device is required for turbine engine powered airplanes and for airplanes with V_{MO}/M_{MO} greater than 0.8 V_{DF}/M_{DF} or 0.8 V_D/M_D. The speed warning device must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots, whenever the speed exceeds V_{MO} plus 6 knots or M_{MO} +0.01. The upper limit of the production tolerance for the warning device may not exceed the prescribed warning speed.

(2) A machmeter is required at each pilot station for airpanes with compressibility limitations not otherwise indicated to the pilot by the airspeed indicating system required under paragraph (b) (1) of this section.

99. Section 25.1305 is amended to read as follows:

§ 25.1305 Powerplant instruments.

The following are required powerplant instruments:

(a) *For all airplanes.* (1) A fuel pressure warning means for each engine, or a master warning means for all engines with provision for isolating the individual warning means from the master warning means.

(2) A fuel quantity indicator for each fuel tank.

(3) An oil quantity indicator for each oil tank.

(4) An oil pressure indicator for each independent pressure oil system of each engine.

(5) An oil pressure warning means for each engine, or a master warning means for all engines with provision for isolating the individual warning means from the master warning means.

(6) An oil temperature indicator for each engine.

(7) Fire-warning indicators.

(8) An augmentation liquid quantity indicator (appropriate for the manner in which the liquid is to be used in operation) for each tank.

(b) *For reciprocating engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required:

(1) A carburetor air temperature indicator for each engine.

(2) A cylinder head temperature indicator for each air-cooled engine.

(3) A manifold pressure indicator for each engine.

(4) A fuel pressure indicator (to indicate the pressure at which the fuel is supplied) for each engine.

(5) A fuel flowmeter, or fuel mixture indicator, for each engine without an automatic altitude mixture control.

(6) A tachometer for each engine.

(7) A device that indicates, to the flight crew (during flight), any change in the power output, for each engine with—

(i) An automatic propeller feathering system, whose operation is initiated by a power output measuring system; or

(ii) A total engine piston displacement of 2,000 cubic inches or more.

(8) A means to indicate to the pilot when the propeller is in reverse pitch, for each reversing propeller.

(c) *For turbine engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required:

(1) A gas temperature indicator for each engine.

(2) A fuel flowmeter indicator for each engine.

(3) A tachometer (to indicate the speed of the rotors with established limiting speeds) for each engine.

(4) A means to indicate, to the flight crew, the operation of each engine starter that can be operated continuously but that is neither designed for continuous operation nor designed to prevent hazard if it failed.

(d) *For turbojet engine powered airplanes.* In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required:

(1) An indicator to indicate a change in thrust resulting from any deficiency in the engine, or to indicate a gas stream pressure that can be related to thrust, for each engine.

(2) A position indicating means to indicate to the flight crew when the thrust reversing device is in the reverse thrust position, for each engine using a thrust reversing device.

(e) *For turbopropeller-powered airplanes.* In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required:

(1) A torque indicator for each engine.

(2) Position indicating means to indicate to the flight crew when the propeller blade angle is below the flight low pitch positon, for each propeller.

(3) A means to indicate to the pilot when the propeller is in reverse pitch, for each reversing propeller.

100. Section 25.1307 is amended to read as follows:

§ 25.1307 Miscellaneous equipment.

The following is required miscellaneous equipment:

(a) A seat and safety belt, for each occupant.

(b) Two or more independent sources of electrical energy.

(c) Electrical protective devices, as prescribed in this part.

(d) Two systems for two-way radio communications, with controls for each

accessible from each pilot station, designed and installed so that failure of one system will not preclude operation of the other system. The use of a common antenna system is acceptable if adequate reliability is shown.

(e) Two systems for radio navigation, with controls for each accessible from each pilot station, designed and installed so that failure of one system will not preclude operation of the other system. The use of a common antenna system is acceptable if adequate reliability is shown.

(f) A windshield wiper, or equivalent, for each pilot station.

(g) An ignition switch, for each engine.

(h) Portable fire extinguishers as prescribed in § 25.853 (e) and (f).

101. Section 25.1309 is amended to read as follows:

§ 25.1309 Equipment systems and installations.

(a) The equipment, systems, and installations whose functioning is required by this subchapter, must be designed to ensure that they perform their intended functions under any foreseeable operating condition.

(b) The airplane systems and associated components, considered separately and in relation to other systems, must be designed so that—

(1) The occurrence of any failure condition which would prevent the continued safe flight and landing of the airplane is extremely improbable, and

(2) The occurrence of any other failure conditions which would result in injury to the occupants, or reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions is improbable.

(c) Warning information must be provided to alert the crew to unsafe system operating conditions, and to enable them to take appropriate corrective action. Systems, controls, and associated monitoring and warning means must be designed so that crew errors that would create additional hazards are improbable.

(d) Compliance with the requirements of paragraphs (b) and (c) of this section must be shown by analysis, and where necessary, by appropriate ground, flight, or flight simulator tests. The analysis must consider—

(1) Possible modes of failure, including malfunctions and damage from external sources.

(2) The probability of multiple failures and undetected failures.

(3) The resulting effects on the airplane and occupants, considering the stage of flight and operating conditions, and

(4) The crew warning cues, corrective action required, and the capability of detecting faults.

(e) Each installation whose functioning is required by this subchapter, and that requires a power supply, is an "essential load" on the power supply. The power sources and the system must be able to supply the following power loads in probable operating combinations and for probable durations:

(1) Loads connected to the system with the system functioning normally.

(2) Essential loads, after failure of any one prime mover, power converter, or energy storage device.

(3) Essential loads after failure of—

(i) Any one engine on two- or three-engine airplanes; and

(ii) Any two engines on four-or-more-engine airplanes.

(4) Essential loads for which an alternate source of power is required by this chapter, after any failure or malfunction in any one power supply system, distribution system, or other utilization system.

(f) In determining compliance with paragraph (e) (2) and (3) of this section, the powerloads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operation authorized. Loads not required in controlled flight need not be considered for the two-engine-inoperative condition on airplanes with four or more engines.

(g) In showing compliance with paragraphs (a) and (b) of this section with regard to the electrical system and equipment design and installation, critical environmental conditions must be considered. For electrical generation, distribution, and utilization equipment required by or used in complying with this chapter, except equipment covered by Technical Standard Orders containing environmental test procedures, the ability to provide continuous, safe service under foreseeable environmental conditions may be shown by environmental tests, design analysis, or reference to previous comparable service experience on other aircraft.

102. Section 25.1321 is amended to read as follows:

§ 25.1321 Arrangement and visibility.

(a) Each flight, navigation, and powerplant instrument for use by any pilot must be plainly visible to him from his station with the minimum practicable deviation from his normal position and line of vision when he is looking forward along the flight path.

(b) The flight instruments required by § 25.1303 must be grouped on the instrument panel and centered as nearly as practicable about the vertical plane of the pilot's forward vision. In addition—

(1) The instrument that most effectively indicates attitude must be on the panel in the top center position;

(2) The instrument that most effectively indicates airspeed must be adjacent to and directly to the left of the instrument in the top center position;

(3) The instrument that most effectively indicates altitude must be adjacent to and directly to the right of the instrument in the top center position; and

(4) The instrument that most effectively indicates direction of flight must be adjacent to and directly below the instrument in the top center position.

(c) Required powerplant instruments must be closely grouped on the instrument panel. In addition—

(1) The location of identical powerplant instruments for the engines must prevent confusion as to which engine each instrument relates; and

(2) Powerplant instruments vital to the safe operation of the airplane must be plainly visible to the appropriate crewmembers.

(d) Instrument panel vibration may not damage or impair the accuracy of any instrument.

103. Section 25.1331 is amended by amending paragraph (a) to read as follows:

§ 25.1331 Instruments using a power supply.

(a) For each instrument required by § 25.1303(b) that uses a power supply, the following apply:

(1) Each instrument must have a visual means integral with, or adjacent to, the instrument, to indicate when power adequate to sustain proper instrument performance is not being supplied. The power must be measured at or near the point where it enters the instruments. For electric instruments, the power is considered to be adequate when the voltage is within approved limits.

(2) Each instrument must have two independent power sources and a means for selecting either source.

* * * * *

104. Section 25.1333 is amended to read as follows:

§ 25.1333 Instrument systems.

For systems that operate the instruments required by § 25.1303(b) which are located at each pilot's station—

(a) Means must be provided to connect the required instruments at the first pilot's station to operating systems which are independent of the operating systems at other flight crew stations, or other equipment.

(b) The equipment, systems, and installations must be designed so that one display of the information essential to the safety of flight which is provided by the instruments, including attitude, direction, airspeed, and altitude will remain available to the pilots, without additional crewmember action, after any single failure or combination of failures that is not shown to be extremely improbable; and

(c) Additional instruments, systems, or equipment may not be connected to the operating systems for the required instruments, unless provisions are made to ensure the continued normal functioning of the required instruments in the event of any malfunction of the additional instruments, systems, or equipment which is not shown to be extremely improbable.

§ 25.1355 [Amended]

105. Section 25.1355 is amended by revoking paragraph (b).

§ 25.1369 [Revoked]

106. Section 25.1369 is revoked.

107. Section 25.1419 is amended by amending paragraph (c) to read as follows:

§ 25.1419 Ice protection.

* * * * *

(c) In addition to the analysis and physical evaluation prescribed in paragraph (b) of this section, the effectiveness of the ice protection system and its components must be shown by flight tests of the airplane or its components in measured natural atmospheric icing conditions and by one or more of the following tests as found necessary to determine adequacy of the ice protection system:

(1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.

(2) Flight dry air tests of the ice protection system as a whole, or of its individual components.

(3) Flight tests of the airplane or its components in measured simulated icing conditions.

* * * * *

108. Section 25.1435 is amended by amending paragraph (a)(4) to read as follows:

§ 25.1435 Hydraulic systems.

(a) * * *

(4) There must be means to insure that system pressures, including transient pressures and pressures from fluid volumetric changes in components which are likely to remain closed long enough for such changes to occur—

(i) Will be within 90 to 110 percent of pump average discharge pressure at each pump outlet or at the outlet of the pump transient pressure dampening device, if provided; and

(ii) Will not exceed 125 percent of the design operating pressure, excluding pressures at the outlets specified in subdivision (i) of this subparagraph. Design operating pressure is the maximum steady operating pressure.

* * * * *

109. Section 25.1455 is amended to read as follows:

§ 25.1455 Draining of fluids subject to freezing.

If fluids subject to freezing may be drained overboard in flight or during ground operation, the drains must be designed and located to prevent the formation of hazardous quantities of ice on the airplane as a result of the drainage.

110. Section 25.1505 is amended to read as follows:

§ 25.1505 Maximum operating limit speed.

The maximum operating limit speed (V_{MO}/M_{MO} airspeed or Mach Number, whichever is critical at a particular altitude) is a speed that may not be deliberately exceeded in any regime of flight (climb, cruise, or descent), unless a higher speed is authorized for flight test or pilot training operations. V_{MO}/M_{MO} must be established so that it is not greater than the design cruising speed V_C and so that it is sufficiently below V_D/M_D or V_{DF}/M_{DF}, to make it highly improbable that the latter speeds will be inadvertently exceeded in operations. The speed margin between V_{MO}/V_{MO} and V_D/M_D or V_{DF}/M_{DF} may not be less than that determined under § 25.335(b) or found necessary during the flight tests conducted under § 25.253.

111. Section 25.1585 is amended by amending paragraph (a) by striking out the word "and" at the end of subparagraph (5), by striking out the period at the end of subparagraph (6) and by inserting a semicolon and the word "and" in place thereof, and by adding new subparagraphs (7) and (8); and by adding a new paragraph (c), to read as follows:

§ 25.1585 Operating procedures.

(a) * * *

(7) Use of fuel jettisoning equipment (including information to warn flight crewmembers against jettisoning fuel when any means (including flaps, slots, and slats) for changing the airflow across or around the wings are being used); and

(8) Operation in turbulence for turbine powered airplanes (including recommended turbulence penetration airspeeds, flight peculiarities, and special control instructions).

* * * * *

(c) The buffet onset envelopes determined under § 25.251 must be furnished.

112. Section 25.1587 is amended by amending paragraph (a) to read as follows:

§ 25.1587 Performance information.

(a) *Each airplane.* For each airplane the Airplane Flight Manual must contain information to permit conversion of the indicated temperature to free-air temperature if other than a free-air temperature indicator is used to comply with the requirements of § 25.1303(a)(1).

* * * * *

(Secs. 313(a), 601, 603, Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)).

Issued in Washington, D.C., on April 1, 1970.

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Administrator.