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14 CFR Parts 1, 27, 29, and 91
Rotorcraft Regulatory Review Program; Amendment No. 2; Final Rule

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 1, 27, 29, and 91

[Docket No. 23266; Amdts. 1-32, 27-21, 29-24, and 91-185]

Rotorcraft Regulatory Review Program; Amendment No. 2

See correction

AGENCY: Federal Aviation Administration (FFA), DOT.

ACTION: Final rule.

SUMMARY: This rule adopts new airworthiness standards for type certification of normal and transport category rotorcraft. New Standards are necessary because of the phenomenal growth of the rotorcraft industry and the recognition by both government and industry that the updated standards are needed. This rule changes those sections of Parts 1, 27, 29, and 91, of the Federal Aviation Regulations which apply to rotorcraft flight characteristics, systems, and equipment.

EFFECTIVE DATE: December 6, 1984.

FOR FURTHER INFORMATION CONTACT: Jim S. Honaker, Regulations Program Management (ASW-111), Aircraft Certification Division, mailing address: P.O. Box 1689, Fort Worth, Texas 76101, or office location at 4400 Blue Mound Road, Fort Worth, Texas 76106, telephone (817) 877-2552.

SUPPLEMENTARY INFORMATION: These amendments are the second in a series of amendments to be issued as a part of the Rotorcraft Regulatory Review Program. The first of the series of amendments of the Rotorcraft Regulatory Review Program addressed applicability, instrument flight rules (IFR) certification and icing certification standards and was published in the **Federal Register** on January 31, 1983 (48 FR 4374).

These amendments are based on Notice of Proposed Rulemaking No. 82-12 published in the **Federal Register** on August 26, 1982 (47 FR 37806). All interested persons have been given an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review by the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and reasons for their adoption are the same as those contained in Notice 82-12, and, unless otherwise indicated, the proposals contained in the notice have been adopted without change.

Discussion of Comments

The following discussions are keyed to like-numbered proposals in Notice 82-12 and are presented in the same order as the corresponding amendments found in the rules portion of this document.

Proposal 2-1. Three comments were received to this proposal, all of which primarily agreed but raised areas of concern. One commenter recommends deleting the last sentence of the § 1.1 proposed definitions of climbout speed and takeoff safety speed. That sentence, in both definitions, states that these airspeeds are determined from the Rotorcraft Flight Manual. The commenter is correct in that this location of airspeed information is not appropriate in a definition. The location of airspeed information is also inappropriate for a certification applicant that determines these airspeeds by engineering actions which are used to develop the Rotorcraft Flight Manual. Accordingly, the last sentences in these proposed definitions are deleted.

The same commenter and a second commenter suggest that further changes appear necessary to clarify and differentiate between the definitions and abbreviations in Part 1 pertaining to fixed-wing aircraft and helicopters. Such a change, however, was recognized by the commenters as being beyond the scope of the notice.

A third commenter suggests that, as worded, takeoff safety speed will be applicable to fixed-wing aircraft and a decision on its inclusion should be withheld until fixed-wing operators have commented. All these commenters have some association with fixed-wing aircraft and offered no comments on conflict with aircraft usage. The FAA concludes that the definition is compatible with all aircraft. The definitions of this proposal are adopted with the changes noted.

Proposal 2-2. No comments were received on the proposal to add the definition of V_{TOSS} to § 1.2 except the recommendation for further clarification between rotorcraft and airplane definitions and abbreviations of Part 1 noted in Proposal 2-1. The proposed amendment is adopted without change.

Proposal 2-3. No comments were received on this proposal.

Proposal 2-4. One commenter recommends deleting the phrase "prior to takeoff" from the proposed addition of § 27.45(f) concerning engine power determination. A second commenter made the same recommendation for Proposal 2-33.

Determining engine power available before being committed to flight has long been a problem that helicopter pilots have faced. During normal operations, applying full power results in the helicopter becoming airborne and climbing. Even applying full power to only one engine on a multiengine helicopter will result in it becoming light on the landing gear, essentially flying, or actually airborne if operating at a light weight. Shortly after becoming airborne is not the proper time for the pilot to discover that there is less power available than anticipated.

The first commenter states that the proposed change does not recognize advances in technology which may indicate engine condition to the pilot before takeoff and that a power check before each flight is time-consuming, unnecessary, and economically punishing. The second commenter states that engine characteristics are such that meaningful checks must be completed at or near such [full power] ratings which would probably result in single-engine liftoff.

As noted in the explanation of Proposal 2-33, a preflight power-assurance check procedure is required by special conditions for all current transport category turbine-powered rotorcraft. Compliance typically involves flight manual instructions for partial power checks in addition to specifications for validating limit power during production acceptance and engine maintenance or replacement activities. Similar methods of compliance are suitable under the proposed rule. The FAA recognizes the deficiencies of such a pretakeoff check as stated by the second commenter but considers this procedure significantly safer than having no means to evaluate engine operation.

The second commenter suggests that a system of engine condition monitoring carried ou' at significantly high power plus a preflight function check would satisfy this requirement. The FAA agrees provided the commenter's meaning of "preflight functional check" is essentially the same as "a means must be provided to permit the pilot to determine prior to takeoff." The proposal does not preclude the use of advanced technology for a system such as automatic monitoring of engine condition with appropriate warning to the pilot.

A third commenter states that there is a need to simplify procedures and recommends use of a calculator, either mechanical or electronic, as an

improvement over charts. Specifying such a means to make a power check would inhibit innovation. The proposed amendment is adopted without change.

Proposal 2–5. The only comment received agrees with the proposal.

Proposal 2–6. One commenter agrees with the proposal to change § 27.79 to permit determination of the height-velocity envelope at the highest weight allowing hovering out-of-ground effect. A second commenter recommends that the second sentence of the proposal be changed for helicopters such that the weight need not exceed the highest weight allowing hovering out-of-ground effect at altitudes above sea level. This commenter states that his proposed change would be in agreement with the change proposed (and subsequently accepted) for § 29.79 in Notice 80–25 (45 FR 83424), the first notice of this Rotorcraft Regulatory Review Program. However, that notice states that the height-velocity demonstration weight must be the maximum approved for takeoff and landing but need not exceed the weight allowing hovering out-of-ground effect. The new § 29.79(a)(2) establishes demonstration weights at or near the maximum operating weight. The commenter's suggestion does not establish a minimum demonstration weight, that is, minimum weight does not exceed the highest weight allowing hovering out-of-ground effect. Accordingly, the amendment is adopted without change.

Proposal 2–7. One commenter agrees with the proposal to simplify § 27.141 and add temperature accountability into the flight characteristics requirements. A second commenter questions the need to demonstrate all flight characteristics at all allowable temperatures and requests that the basis for the need be clearly addressed in Advisory Circular 29–2, "Certification of Transport Category Rotorcraft," and in the comparable document that is to be written for Part 27. This information will be included in the advisory circulars. The FAA has found that some advanced technology rotor systems are affected by temperature variations in some areas of stability and control, vibration, and the more well-known rotor blade tip mach number effects. The amendment is adopted as proposed.

Proposal 2–8. Only one comment was received, and that comment agrees with the proposal.

Proposal 2–9. Only one comment was received, and that comment agrees with the proposal.

Proposal 2–10. One comment on the proposed § 27.161 trim control requirements recommends that the control forces must be trimmable only to "approximately zero" rather than "zero." The proposal did not address control force but only adds collective trim control to the present requirement for longitudinal and lateral trim controls. The commenter states that for many years helicopters have operated successfully without "zero" trimming and that the small deviations from zero have been taken care of by small amounts of friction.

The commenter's suggestion is the same as one received for the Rotorcraft Regulatory Review conference (conference Proposal 35) and was discussed in the Appendix to Notice 82–12. The FAA finds that the reasons given in the Appendix to Notice 82–12 for requiring zero trim are still valid.

A second commenter agrees with the proposal, but wants the capability of disabling the trim system at the pilot's option for takeoff, landing, and hovering. This change is beyond the scope of the notice. The amendment is adopted as proposed.

Proposals 2–11 and 2–12. One commenter recommends deleting proposed §§ 27.173(c) and 27.175(d), both of which refer to static longitudinal stability in a hover. The commenter states that hovering is a hands-on flight condition requiring continuous movement of all four controls. The commenter argued that requiring that the pilot's hand be in a certain range of positions does not result in an increased level of safety. The commenter also states that the general paragraph on controllability and maneuverability provides adequate safety requirements.

The proposed changes concerning the hover flight regime serve only to clarify the present rules. Existing stability and control literature shows the unsafe flight conditions resulting from excessive negative stability and the limits of negative stability that allow controlled, but not necessarily acceptable, flight. The FAA agrees that hovering presents special considerations. Deleting the paragraphs, as the commenter suggests, would leave the hover flight condition addressed by the most general of requirements. This could lead to a confusion of interpretations of hover requirements such as including requirements intended only for level forward flight. To meet the positive stability requirements of forward flight during hover would be extremely burdensome, perhaps not even possible.

A second commenter agrees with both proposals as written. These amendments are adopted as proposed.

Proposal 2–13. One commenter agrees with the proposal to add a new § 27.177 requiring positive static directional stability. A second commenter recommends deleting the last sentence, which requires sufficient pilot cues of sideslip to assure safe operations, because it is unnecessary and introduces a qualitative issue which could lead to misinterpretation and misapplication of the intended rule.

While the FAA does not agree that the last sentence should be deleted, it has been changed to read "Sufficient cues must accompany sideslip to alert the pilot when approaching sideslip limits." This will more clearly state the intent of the rule. The alternative to this somewhat broad statement would be to identify all possible cues which would result in unnecessary complexity.

A third commenter recommends that instead of requiring positive static directional stability, the rule should only require that there be no negative static directional stability perceptible to the pilot through the directional pedals. Positive directional stability is necessary to ensure minimum satisfactory stability and control characteristics and to inhibit exceeding sideslip limits. This suggestion could result in considerable misinterpretation and misapplication as to how much negative stability is perceptible to which pilot.

The third commenter also states that the proposed requirement to demonstrate static directional stability will increase certification test time by 5 hours. Review by the FAA indicates that the wording of the proposal, with reference to the conditions for demonstration of static longitudinal stability, could be misinterpreted to require excessive (5 hours) testing. The amendment is reworded to specify testing at the trim airspeeds used to demonstrate static longitudinal stability in climb and level flight (and in autorotation for Part 29) tests. This will permit the directional stability tests to be accomplished on the same flights as static longitudinal stability tests with an increase of test time of less than 1 hour.

The amendment is adopted with the noted changes to clarify the intent of the proposal.

Proposal 2–14. One commenter agrees with the proposal to add a new § 27.610 specifying lightning protection requirements. A second commenter suggests limiting the lightning protection requirement to those rotorcraft being certificated for IFR flight. This commenter states that in 13 million VFR flight hours of one manufacturer's fleet, only one non-severe lightning strike was reported and that a statement in the Rotorcraft Flight Manual to avoid flying near storms or vertical clouds would be sufficient. This commenter also states

that meeting the requirement would be very expensive and complex but he fails to provide any details or other indication of cost or magnitude. Research by numerous technical groups studying lightning has disclosed that strikes occur in both VFR and IFR conditions. These studies have also shown that unless thunderstorm turbulence, hail, and rain are circumnavigated by well over 25 miles, an occasional lightning strike will occur. There are many reports of lightning strikes occurring to aircraft operating between clouds or in areas where no thunderstorms were forecast, and a few pilots have reported "bolts from the blue."

The FAA is aware of one U.S. manufactured helicopter series that has been struck by lightning four times since certification in 1980. This particular helicopter series is very limited in number, but most operations have been in a more than normally hostile weather environment. Only minor damage resulted from the lightning strikes because the helicopter manufacturer voluntarily followed good design practices for lightning protection although the applicable airworthiness regulation had no specific lightning protection requirement. In a recent study including in-flight strike data collected over an eight year period, 36 percent of the recorded strikes occurred below 10,000 feet man sea level (MSL) altitude, and 87 percent of the recorded strikes occurred below 16,000 feet MSL. Since rotorcraft are not pressurized, are rarely equipped with oxygen, and operation at the higher altitudes is inefficient, most operations occur below 10,000 feet MSL and very rarely above 16,000 feet MSL.

The proposed change uses the same words as those used for large airplanes in Part 25. Many airplanes have been struck by lightning, but only a very few have resulted in catastrophic failure. Since the wording of the proposed change is general in nature and there are no specific provisions uniquely applicable to fixed-wing aircraft, the FAA concludes extension of the standard to rotorcraft will provide rotorcraft occupants the same degree of safety from lightning as provided fixed-wing aircraft occupants.

The FAA forecasts that by the year 2000 the rotorcraft fleet size will nearly double to approximately 20,000 units. In addition, the trend is going towards more complex, fully instrument flight equipped rotorcraft that will be conducting more operations in adverse weather conditions, including icing, where lightning strikes are more likely to occur.

Application of new technology to rotorcraft is also a factor in consideration of the need for protection against lightning. There is an increasing trend toward the use of composite materials in the rotorcraft structure. Since these materials are nonconductive, additional precautions must be taken to assure proper lightning current paths to retain structural integrity and allow protection of installed systems. Programmable, microprocessor-based digital equipment is rapidly being applied in critical functions such as electronic fuel controls and Electronic Flight Instrument Systems (EFIS). The EFIS systems have complete instrument panel displays that are of the cathode ray type, driven by digital computers. Many present generation automatic flight control systems are digital based, and further application of digital computer technology to critical flight controls is anticipated. If proper design precautions are not taken in the basic rotorcraft and system installations, computer memories can be lost, programs can be upset, or complete computer destruction can occur with a lightning strike.

Although Notice 82-12 presented no economic estimate for this change and specifically requested such data, none was received—except the second commenter's statement that it would be "very expensive." However, as noted in Table 1 of the economic summary, an FAA, NASA, and DOD task force is engaged in a lightning research effort. The FAA plans to pass the results of that effort on to the public via advisory circular material, thus minimizing each applicant's lightning research costs.

In view of the increased criticality of structure and systems subject to lightning damage, plus the increase in fleet size and operations in environments where lightning strikes frequently occur, the FAA finds it necessary to provide these standards. Therefore the amendment is adopted as proposed.

Proposal 2-15. One commenter suggests that "any failure" as used in proposed § 27.672(a) be clarified to exclude mechanical failures. The FAA disagrees as §§ 27.695(c) and 29.695(c) require that for power-boost and power-operated control systems, "The failure of mechanical parts (such as piston rods and links), and the jamming of the power cylinders, must be considered unless they are extremely improbable." FAA review noted that the reference to § 29.671 should be § 27.671; this is corrected. The proposed amendment is adopted with the corrected reference.

Proposal 2-16. Only one comment was received, and it agrees with this proposal.

Proposal 2-17. One commenter agrees with the proposal to add a new § 27.729 concerning landing gear retracting mechanisms but states that with existing systems where "landing-gear-not-down-warning" is based only on airspeed, there is a problem of continuous warning when operating with Category B external loads at slow airspeeds and with the landing gear retracted. The proposal requires a manual shutoff capability which will enable the crew to silence the aural warning and continue such external-load Category B operations. Several rotorcraft have an airspeed activated system and the FAA has found that this is satisfactory. The amendment is adopted as proposed.

Proposal 2-18. Only one comment was received and it agrees with this proposal.

Proposal 2-19. This is a parallel proposal to Proposal 2-52. See that proposal for comments, analysis, and changes.

Proposal 2-20. This proposal changes the title of § 27.785 and significantly increases the detail of seats, berths, safety belts, and harnesses requirements. One commenter suggests that paragraph (b) be replaced by a requirement that each occupant must be protected from head and upper torso injury by a safety belt and shoulder harness. This commenter states that the shoulder harness increases an occupant's tolerance to vertical impact loads without injury from about 4g to 25g. However, no cost data for this requirement were submitted and the FAA estimates that the cost would be significant. The FAA is participating in several studies and reviews of crash results and requirements. The proposed amendment aligns the rule with airplane rules and the limited conclusions available to date. It would be inappropriate to accept the suggested change until more data, especially cost, are available from these or other studies.

A second commenter suggests that a third option be listed in paragraph (b)(2) indicating that a safety belt plus a shoulder harness is acceptable and that the proposed (b)(2)(ii) be prefaced by the phrase, "for aft-facing seats."

The latter portion of this suggestion would appear to eliminate consideration for side-facing seats, while the proposal, without the "aft-facing seat" phrase, was intended to include seats with any orientation.

The first portion of this commenter's suggestion points out that a combination

of safety belt and shoulder harness is an acceptable method. This proposed change helps clarify the amendment and is included in paragraph (b)(2).

A third commenter notes that the National Transportation Safety Board (NTSB) has recommended for many years that shoulder harnesses be installed in light airplanes at all seat locations and sees no difference in the basic survivability issues between airplanes and rotorcraft. This commenter concludes that sufficient data, including U.S Army crashworthiness data dating back to 1960, are available to justify a requirement for a shoulder harness at each seat location in normal category rotorcraft. A fourth commenter states that every effort should be made to take advantage of the research and development conducted during the last several years to require built-in crashworthiness. As noted, most of the crashworthiness studies have been accomplished by and for the military, which has different design standards than civil rotorcraft. Using only military data to establish civil requirements could very well result in requirements that would be excessively and possibly prohibitively expensive in initial and operating costs. Further changes will be deferred until completion of the FAA crashworthiness program. The amendment is adopted with the one change discussed.

Proposal 2–21. Only one comment was received. It agrees with this proposal.

Proposal 2–22. One commenter agrees with the proposal to relax equipment, systems, and installation design requirements for single engine rotorcraft and to require consideration of lightning strikes on rotorcraft.

Two additional commenters suggest that proposed § 27.1309(d) include a reference to § 27.610, to agree with the § 29.1309. This reference is added.

A fourth commenter says he does not understand the different criteria based on the number of engines. In the present rules, the requirements in § 27.1309 (a) and (b) are identical to § 29.1309 (a) and (b), which is contrary to the concept of less strict requirements in Part 27, where applicable. The proposed change relieves the requirements of Part 27 by considering only probable failures and by recognizing the different operational capabilities and levels of probable safety between single-engine and multiengine rotorcraft after a probable failure. The proposed amendment is adopted with the reference to § 27.610 added.

Proposal 2–23. This proposal adds a new § 27.1329 describing automatic pilot system requirements. One comment suggests that "system" be replaced with "automatic pilot" to be consistent with § 29.1329(e). This will also be consistent with §§ 23.1329(e) and 25.1329(g). The FAA concurs and the proposal is adopted with this change.

Proposal 2–24. Only one comment was received and that comment agrees with the proposal.

Proposal 2–25. Only one comment was received and that comment agrees with this proposal.

Proposal 2–26. One commenter recommends adding the phrase "except for the weight demonstrated according to § 27.79" to indicate more clearly that height-velocity data are in no way limiting to the proposed change to delete § 27.1519 (b) and the (a) designation of § 27.1519(a).

The explanation in the notice gives considerable detail about changes being made to the rule to clarify that height-velocity data are not limitations. Also similar wording has been in effect for many years without causing problems. Therefore, the commenter's exception phrase is not considered necessary. A second commenter agrees with the proposal. The amendment is adopted as proposed.

Proposal 2–27. Only one comment was received and it agrees with this proposal.

Proposal 2–28. One commenter agrees with the proposal concerning § 27.1555, Control markings. A second commenter suggests that proposed paragraph (e), which would require that the maximum landing gear operating speed be plainly marked close to the landing gear control, be deleted as unnecessary. This commenter states that all pilots know landing gear operating speeds without spoonfeeding them with unwarranted placards and instructions. The FAA does not agree.

Retractable landing gear is still not common in small helicopters. A pilot that flies rotorcraft with and without retractable gear may know and review the operating speeds but landing gear speeds are not speeds that stand out during a review. Therefore, a placard reminder seems prudent.

The FAA has reviewed the proposal to require the marking to be located close to the landing gear control. While displaying the speed near the control has several advantages, many pilots prefer using one placard for several airspeed limits. A one-placard concept allows placing this information where it is consolidated and clearly available to the pilot without disrupting good instrument or control placement. Therefore, this proposal, as adopted, requires the maximum landing gear operating speed to be displayed in clear view of the pilot to permit the one-placard concept.

Proposal 2–29. One commenter agrees with the proposal to shorten the limitation placard wording required by § 27.1559. A second commenter suggests that the required placard state, "Refer to the approved Rotorcraft Flight Manual for kinds of approved operations." According to the commenter, this would relieve the requirement for a drawing change, a new decal, and FAA approval of these each time there is a change in approved operations.

Normally, this would be a very minor part of the effort to obtain FAA approval of a different kind of operation. One manufacturer sends Rotorcraft Flight Manual Supplements to all owners when a modification kit is FAA approved; however, each rotorcraft is not approved for the new kind of operation until the kit is installed, so a pilot looking at one of these Rotorcraft Flight Manuals still would not know if the helicopter is approved for that type operation. The limitation placard as proposed is the most positive method of readily identifying the kinds of operations that are approved for a specific rotorcraft. The amendment is adopted as proposed.

Proposal 2–30. One commenter agrees with the proposal. A second commenter recommends that the proposed § 27.1585(a) (1) and (2) and the lead-in sentence to these subdivisions be deleted. This commenter states that the phrase "other information" in paragraph (a), concerning operating procedures, adequately covers the requirement to identify takeoff and landing surfaces used in the tests and the appropriate airspeeds. The commenter states that the requirement to identify takeoff and landing surface and associated airspeeds is not the only type of "other information" and should be contained in guidance information rather than the rule. While the kind of takeoff and landing surface and associated airspeeds are not the only type of "other information," these are important and specific enough to be included in the rule as a requirement for all rotorcraft. The amendment is adopted as proposed.

Proposal 2–31. One commenter agrees with the proposal. A second commenter suggests statements in § 27.1587 to prevent including performance information which exceeds operating limits and a requirement to show the maximum demonstrated wind for starting and stopping the rotors. This commenter also suggests that the minimum demonstration wind for starting and stopping the rotors be at least 17 knots to agree with

controllability and maneuverability requirements. These suggestions were originally conference Proposal 144 and were removed from further consideration as noted in the appendix of Notice 82–12 as being an unnecessary burden for small rotorcraft. The rationale in the appendix explanation is still valid. The amendment is adopted as proposed.

Proposal 2–32. No comments were received on this proposal.

Proposal 2–33. Two commenters suggest that the word "limiting" be deleted from the proposed § 29.45(c)(2) as it relates to power absorbed by the accessories and services. The second of these commenters recommends that "and approved" be added to the end of this proposal. Both commenters state that including the word "limiting" will cause confusion since the intent of the change is to allow power determination with the accessories at a value less than the limit value. As an example, an applicant may select a generator that has a "limit" rating of 300 amperes but the maximum load possible for this specific rotorcraft would be 200 amperes; therefore, the power absorbed by this generator load would be based on 200 rather than 300 amperes. Adding equipment to this rotorcraft that could impose a load greater than the 200 amperes would require meeting all the certification requirements, including power determination, as if a larger generator were installed. Both commenters suggest that guidance material should be used to clarify power determination. The FAA agrees with these comments and § 29.45(c)(2) is changed by deleting "limiting" and adding "and approved".

The same two commenters also recommend that the phrase "prior to takeoff" be deleted in the proposed § 29.45(f). A third commenter suggests simplifying the procedure with a mechanical or electronic computer. The FAA's response to these comments is contained in the discussion of Proposal 2–4. This portion of the amendment is adopted as proposed.

Proposal 2–34. One commenter agrees with the proposal. A second commenter notes that as the proposal is worded, a critical decision point (CDP) and acceleration to V_{TOSS} below 35 feet or a descent from the CDP to below 35 feet while accelerating to V_{TOSS} would not be permitted. This is not the intent of the proposal. This commenter suggests the wording ". . . takeoff safety speed and a height of 35 feet above the ground or greater and the climbout must be made . . . ." This wording corrects the proposal to that intended and § 29.59 is revised accordingly.

Proposals 2–35 and 2–36. Only one commenter responded to these proposals, and his comments agree with both proposals.

Proposal 2–37. The comments offered on Proposal 2–7 were also provided on the proposal to add temperature considerations to § 29.141. See explanation for Proposal 2–7. The amendment is adopted as proposed.

Proposal 2–38. Only one comment was received, and it agrees with this proposal.

Proposal 2–39. Only one comment was received and it agrees with the proposal.

Proposal 2–40. One commenter suggests that a directional trim requirement be added to § 29.161. As stated in Proposal 2–10 explanation, directional trim was considered and deemed not required. The commenter does not present justification that had not been previously considered. The commenter also suggests requiring trimming of collective forces to zero in a hover. This was also considered and, as noted in Notice 82–12 (Proposal 2–10), hovering flight is considered a hands-on condition for which a trim requirement is not warranted.

The same commenter further suggests that cyclic and directional control forces of zero in a hover are not required, but some maximum value, such as 5 pounds, should be required for each axis. This is beyond the scope of the notice.

A second commenter suggests requiring the capability to disarm the trim system. This also is beyond the scope of the notice. The amendment is adopted as proposed.

Proposals 2–41 and 2–42. Both of these proposals concern static longitudinal stability in a hover as addressed in § 29.173 and § 29.175. One commenter agrees with both. A second commenter had the same comments as for Proposals 2–11 and 2–12, proposals for comparable requirements for Part 27. Refer to Proposals 2–11 and 2–12 for explanation. In Proposal 2–41, reference to § 27.175 (a) and (d) is corrected to § 29.175 (a) and (d). The amendment is adopted with the noted corrections.

Proposal 2–43. The same comments as for Proposal 2–13 were received for this proposal adding static directional stability requirements in a new § 29.177. See Proposal 2–13 for explanation; the same changes are made and the amendment adopted.

Proposal 2–44. One commenter agrees with the proposal for a new § 29.181 concerning dynamic stability for Category A rotorcraft. A second commenter suggests deleting the entire proposal because the FAA's claims are incorrect when stating that all recently certificated models have met this dynamic stability requirement and that it is less stringent than the fixed-wing requirement. This commenter states that some recently certificated rotorcraft may possess positive damping but most do not comply throughout the approved operating envelope. To meet this requirement, according to this commenter, some degree of added stability augmentation would be required at a significant increase in cost and complexity.

The proposal explanation includes considerable detail as to why this dynamic stability requirement is for Category A rotorcraft only, how it relates to the Category A concept, and how it is necessary as a backup standard for the Category A IFR stability augmentation failure condition. Recently certificated Category A rotorcraft have met this standard at airspeeds above climb speed which is the proposed requirement. All recently certificated Category A rotorcraft may not have met this standard throughout their approved operating envelope as this commenter incorrectly implies the requirement to be.

In comparing the proposed dynamic stability requirements with those of fixed-wing airplanes, this second commenter states that following a stability augmentation failure, § 25.672 requires an airplane to meet only the controllability and maneuverability standards, not the stability or other flight characteristics standards, while the proposed IFR requirements for Part 29 (Notice 80–25 [45 FR 83424; December 18, 1980], which have been adopted without change in this area) include the requirement to meet all the flight characteristics of Subpart B of Part 29. This difference in the requirements between Part 25 and Part 29 results in airplanes not being required to comply with the dynamic stability standards after a stability augmentation system failure, while including this proposal in the Subpart B of Part 29 will require the Category A rotorcraft to continue to meet the standard after a failure when seeking IFR certification. The commenter is correct in that for the IFR failure case, not only is the specific standard for dynamic stability more strict but flight characteristics standards, in general, are more strict. Justifications for the Part 29 IFR requirements are contained in Notice 80–25 and in the preamble of the final rule (48 FR 4374; January 31, 1983). However, Notice 82–12 proposes a new § 29.672 which reads essentially the same as § 25.672; so for the Part 29 VFR case, a stability augmentation system failure does not increase the standard

compared to Part 25. For VFR certification under Part 29, the proposed requirement for only positive damping is less stringent than the heavily damped requirement in Part 25. Accordingly, the amendment is adopted as proposed.

Proposal 2–45. This proposal establishes lightning protection requirements in a new § 29.610. See Proposal 2–14 for comments and explanation. The amendment is adopted as proposed.

Proposal 2–46. One commenter agrees with the proposal to add a new § 29.671(c), stating that it "could add appreciably to the cost of manufacture and maintenance; however, . . . the cost may be justified." This commenter also notes that future "fly-by-wire" helicopters will require ground testing such as proposed.

A second commenter suggests the proposal be deleted stating that it would not fulfill the objectives desired by the FAA, that control interference and rigging checks cannot be conducted on the flight line, and that the quality of maintenance is not relevant to airworthiness regulatory action. It is likely that only significant control interference or misrigging would be discovered on a preflight check and these should have been detected on maintenance inspections; however, foreign objects in the control system and some partial failures could be detected. The quality of maintenance may not be relevant to type certification, but affording the pilot the capability to assure (within limits) that the aircraft is airworthy certainly is relevant. The recent trend towards use of composite rotor hubs with fewer hinges further restricts the allowable control inputs that can be made with the rotors turning and the rotorcraft on the ground. Therefore, unless some other alternative is provided, the pilot will have even less capability to determine airworthiness.

The second commenter further reviews the 13 accidents cited in the notice where it was stated that three might have been prevented by a method to check full control action before takeoff. This commenter states that none of these accidents would have been prevented by the proposal. This commenter cites one accident that occurred 3 to 4 miles from the departure point, and concludes that the proposed preflight check would not have been of merit. The same conclusion is reached in three other accidents where there was some period of flight before an accident. The FAA does not concur that a period of flight before an accident occurs proves that the proposed check is invalid. The critical control condition may not have been encountered until that point in the flight. It also should be noted that the six types of helicopters involved in these accidents were certificated in 1952, 1956, 1961, 1968, 1970, and 1976. This commenter concludes with the statement, "Thus, it appears that from Part 29 helicopter accident history, there is no justification to incorporate this NPRM." As explained in the notice, a few accidents "might" have been prevented. The available data are not sufficient for a positive conclusion either way. But there has been a sufficient number of control system failures and incidents to clearly indicate a problem area. In view of the catastrophic effects of a failure and the increasing complexity of control systems, improved preflight check capability is appropriate. Accordingly, the amendment is adopted as proposed.

Proposal 2–47. This is a parallel proposal to that contained in 2–15. See that proposal for explanation and analysis. A second commenter noted the typographical error that refers to § 29.67 which should be § 29.671; this is corrected and the amendment is adopted.

Proposal 2–48. Only one comment was received, and it agreed with the proposal.

Proposal 2–49. One commenter agrees with the proposal to revise § 29.729(f) and add a new § 29.729(g), but references his comment on Proposal 2–17. See the explanation for that proposal. The amendment is adopted as proposed.

Proposal 2–50. Only one comment was received, and it agrees with the proposal.

Proposal 2–51. One commenter agrees with the proposed change to § 29.771(b) to require consistency between pilot stations and states that the requirement should apply to Part 27 as well. This is beyond the scope of the notice. The amendment is adopted as proposed.

Proposal 2–52. One commenter agrees with the proposal to add a new § 29.779. A second commenter suggests that paragraph (a) should be worded, "Primary flight controls must operate . . ." stating that Proposal 2–48 defines primary controls as including the collective. A third commenter makes this same suggestion and adds a paragraph to state that other controls must operate forward or up to increase the related controlled parameter as it is related to the rotorcraft axis.

Including the word "primary" would exclude consideration of secondary controls. The third commenter's suggested paragraph would cover only a limited number of considerations that are best covered in guidance material.

A fourth commenter suggests that proposed paragraph (c) state that the normal landing gear control operate downward rather than just landing gear control, since emergency landing gear controls may require different actions. This suggestion is accepted and the amendment is adopted with this change.

Proposal 2–53. See explanation for Proposal 2–20. This amendment is adopted with the same change as identified for Proposal 2–20.

Proposal 2–54. No comments were received on the proposal to delete paragraphs (f) and (g) of § 29.811 and redesignate the remaining paragraphs. The proposal is adopted without change.

Proposal 2–55. One commenter agrees with the proposal. The FAA notes that the proposal was not clear in allowing the emergency lighting system to share common sources of illumination (bulbs) with the normal cabin lighting system provided the power supplies are independent. Therefore § 29.812(a) is revised as follows: "(a) A source of light with its power supply independent of the main lighting system must be installed to . . . ."

A second commenter suggests that the cockpit control device in proposed § 29.812(b) could have either "off," "on," and "armed" positions or "off" and a common "on/armed" positions. The control device in the cockpit needs an "on" position (sometimes referred to as "test") to allow the crew to preflight check the emergency lights and to turn on the emergency lights when the normal rotorcraft power is not interrupted. The FAA agrees that the wording of this paragraph could be improved; therefore, the second sentence of § 29.812(b) is revised as follows: "The cockpit control device must have an 'on,' 'off,' and 'armed' position so that when turned on at the cockpit or passenger compartment station or when armed at the cockpit station, the emergency lights will either illuminate or remain illuminated upon interruption of the rotorcraft's normal electric power."

A third commenter suggest that the exterior emergency lighting in proposed § 29.812(c) could be provided by internal or external sources with intensity measurements made with the normal exits open. The FAA concurs except the measurements would be made with only the emergency exits open. Therefore, the following is added: "The exterior emergency lighting may be provided by either interior or exterior sources with light intensity measurements made with the emergency exits open."

Further FAA review notes that the method of activating the exterior lighting

in § 29.812(c) is not stated. To correct this, proposed paragraph (c) will be reidentified as paragraph (b) and proposed paragraph (b) reidentified as paragraph (c). The first sentence of new paragraph (c) is revised to read: "Each light required by paragraph (a) or (b) of this section . . . ." The proposed amendment is adopted with the noted changes.

Proposal 2–56. Only one comment was received, and it agrees with the proposal.

Proposal 2–57. One commenter agrees with the proposal to add the requirement for a maximum allowable airspeed indicator and warning system for certain Category A rotorcraft in § 29.1303. A second commenter suggests that a radar altimeter should be mandatory for Part 29 helicopters and there should be criteria to establish maximum allowable vibration; these suggestions are beyond the scope of the notice.

A third commenter states that V_{NE} is defined as the never-exceed speed and that structural substantiations do not cover any intentional operation above V_{NE}, so that warning should operate at V_{NE} and above (with up to 5 knots below V_{NE} for production tolerance). This commenter suggests that establishing a normal operating speed limit, V_{NO}, below V_{NE} would solve the problem of nuisance operation of the warning at, or near, the allowable speed.

A fourth commenter suggests deleting the proposed change, stating that airspeeds greater than V_{NE} (up to at least 1.1 V_{NE}) are already considered in substantiating the structural adequacy and flight characteristics of the rotorcraft. This commenter further states that the added cost, weight, and complexity are not warranted by service experience, and questions whether a single system would suffice. In support of the question, this commenter explains the complexity in accounting for factors which can affect V_{NE}, such as power-on vs. power-off flight, gross weight, rotor speed, pressure altitude, and outside air temperature. This commenter leads the FAA to conclude that if it is this complex to determine V_{NE} (and, in fact, it is), then there is all the more reason to provide the pilot some assistance. As to the differences between the third and fourth commenters' interpretation of structural and flight verification above V_{NE}, (to 1.1 V_{NE}), the fourth commenter is correct in that intentional flight above V_{NE} is not permitted but the substantiation analysis and tests required do account for infrequent and inadvertent excursions beyond V_{NE}. Therefore, establishing a warning below V_{NE} is not necessary and requiring the warning to operate 3 knots above V_{NE} is appropriate to allow flight at V_{NE} without nuisance warnings. As rotorcraft have become larger and longer flights scheduled, fuel used has become a significant percentage of gross weight. To establish a V_{NE} based on maximum gross weight as is presently done precludes more economical operations at higher airspeeds as the flight progresses and the weight is reduced through fuel consumption. The proposed V_{NE} indicator would enhance the capability for this more economical operation.

The fourth commenter also suggests eliminating the warning device to be consistent with the suggestion to eliminate the V_{NE} indicator requirement, and further, that an aural warning could degrade the overall safety level by adding to the number of aural warnings now used; for example, fire, engine out, and landing gear. The third commenter also suggests that a warning light is sufficient. The proposal specifically states that the aural warning must differ distinctively from aural warnings used for other purposes so that there should be no confusion and the safety level would be enhanced. The proposal requires the V_{NE} indicator and warning only when other pilot cues are not provided; under these circumstances, a light, without aural warning, would more likely be overlooked. Accordingly, the amendment is adopted as proposed.

Proposal 2–58. One commenter agrees with the proposal. A second commenter assumes that proposed § 29.1309(b)(2)(i) would apply to the rotor and transmission systems since § 29.1309(a) refers to "this subchapter." This commenter's concern is that the proposed amendment would impose an extremely improbable failure requirement, defined as 1×10^{-9} or less per flight hour in Advisory Circular (AC) 29–2, Certification of Transport Category Rotorcraft, and AC 25.1309–1, System Design Analysis. The commenter states experience has shown the rotor and transmission systems failure rate to be only 1×10^{-6} at best. The FAA acknowledges that, as proposed, this section could be interpreted to include consideration of rotor and transmission systems, although the specific requirements for these systems are primarily contained in §§ 29.571, 29.901, 29.917, and 29.923. As noted in AC 29–2, § 29.1309 includes "but is not limited to electrical, pneumatic, and hydraulic power sources, associated distribution, and corresponding utilization systems," indicating, by these examples, the systems to which § 29.1309 is most applicable. There are other rotorcraft "systems" such as landing gear, propulsion, and fuselage that do not meet the 1×10^{-9} failure rate probability. To single out the rotor and transmission systems in this section is not appropriate. The general wording and concepts of this section have not caused problems in this area during past certifications.

The second commenter also notes that the term "improbable," as used in the proposed § 29.1309(b)(2)(ii) and as defined in AC 29–2, covers a failure rate range from 1×10^{-5} to 1×10^{-9}, which is too broad to be meaningful. This comment implies a need for an intermediate descriptive term and associated failure rate. Inclusion of such a term and associated failure rate would be more restrictive than the proposal since those systems to which the intermediate term would apply could be certificated under the proposal with a failure rate of only 10^{-5} per flight hour.

A third commenter questions the meaning and rationale for the phrases, "do not cause a hazard" (proposed § 29.1309(b)(1)), "prevent hazards" (proposed § 27.1309(b)), and "minimize hazards" (proposed § 27.1309(c)). In response to this comment, the FAA finds the phrase "do not cause a hazard" inappropriate since no difference in meaning is intended between the present § 29.1309(b) and proposed § 29.1309(b)(1) for Category B rotorcraft. Therefore, proposed § 29.1309(b)(1) is revised to read, "For Category B rotorcraft, the equipment, systems, and installations must be designed to prevent hazards to the rotorcraft if they malfunction or fail." The phrase "minimize hazards", as contrasted with "prevent hazards," allows (1) a level of safety that is compatible with single-engine rotorcraft, (2) less complexity, and (3) less costly systems and equipment. This lower level of safety for single-engine normal category rotorcraft is intended to permit practical designs that minimize weight and cost penalties.

A fourth commenter suggests combining proposed § 29.1309(b)(2) (i) and (ii) to state: "(2) For Category A rotorcraft, the equipment systems and installations must not prevent the continued safe flight and landing or cause injury to the occupants if they malfunction or fail, unless the malfunction or failure is shown to be extremely improbable." This suggestion would be more restrictive since it establishes the "extremely improbable" condition for a failure that only reduces the capability of the rotorcraft or crew. The FAA has also determined that injury to occupants is not a proper factor to be required in this analysis and this reference is deleted. This agrees with

Part 25 in this area. For this reason, the suggestion is beyond the scope of the notice. The commenter also refers to the National Transportation Safety Board (NTSB) Review of Rotorcraft Accidents 1977–1979 and quotes the document as showing that only 2.7 percent of the accidents were due to systems, instruments, and equipment. The FAA finds that during the 1977 to 1979 period, instrument-flight-equipped helicopters were a small percentage of the total helicopter fleet. This small percentage is not representative of the present fleet and it is projected to be even less representative each year. This is largely due to a rapid progression to increased system complexity from that of the 1977 to 1979 period. Systems such as electronic flight instrument systems (EFIS), fly-by-wire, and electronic fuel controls are now being presented for approval or are on the threshold of being presented. Loss of any one of these systems during instrument flight or loss of fly-by-wire or electronic fuel controls in any flight operation could be catastrophic. Therefore, the provisions of proposed § 29.1309(b)(2) (i) and (ii) are necessary to assure an adquate level of safety and are adopted.

The fourth commenter and a fifth commenter also suggest deleting the last sentence of the proposed § 29.1309(c) which requires designs to minimize crew errors which could create additional hazards. Both commenters state that it is too broad for clear application. While the requirement is broadly stated, there is a need to assure that installations such as identical switches, one frequently used and one infrequently used, such as fuel shutoff, are not placed side by side. It is impracticable to list all such poor design possibilities and the requirement is adopted as proposed.

The fourth and fifth commenters also suggest that the entire proposed § 29.1309(d) be deleted as it is "how to" which should only be in advisory circular material. This paragraph defines certain failure analysis criteria that can be stated clearly in the requirements. Accordingly, the amendment is adopted as proposed.

Proposal 2–59. This proposal would revise the airspeed system accuracy requirements of § 29.1323 to consider Category A and Category B flight profiles instead of differentiation by number of engines and to clarify that the requirements do not include instrument errors. One commenter states that since an airspeed error of not more than 5 knots is achievable, it should not be relaxed to 10 knots in a climb. Meeting the 10-knot error in a climb has been difficult for some rotorcraft and has resulted in complex systems or configurations requiring precise positioning of components. Retaining only a 5-knot error in a climb would not resolve these problems. The original conference proposal to allow a 15-knot error is an indication of the difficulties encountered in this area, but was considered to be excessive. A 10-knot error appears to be the best compromise between system complexity and safe, realistic indications. This same commenter suggests that the limit of a 3 percent error be deleted since an airspeed of 167 knots is required before it becomes a benefit. While 167 knots exceeds V_{NE} for most present-day rotorcraft, the proposal provides a design standard for the few present and any future rotorcraft with a V_{NE} greater than 167 knots.

A second commenter suggests that the minimum calibration speed in level flight be 30 knots rather than the proposed 20 knots because the difference is insignificant and does not improve safety or provide necessary information. The present rule requires single-engine rotorcraft systems to be calibrated at 20 knots and above, but requires calibration at 30 knots and above for multiengine rotorcraft. Amendment 29–3, effective February 25, 1968, changed the calibration requirement from 10 mph to the present 20 knots. Notice 82–12 explained the need for low-speed accuracy requirements for Category A operations. Accordingly, the amendment is adopted as proposed.

Proposal 2–60. This proposed change to § 29.1325(f) would relax the transport rotorcraft static systems accuracy of ±30 feet at all airspeeds to ±30 feet per 100 knots airspeed as currently required for transport airplanes. One commenter agrees with the proposal and states that Part 27 should reflect the same level of accuracy as that required by Part 29. There is no comparable requirement in Part 27 and one was not proposed. Therefore, this suggestion is beyond the scope of the notice. A second commenter notes that as written, the proposal would require zero altitude error at zero airspeed and suggests including the sentence from Part 25 which states that the error need not be less than ±30 feet. The FAA agrees and the amendment is changed to reflect that wording. A third commenter suggests changing the requirement to an allowable error of no more than ±30 feet below 100 knots or ±60 feet at higher speeds since there is no foreseeable need to consider speeds above 200 knots. However, the proposed amendment includes speeds above 200 knots and will not require a rule change if the unforeseeable does occur. Accordingly, the amendment is adopted with the change described.

Proposal 2–61. This proposal would clarify the design requirements for autopilots used in transport category rotorcraft and would add requirements in § 29.1329(e) for autopilots when interconnecting them with other systems. One commenter agrees with the proposal. A second commenter suggests that where an autopilot failure can result in hazardous effects on the control of the rotorcraft, a disengage control should be required to be on the cyclic control. Hazardous effects after a failure are precluded by compliance with the current § 29.1329(d). Requiring the disengaging control on the cyclic was discussed at the review conference and sufficient justification was provided to require only readily available disengagement. This decision is discussed in Notice 82–12, the major factor being that autopilot design must permit the pilot to control the rotorcraft first by overpowering a malfunctioning system, then disconnecting it. Where crew action is necessary to prevent a hazardous situation, this commenter suggests requiring a system to indicate the autopilot mode of operation and warning if it ceases to operate correctly. While the commenter's recommendation is beyond the scope of the notice, the suggestion for indicating the mode of operation is retained for possible future action. Accordingly, the amendment is adopted as proposed.

Proposal 2–62. This proposed revision would modify the requirement for a power adequacy indicator for each required flight instrument. It would define the point at which required power measurements must be made. One commenter agrees with the proposal. A second commenter suggests that the term "required flight instrument" in current § 29.1331(a) should be clarified and recommends using Part 25 as an example. The commenter notes that this is beyond the scope of the notice and recommends that Advisory Circular 29–2 address this question. Considering the definition of "instrument" in § 1.1, the FAA considers this section adequate as written but agrees that a discussion of the term "required" is appropriate for future revisions of AC 29–2. The amendment is adopted as proposed.

Proposal 2–63. The notice contained a typing error which identified the proposals for §§ 29.1333 and 29.1335 both as Proposals 2–63 and no Proposal 2–64. This did not appear to cause a problem since only one commenter

addressed these proposals and the comments were identified by section number, not proposal number. The commenter agrees with both proposals. The proposal for § 29.1333 would revise the requirements for instrument systems to reflect the increased complexity of instrumentation available, used, and necessary for transport rotorcraft to operate safely in the extreme range of operating environments to which they are now routinely exposed. The proposal for § 29.1335 would require Category B rotorcraft to meet the same electrical power source standards for required equipment and systems as are required for Category A rotorcraft. It further proposes wording as to the manner in which electrical power is maintained under fault conditions. The intent is to require two independent electrical power sources for essential load circuits for transport category rotorcraft. Accordingly, both amendments are adopted as proposed.

Proposal 2–65. This proposal would revise § 29.1357 by requiring Category B rotorcraft to have the overvoltage protection now required for Category A rotorcraft, by clarifying that all parts of a single essential system may be protected by the same circuit protective device, and by specifically stating under what circumstances automatic reset circuit breakers may be used. One commenter agrees with the proposal. A second commenter agrees with the proposal, but requests the term "essential to safety of flight" be well defined in advisory Circular 29–2. This will be done. The amendment is adopted as proposed.

Proposal 2–66. Only one comment was received and it agreed with the proposal.

Proposal 2–67. This proposal would change the wording of § 29.1525 to clarify the requirements for approved kinds of operation without affecting the actual certification process. One commenter agrees with the proposal. A second commenter suggests that the list of kinds of operations be expanded to include all typical kinds and to require, by § 29.1583(e), the flight manual to include the appropriate compliance status with § 29.1525. The proposal lists, as examples, all such kinds of operations except external-load carrying that are applicable to certification. Specific uses, such as passenger-carrying, power-line patrol, logging operations, etc., are huge in number and not a basic certification requirement. Section 29.1583(e) presently requires that the flight manual list the approved kinds of operations. Since kinds of operations are defined by § 29.1525, there is no need to repeat them in § 29.1583. Accordingly, the amendment is adopted as proposed.

Proposal 2–68. This proposed revision to § 29.1555(a) would remove flight controls and other obvious control functions from the marking requirements for cockpit controls. The proposed change to § 29.1555(e) would require a placard stating the maximum landing gear operating speed (V_{LO}) in rotorcraft with retractable gear. One commenter agrees with the proposal. A second commenter proposes deleting the requirement for a (V_{LO}) placard near the landing gear control. This is discussed under Proposal 2–28. The same change to require a limit speed placard in clear view of the pilot is included in this amendment. A third commenter suggests that a rotorcraft could have a (V_{LE}) different from (V_{LO}) and that this should also be placarded. Where (V_{LE}) and (V_{LO}) are different, the landing gear operating speed normally is less than the landing gear extended speed. Requiring only (V_{LO}) would be the most conservative, but would not preclude placards of other speeds where appropriate. This third commenter also suggests that standardization (shape and color) of controls should be added to the rule with detail information in Advisory Circular 29–2. This suggestion is beyond the scope of this notice. The amendment is adopted with the change identified in Proposal 2–28.

Proposal 2–69. This proposal would remove the requirement for a placard which states that the rotorcraft must comply with the operating limitations contained in the rotocraft flight and maintenance manuals. The required placard, containing over 50 words, was redundant to requirements specified elsewhere in the certification and operating rules. A much shorter placard was proposed. One commenter supports the proposal. A second commenter recommends the limitations placard reference the flight manual for information on limits. This same comment was made for Proposal 2–29; see that proposal for explanation. The amendment is adopted without change.

Proposal 2–70. This proposal implements an existing practice by specifying ambient temperature as an operating limitation. The proposal also adds the maximum allowable wind for safe operation near the ground as a limitation for transport Category A rotorcraft. One commenter agrees with the proposal but states that the explanation for excluding Category B rotorcraft from the maximum allowable wind limitation is not complete and the information should be included in the performance section of the flight manual. Proposal 2–72 does require the maximum demonstrated wind for safe opration near the ground as performance information for Category B rotorcraft. A second commenter suggests that the proposal be expanded to indicate more clearly that the sideward and rearward flight limits for crosswinds and tailwinds established by § 29.143(c) are the limits of concern. Section 29.143(c) is a controllability and maneuverability requirement. However, such factors as engine stall or surge due to inlet distortion, rotorcraft attitudes that could influence the unusable fuel quantity, and structural considerations also have been encountered as limiting conditions for maximum winds. Although these examples influenced the limits established for compliance with § 29.143(c), the controllability and maneuverability, in the narrowest sense, were not the limiting factors. Therefore, it is not appropriate to specify that this proposal is concerned only with § 29.143(c).

A third commenter states that the proposal seems appropriate, but goes on to state that the explanation implies restrictions to operations which would not be practicable or acceptable if operating to an unmanned site where wind and temperature information are not available. Under present VFR operating rules, when only area weather information is provided before departure, the pilot is responsible for evaluating the destination weather upon arrival. Under IFR operating rules, the pilot must be provided destination weather before beginning an instrument meteorological condition (IMC) approach. Therefore, the concerns of the third commenter are valid only under IMC where consideration must be given to several other IFR requirements that are more restrictive than those resulting from this proposal. The amendment is adopted as proposed.

Proposal 2–71. Only one comment was received and it agrees with the proposal.

Proposal 2–72. Three commenters suggest that the proposed § 29.1587 restriction on showing performance information beyond any operating limit should be deleted. The first of these commenters states that performance information beyond operating limits is used to calculate the effect of optional equipment. The second and third of these commenters give examples where the maximum allowable gross weight is greater with an external load. Two of these commenters suggest shading or other methods to indicate limits. These techniques have merit and have been used on recently certificated rotorcraft;

however, some proposed manuals have been submitted to FAA with data that greatly exceed several limits and with little or no indication of the limits. The wording of the amendment is changed as follows:

"Flight manual performance information which exceeds any operating limitation may be shown only to the extent necessary for presentation clarity or to determine the effects or approved optional equipment or procedures. When data beyond operating limits are show, the limits must be clearly indicated."

A fourth commenter suggests that instead of requiring the maximum demonstrated wind for starting and stopping the rotors in proposed § 29.1587(a)(4) and (b)(4), the maximum recommended wind should be required. Difficulty in obtaining the needed wind conditions for demonstration is cited as the major objection to the proposed wording. A fifth commenter states that even though the maximum demonstrated wind would appear under performance information, it would be interpreted as a limit. A sixth commenter suggest that a minimum of 17-knots wind, to be compatible with the control and manuverability requirements, be required for the demonstration.

Guidance on rotor characteristics during starting and stopping is very desirable. However, there are so many variables to be considered that significant questions are raised on the capability to develop and verify adequate information without large and expensive analysis and test programs. A few of the wind-related variables that must be considered are wind velocity, gust magnitude, gust frequency, relative direction of the wind, and turbulence—natural and object induced. Imposed upon the wind factors are the rotor design, aerodynamic characterists, and control techniques. Demonstrations (or recommendations) that address only a steady wind could be misleading. The FAA considers information on rotor characteristics during start and stop as highly desirable and encourages the manufacturers to provide as much guidance as feasible. However, in view of the difficulty and expense that would be required to develop and evaluate even an absolute minimum of data, the proposal to require the maximum wind for starting and stopping rotors is withdrawn.

A seventh commenter suggests that the last sentence of proposed § 29.1587(a) (5) and (6) be deleted. These sentences state that the distances determined for takeoff under § 29.59 and landing under §§ 29.75 and 29.77 must be used in establishing takeoff and landing field lenghts. The commenter is correct in stating that these sentences are unnecessary; therefore, they are deleted.

An eighth commenter objects to proposed § 29.1587(b)(6) which requires glide distance as a function of altitude. This commenter states that this is useless information and suggests that the speeds for minimum rate of descent and best glide angle with the associated glide angles be required. Requirements to provide the speeds associated with minimum rate of descent and best glide angle are included in § 29.1585 (Proposal 2–71). As discussed in the notice, glide distance as a function of altitude is more readily usable information than just glide angle. Accordingly, this portion of the amendment is adopted as proposed.

A ninth commenter suggests that out-of-ground-effect hover performance information should be required for all transport category rotorcraft. This is beyond the scope of the notice.

Amendment 29–21, effective after publication of Notice 82–12, added a new § 29.1587(b)(6). Therefore, the proposal is edited as necessary and is adopted as discussed.

Proposal 2–73. One commenter suggests that the proposed title of § 91.31 be changed to "Civil aircraft operating limitations." This section includes the requirements for markings and placards in older aircraft that do not require flight manuals. Therefore, the title proposed in the notice is more descriptive of the section. FAA review notes that the proposed wording could be interpreted to require compliance with only flight manual, marking, or placard operating limitations. Experimental aircraft, which includes amateur-built aircraft, do not require a flight manual, markings, or placards, but operating limitations normally are issued with the airworthiness certificate. To provide for this example, or any other similar case, the last phrase is revised to read: ", or as otherwise prescribed by the certificating authority of the country of registry," and the amendment is adopted.

Economic Summary

The FAA conducted an evaluation of the economic impact of these regulatory changes. A copy of the evaluation has been placed in the docket.

The assumptions used in preparing the economic impact estimates of the changes to the certification regulations are derived from earlier cost impact assessments of the proposals contained in Notice 82–12. Notice 82–12 invited public comments concerning technical and operational considerations and economic impact assumptions as they apply to rotorcraft performance, flight characteristics, systems, and equipment. Comments on the proposal were submitted by domestic and foreign manufacturer and operator trade associations. The majority of the comments recommend minor technical modifications and editorial clarifications. A number of comments, however, disagree with the economic impact estimates of various proposals. The FAA has evaluated the public comments and made final determinations regarding their impact. With only one exception, the FAA finds that the proposals determined to have an economic impact at the NPRM stage of rulemaking will also have an economic impact if the rule is adopted. The one exception is that the estimated savings resulting from § 29.175 is reduced from $50,000 per certification to a negligible amount as a result of industry comments and subsequent FAA technical amendments.

The five amendments determined to have an economic impact are related to limiting height-speed envelope, lightning protection for Parts 27 and 29 rotorcraft, providing of a means that will allow the pilot to determine that full control authority is available prior to flight for transport category rotorcraft, and adding an aural, never-exceed-speed indicator as a requirement for Part 29 certification. The evaluation of these amendments is summarized in Table 1.

TABLE 1.—COSTS AND SAVINGS OF NPRM 2 CHANGES HAVING ECONOMIC IMPACTS

Proposal	Cost (savings)	Benefits
27.79 Limiting Height-Speed Envelope. Revision of the weight requirements needed to establish performance at various altitudes.	(50 thousand per certification)	Reduction of Flight testing time by 10 hours and demonstration weight by approximately 15% at altitudes above sea level.
29.671 Control Systems: General. The provisions of a means performing a control command verification procedure prior to flight in rotorcraft with boosted flight control systems.	5.2 million total incurred for first 3 production years.[1]	Benefit not quantified. Undetermined benefits are expected to accrue to operators and travelers by the prevention of accidents attributed to flight control system failures.
27.610 Lightning Protection. (See 29.610.)	(See 29.610)	(See 29.610).

TABLE 1.—COSTS AND SAVINGS OF NPRM 2 CHANGES HAVING ECONOMIC IMPACTS—Continued

Proposal	Cost (savings)	Benefits
29.610 **Lightning Protection.** The protection of digital/electronic avionic and flight control systems against the disruptive effects of lightning strikes. The rule places special emphasis on rotorcraft with composite material primary and secondary flight structures.	The FAA requested industry comments on the cost of the lightning protection requirements of this section. Commentors did not provide cost data analysis required on the design and data analysis required to protect advanced digital avionics flight control systems will be funished by a major FAA, NASA, and DOD task force research effort. The results of this study are expected to minimize the cost impact and the FAA believes that the rule will be cost beneficial.	The FAA believes that benefits will accrue to operators and travelers by the prevention of accidents attributed to the catastrophic effects of lightning strikes on critical avionics, flight control systems, structures, and fuel systems.
29.1303 **Flight and Navigation Instruments**	$1.1 million total incurred for first three production years, including maintenance costs.[2]	The provision of maxium allowable airspeed indicating system is expected to prevent fatigue failure accidents attributed to overspeed conditions. On the basis of the $2.0 million average cost of fatigue failure accidents, the amendment would have to prevent less than one accident to justify its costs.

[1] Cost estimates are based on the addition of an electronic motor to allow full control movement prior to flight. The FAA did not receive comments on the cost of implementing alternative means of complying with the proposal.

[2] *The cost estimate is based on an instrumentation developed by one manufacturer to provide V_{NE} measurement and warning capability and to perform a power assurance check.* The costs shown here are those attributable to the V_{NE} indicator and V_{NE} overspeed warning device. The cost shown should provide an instrument that meets all safety aspects and gives a true speed measurement under all factors which can use V_{NE} to vary.

Regulatory Flexibility Determination

The FAA has determined that under the criteria of the Regulatory Flexibility Act (RFA) of 1980, the amendments to Parts 1, 27, 29, and 91 contained in this final rule, at promulgation, will not have a significant economic impact on a substantial number of small entities. The RFA requires agencies to specifically review rules which may have a "significant economic impact on a substantial number of small entities." The FAA recently adopted criteria and guidelines for rulemaking officials to apply when determining if a proposed or existing rule has a significant economic impact on a substantial number of small entities and guidance for the conduct of regulatory flexibility analyses and reviews. The FAA small entity size standards criteria define a small helicopter manufacturer as an independently owned and managed firm having fewer than 75 employees. Under the FAA size standard criteria, only one manufacturer subject to the certification changes to Parts 1, 27, 29, and 91 has fewer than 75 employees. Table 2 shows domestic helicopter manufacturers and designation as to size. Accordingly, the amendments to Parts 1, 27, 29, and 91 contained in this final rule will not impact a substantial number of small entities.

There are no known diseconomies of scale associated with the anticipated marginal increase in certification costs. This change to the certification rules for Parts 27 and 29 helicopter manufacturers is not perceived to raise any barrier to entry into this market for small manufacturers.

TABLE 2.—PARTS 27 AND 29 ROTORCRAFT MANUFACTURERS

	Firm size
Part 27 Manufacturers:	
Brantly-Hynes Helicopters, Inc	Small.
Enstrom Helicopters Corp	Large.
Hiller Aviation	Do.
Hughes Helicopters, Inc	Do.
Kaman Aerospace	Do.
Robinson Helicopters	Do.
Part 29 Manufacturers:	
Bell Helicopter Textron, Inc	Do.
Boeing Vertol Company	Do.
Sikorsky Aircraft—United Technologies	Do.

Paperwork Reduction Act Statement

This final rule does not contain a new or amended information collection requirement subject to the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). Existing requirements were approved by the Office of Management and Budget approval number 2120–0018.

List of Subjects

14 CFR Part 1

Airmen, Flights, Aircraft pilots, Pilots, Transportation, Air Safety, Safety, Aviation safety, Air transportation, Air carriers, Aircraft, Helicopters, Rotorcraft.

14 CFR Parts 27 and 29

Air transportation, Aircraft, Aviation safety, Safety, Tires, Rotorcraft.

14 CFR Part 91

Air carriers, Aviation safety, Safety, Aircraft, Aircraft pilots, Air traffic control, Pilots, Air transportation, Airworthiness directives and standards.

Adoption of the Amendment

Accordingly, Parts 1, 27, 29, and 91 of the Federal Aviation Regulations (14 CFR Parts 1, 27, 29, and 91) are amended as follows, effective December 6, 1984.

PART 1—DEFINITIONS AND ABBREVIATIONS

1. By amending § 1.1 by adding the following definitions after the definitions of "Clearway" and "Takeoff power," respectively:

§ 1.1 General definitions.

* * * * *

"Climbout Speed," with respect to rotorcraft, means a referenced airspeed which results in a flight path clear of the height-velocity envelope during initial climbout.

* * * * *

"Takeoff Safety Speed" means a referenced airspeed obtained after lift-off at which the required one-engine-inoperative climb performance can be achieved.

* * * * *

2. By amending § 1.2 to add a definition for "V_{TOSS}" after "V_{SI}" as follows:

§ 1.2 Abbreviations and symbols.

* * * * *

"V_{TOSS}" means takeoff safety speed for Category A rotorcraft.

* * * * *

PART 27—AIRWORTHINESS STANDARDS: NORMAL CATEGORY ROTORCRAFT

§ 27.21 [Amended]

3. By amending § 27.21 by removing the paragraph designator "(a)" in § 27.21(a); by changing paragraph designators (a)(1) and (a)(2) to (a) and (b), respectively; and by removing paragraph (b).

4. By amending § 27.45 by adding a new paragraph (f) to read as follows:

§ 27.45 General.

* * * * *

(f) For turbine-engine-powered rotorcraft, a means must be provided to permit the pilot to determine prior to takeoff that each engine is capable of

developing the power necessary to achieve the applicable rotorcraft performance prescribed in this subpart.

5. By adding a new § 27.71 to read as follows:

§ 27.71 Glide performance.

For single-engine helicopters and multiengine helicopters that do not meet the Category A engine isolation requirements of Part 29 of this chapter, the minimum rate of descent airspeed and the best angle-of-glide airspeed must be determined in autorotation at—

(a) Maximum weight; and

(b) Rotor speed(s) selected by the applicant.

6. By revising § 27.79(a)(2) to read as follows:

§ 27.79 Limiting height-speed envelope.

(a) * * *

(2) Weight, from the maximum weight (at sea level) to the lesser weight selected by the applicant for each altitude covered by paragraph (a)(1) of this section. For helicopters, the weight at altitudes above sea level may not be less than the maximum weight or the highest weight allowing hovering out of ground effect which is lower.

* * * * *

7. By amending § 27.141 by revising paragraphs (a) and (a)(1) to read as follows:

§ 27.141 General.

* * * * *

(a) Except as specifically required in the applicable section, meet the flight characteristics requirements of this subpart—

(1) At the altitudes and temperatures expected in operation;

* * * * *

8. By amending § 27.143 by removing the word "and" in paragraph (c)(2); by inserting "; and" at the end of (c)(3); and by adding a new paragraph (c)(4) to read as follows:

§ 27.143 Controllability and maneuverability.

* * * * *

(c) * * *

(4) Altitude, from standard sea level conditions to the maximum altitude capability of the rotorcraft or 7,000 feet, whichever is less.

* * * * *

9. By adding a new § 27.151 to read as follows:

§ 27.151 Flight controls.

(a) Longitudinal, lateral, directional, and collective controls may not exhibit excessive breakout force, friction, or preload.

(b) Control system forces and free play may not inhibit a smooth, direct rotorcraft response to control system input.

10. By revising § 27.161(a) to read as follows:

§ 27.161 Trim control.

* * * * *

(a) Must trim any steady longitudinal, lateral, and collective control forces to zero in level flight at any appropriate speed; and

* * * * *

11. By revising § 27.173 to read as follows:

§ 27.173 Static longitudinal stability.

(a) The longitudinal control must be designed so that a rearward movement of the control is necessary to obtain a speed less than the trim speed, and a forward movement of the control is necessary to obtain a speed more than the trim speed.

(b) With the throttle and collective pitch held constant during the maneuvers specified in § 27.175 (a) through (c), the slope of the control position versus speed curve must be positive throughout the full range of altitude for which certification is requested.

(c) During the maneuver specified in § 27.175(d), the longitudinal control position versus speed curve may have a negative slope within the specified speed range if the negative motion is not greater than 10 percent of total control travel.

12. By revising § 27.175(d) to read as follows:

§ 27.175 Demonstration of static longitudinal stability.

* * * * *

(d) *Hovering.* For helicopters, the longitudinal cyclic control must operate with the sense and direction of motion prescribed in § 27.173 between the maximum approved rearward speed and a forward speed of 17 knots with—

(1) Critical weight;

(2) Critical center of gravity;

(3) Power required to maintain an approximate constant height in ground effect;

(4) The landing gear extended; and

(5) The helicopter trimmed for hovering.

13. By adding a new § 27.177 to read as follows:

§ 27.177 Static directional stability.

Static directional stability must be positive with throttle and collective controls held constant at the trim conditions specified in § 27.175 (a) and (b). This must be shown by steadily increasing directional control deflection for sideslip angles up to ±10° from trim. Sufficient cues must accompany sideslip to alert the pilot when approaching sideslip limits.

14. By adding a new § 27.610 to read as follows:

§ 27.610 Lightning protection.

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

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

(1) Electrically bonding the components properly to the airframe; or

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

(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 rotorcraft.

15. By adding a new § 27.672 to read as follows:

§ 27.672 Stability augmentation, 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 § 27.671 of this Part and the following:

(a) A warning which is clearly distinguishable to the pilot under expected flight conditions without requiring the pilot's 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 is unaware 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 allow initial counteraction of failures without requiring exceptional pilot skill or strength by overriding the failure by movement of the flight controls in the normal sense and deactivating the failure system.

(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 rotorcraft is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations;

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

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

16. By adding a new § 27.673 to read as follows:

§ 27.673 Primary flight control.

Primary flight controls are those used by the pilot for immediate control of pitch, roll, yaw, and vertical motion of the rotorcraft.

17. By adding a new § 27.729 to read as follows:

§ 27.729 Retracting mechanism.

For rotorcraft with retractable landing gear, the following apply:

(a) *Loads.* The landing gear, retracting mechansim, wheel-well doors, and supporting structure must be designed for—

(1) The loads occurring in any maneuvering condition with the gear retracted;

(2) The combined friction, inertia, and air loads occurring during retraction and extension at any airspeed up to the design maximum landing gear operating speed; and

(3) The flight loads, including those in yawed flight, occurring with the gear extended at any airspeed up to the design maximum landing gear extended speed.

(b) *Landing gear lock.* A positive means must be provided to keep the gear extended.

(c) *Emergency operation.* When other than manual power is used to operate the gear, emergency means must be provided for extending the gear in the event of—

(1) Any reasonably probable failure in the normal retraction system; or

(2) The failure of any single source of hydraulic, electric, or equivalent energy.

(d) *Operation tests.* The proper functioning of the retracting mechanism must be shown by operation tests.

(e) *Position indicator.* There must be a means to indicate to the pilot when the gear is secured in the extreme positions.

(f) *Control.* The location and operation of the retraction control must meet the requirements of §§ 27.777 and 27.779.

(g) *Landing gear warning.* An aural or equally effective landing gear warning device must be provided that functions continuously when the rotorcraft is in a normal landing mode and the landing gear is not fully extended and locked. A manual shutoff capability must be provided for the warning device and the warning system must automatically reset when the rotorcraft is no longer in the landing mode.

18. By revising the introductory paragraph to § 27.735 to read as follows:

§ 27.735 Brakes.

For rotorcraft with wheel-type landing gear, a braking device must be installed that is—

* * * * *

19. By adding a new § 27.779 to read as follows:

§ 27.779 Motion and effect of cockpit controls.

Cockpit controls must be designed so that they operate in accordance with the following movements and actuation:

(a) Flight controls, including the collective pitch control, must operate with a sense of motion which corresponds to the effect on the rotorcraft.

(b) Twist-grip engine power controls must be designed so that, for lefthand operation, the motion of the pilot's hand is clockwise to increase power when the hand is viewed from the edge containing the index finger. Other engine power controls, excluding the collective control, must operate with a forward motion to increase power.

(c) Normal landing gear controls must operate downward to extend the landing gear.

20. By revising the title and § 27.785 to read as follows:

§ 27.785 Seats, berths, safety belts, and harnesses.

(a) Each seat, berth, safety belt, harness, and adjacent part of the rotorcraft, at each station designated for occupancy during takeoff and landing, must be free of potentially injurious objects, sharp edges, protuberances, and hard surfaces, and must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the inertia forces specified in § 27.561.

(b) Each occupant must be protected from head injury by—

(1) For each crewmember seat and each seat beside a crewmember front seat, a safety belt and harness that will prevent the head from contacting any injurious object; and

(2) For each seat not covered under paragraph (b)(1)—

(i) A safety belt plus the absence of injurious objects within striking radius of the head;

(ii) A safety belt plus a shoulder harness that will prevent the head from contacting any injurious object; or

(iii) A safety belt plus an energy-absorbing rest that will support the arms, shoulders, head, and spine.

(c) Each pilot's seat must have a combined safety belt and shoulder harness with a single-point release that permits the pilot, when seated with safety belt and sholder harness fastened, to perform all of the pilot's necessary functions. There must be a means to secure belts and harnesses, when not in use, to prevent interference with the operation of the rotorcraft and with rapid egress in an emergency.

(d) If seat backs do not have a firm handhold, there must be hand grips or rails along each aisle to enable the occupants to steady themselves while using the aisle in moderately rough air.

(e) Each projecting object that could injure persons seated or moving about in the rotorcraft in normal flight must be padded.

(f) Each seat and its supporting structure must be designed for an occupant weight of 170 pounds, considering the maximum load factors, inertia forces, and reactions between the occupant, seat, and safety belt or harness corresponding with the applicable flight and ground-load conditions, including the emergency landing conditions of § 27.561. In addition—

(1) Each pilot seat must designed for the reactions resulting from the application of the pilot forces prescribed in § 27.397; and

(2) The inertia forces prescribed in § 27.561 must be multiplied by a factor of 1.33 in determining the strength of the attachment of—

(i) Each seat to the structure; and

(ii) Each safety belt or harness to the seat or structure.

(g) When the safety belt and shoulder harness are combined, the rated strength of the safety belt and shoulder harness may not be less than that corresponding to the inertia forces specified in § 27.561, considering the occupant weight of at least 170 pounds, considering the dimensional characteristics of the restraint system installation, and using a distribution of at least 60 percent load to the safety belt and at least 60 percent load to the shoulder harness. If the safety belt is capable of being used

without the shoulder harness, the inertia forces specified must be met by the safety belt alone.

(h) When a headrest is used, the headrest and its supporting structure must be designed to resist the inertia forces specified in § 27.561, with a 1.33 fitting factor and a head weight of at least 13 pounds.

§ 27.807 [Amended]

21. By amending § 27.807(a) by removing the last sentence.

22. By amending § 27.1309 by removing the words "*Functioning and reliability.*" in paragraph (a); by revising paragraph (b); and by adding new paragraphs (c) and (d) to read as follows:

§ 27.1309 Equipment, systems, and installations.

* * * * *

(b) The equipment, systems, and installations of a multiengine rotorcraft must be designed to prevent hazards to the rotorcraft in the event of a probable malfunction or failure.

(c) The equipment, systems, and installations of single-engine rotorcraft must be designed to minimize hazards to the rotorcraft in the event of a probable malfunction or failure.

(d) In showing compliance with paragraph (a), (b), or (c) of this section, the effects of lightning strikes on the rotorcraft must be considered in accordance with § 27.610.

23. By adding a new § 27.1329 to read as follows:

§ 27.1329 Automatic pilot system.

(a) Each automatic pilot system must be designed so that the automatic pilot can—

(1) Be sufficiently overpowered by one pilot to allow control of the rotorcraft; and

(2) Be readily and positively disengaged by each pilot to prevent it from interfering with control of the rotorcraft.

(b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.

(c) Each manually operated control for the system's operation must be readily accessible to the pilots.

(d) The system must be designed and adjusted so that, within the range of adjustment available to the pilot, it cannot produce hazardous loads on the rotorcraft or create hazardous deviations in the flight path under any flight condition appropriate to its use, either during normal operation or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

(e) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation.

§ 27.1413 [Amended]

24. By amending § 27.1413 by removing paragraphs (a) and (b) and the paragraph designator "(c)" only of paragraph (c).

25. By amending § 27.1505 by removing the word "or" at the end of paragraph (a)(2)(i); be removing the period from the end of paragraph (a)(2)(ii) and adding "; or" in its place; and by adding a new paragraph (a)(2)(iii) to read as follows:

§ 27.1505 Never-exceed speed.

(a) * * *

(2) * * *

(iii) 0.9 times the maximum speed substantiated for advancing blade tip mach number effects.

* * * * *

§ 27.1519 [Amended]

26. By amending § 27.1519 by removing the paragraph "(a)" designation and by removing paragraph (b) in its entirety.

27 By revising § 27.1525 to read as follows:

§ 27.1525 Kinds of operations.

The kinds of operations (such as VFR, IFR, day, night, or icing) for which the rotorcraft is approved are established by demonstrated compliance with the applicable certification requirements and by the installed equipment.

28. By revising § 27.1555(a) and adding a new paragraph (e) to read as follows:

§ 27.1555 Control markings.

(a) Each cockpit control, other than primary flight controls or control whose function is obvious, must be plainly marked as to its function and method of operation.

* * * * *

(e) For rotorcraft incorporating retractable landing gear, the maximum landing gear operating speed must be displayed in clear view of the pilot.

29. By revising § 27.1559 to read as follows:

§ 27.1559 Limitations placard.

There must be a placard in clear view of the pilot that specifies the kinds of operations (such as VFR, IFR, day, night, or icing) for which the rotorcraft is approved.

30. By revising § 27.1585(a) and adding a new paragraph (g) to read as follows:

§ 27.1585 Operating procedures.

(a) Parts of the manual containing operating procedures must have information concerning any normal and emergency procedures and other information necessary for safe operation, including takeoff and landing procedures and associated airspeeds. The manual must contain any pertinent information including—

(1) The kind of takeoff surface used in the tests and each appropriate climbout speed; and

(2) The kind of landing surface used in the tests and appropriate approach and glide airspeeds.

* * * * *

(g) The airspeeds and rotor speeds for minimum rate of descent and best glide angle as prescribed in § 27.71 must be provided.

31. By amending § 27.1587 by revising paragraph (a)(2)(ii); by removing the period at the end of paragraph (a)(2)(iii) and inserting"; and" in its place; by adding a new paragraph (a)(2)(iv); by adding the word "and" after the semicolon at the end of paragraph (b)(1); by removing paragraph (b)(2); and by redesignating paragraph (b)(3) as (b)(2) as follows:

§ 27.1587 Performance information.

(a) * * *

(2) * * *

(ii) The maximum safe wind for operation near the ground. If there are combinations of weight, altitude, and temperature for which performance information is provided and at which the rotorcraft cannot land and takeoff safely with the maximum wind value, those portions of the operating envelope and the appropriate safe wind conditions shall be identified in the flight manual;

(iii) * * *

(iv) Glide distance as a function of altitude when autorotating at the speeds and conditions for minimum rate of descent and best glide as determined in § 27.71.

* * * * *

PART 29–AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT

§ 29.21 [Amended]

32. By amending § 29.21 by removing paragraph (b); by removing the designator "(a)" in § 29.21(a); and by redesignating paragraphs (a)(1) and (a)(2) as (a) and (b), respectively.

33. By amending § 29.45 by revising (b)(2) and (c)(2) and by adding a new paragraph (f) to read as follows:

§ 29.45 General.

* * * * *

(b) * * *

(2) For the approved range of atmospheric variables.

(c) * * *

(2) The power absorbed by the accessories and services at the values for which certification is requested and approved.

* * * * *

(f) For turbine-engine-power rotorcraft, a means must be provided to permit the pilot to detemine prior to takeoff that each engine is capable of developing the power necessary to achieve the applicable rotorcraft performance prescribed in this subpart.

34. By revising § 29.59(b) and introductory paragraph (c) to read as follows:

§ 29.59 Takeoff path: Category A.

* * * * *

(b) The rejected takeoff path must be established with not more than takeoff power on each engine from the start of takeoff to the critical decision point, at which point it is assumed that the critical engine becomes inoperative and that the rotorcraft is brought to a safe stop.

(c) The takeoff climbout path must be established with not more than takeoff power on each engine from the start of takeoff to the critical decision point, at which point it is assumed that the critical engine becomes inoperative and remains inoperative for the rest of the takeoff. The rotorcraft must be accelerated to achieve the takeoff safety speed and a height of 35 feet above the ground or greater and the climbout must be made—

* * * * *

35. By amending § 29.67 by revising paragraphs (a)(1), (a)(1)(ii), (a)(2), and (a)(2)(ii) to read as follows:

§ 29.67 Climb: One-engine inoperative.

(a) * * *

(1) The safety rate of climb without ground effect must be at least 100 feet per minute for each weight, altitude, and temperature for which takeoff and landing data are to be scheduled, with—

(i) * * *

(ii) The most unfavorable center of gravity;

* * * * *

(2) The steady rate of climb without ground effect must be at least 150 feet per minute 1,000 feet above the takeoff and landing surfaces for each weight, altitude, and temperature for which takeoff and landing data are to be scheduled, with—

(i) * * *

(ii) The most unfavorable center of gravity;

* * * * *

36. By amending § 29.77 by removing the word "and" at the end of paragraph (a); by removing the period at the end of paragraph (b) and inserting "; and" in its place; and by adding a new paragraph (c) to read as follows:

§ 29.77 Balked landing: Category A.

* * * * *

(c) The rotorcraft does not descend below 35 feet above the landing surface in the maneuver described in paragraph (b) of this section.

37. By amending § 29.141 by revising introductory paragraph (a) and (a)(1) to read as follows:

§ 29.141 General.

* * * * *

(a) Except as specifically required in the applicable section, meet the flight characteristics requirements of this subpart—

(1) At the approved operating altitudes and temperatures;

* * * * *

38. By revising § 29.143(c) (1) and (2) and by adding (c)(3) to read as follows:

§ 29.143 Controllability and maneuverability.

* * * * *

(c) * * *

(1) Critical weight;

(2) Critical center of gravity; and

(3) Critical rotor r.p.m.

* * * * *

39. By adding a new § 29.151 to read as follows:

§ 29.151 Flight controls.

(a) Longitudinal, lateral, directional, and collective controls may not exhibit excessive breakout force, friction, or preload.

(b) Control system forces and free play may not inhibit a smooth, direct rotorcraft response to control system input.

40. By revising § 29.161(a) to read as follows:

§ 29.161 Trim control.

* * * * *

(a) Must trim any steady longitudinal, lateral, and collective control forces to zero in level flight at any appropriate speed; and

* * * * *

41. By revising § 29.173 to read as follows:

§ 29.173 Static longitudinal stability.

(a) The longitudinal control must be designed so that a rearward movement of the control is necessary to obtain a speed less than the trim speed, and a forward movement of the control is necessary to obtain a speed more than the trim speed.

(b) With the throttle and collective pitch held constant during the maneuvers specified in § 29.175 (a) through (c), the slope of the control position versus speed curve must be positive throughout the full range of altitude for which certification is requested.

(c) During the maneuver specified in § 29.175(d), the longitudinal control position versus speed curve may have a negative slope within the specified speed range if the negative motion is not greater than 10 percent of total control travel.

42. By amending § 29.175 by revising introductory paragraphs (a) and (c) and the entire paragraph (d) to read as follows:

§ 29.175 Demonstration of static longitudinal stability.

(a) *Climb.* Static longitudinal stability must be shown in the climb condition at speeds from 0.85 V_Y, or 15 knots below V_Y, whichever is less, to 1.2 V_Y or 15 knots above V_Y, whichever is greater, with—

* * * * *

(c) *Autorotation.* Static longitudinal stability must be shown in autorotation at airspeeds from 0.5 times the speed for minimum rate of descent, or 0.5 times the maximum range glide speed for Category A rotorcraft, to V_{NE} or to 1.1 V_{NE} (power-off) if V_{NE} (power-off) is established under § 29.1505(c), and with—

* * * * *

(d) *Hovering.* For helicopters, the longitudinal cyclic control must operate with the sense, direction of motion, and position as prescribed in § 29.173 between the maximum approved rearward speed and a forward speed of 17 knots with—

(1) Critical weight;

(2) Critical center of gravity;

(3) Power required to maintain an approximate constant height in ground effect;

(4) The landing gear extended; and

(5) The helicopter trimmed for hovering.

43. By adding a new § 29.177 to read as follows:

§ 29.177 Static directional stability.

Static directional stability must be positive with throttle and collective

controls held constant at the trim conditions specified in § 29.175 (a), (b), and (c). Sideslip angle must increase steadily with directional control deflection for sideslip angles up to ±10° from trim. Sufficient cues must accompany sideslip to alert the pilot when approaching sideslip limits.

44. By adding a new § 29.181 to read as follows:

§ 29.181 Dynamic stability: Category A rotorcraft.

Any short-period oscillation occurring at any speed from V_Y to V_{NE} must be positively damped with the primary flight controls free and in a fixed position.

45. By adding a new § 29.610 to read as follows:

§ 29.610 Lightning protection.

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

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

(1) Electrically bonding the components properly to the airframe; or

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

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

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

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

46. By amending § 29.671 by adding a new paragraph (c) to read as follows:

§ 29.671 General.

* * * * *

(c) A means must be provided to allow full control movement of all primary flight controls prior to flight, or a means must be provided that will allow the pilot to determine that full control authority is available prior to flight.

47. By adding a new § 29.672 to read as follows:

§ 29.672 Stability augmentation, automatic, and power-operated systems.

If the functioning of stability augmentation or other automatic or power-operated system is necessary to show compliance with the flight characteristics requirements of this Part, the system must comply with § 29.671 of this Part and the following:

(a) A warning which is clearly distinguishable to the pilot under expected flight conditions without requiring the pilot's 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 is unaware 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 allow initial counteraction of failures without requiring exceptional pilot skill or strength, by overriding the failure by moving the flight controls in the normal sense, and by deactivating the failed system.

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

(1) The rotorcraft is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations;

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

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

48. By adding a new § 29.673 to read as follows:

§ 29.673 Primary flight controls.

Primary flight controls are those used by the pilot for immediate control of pitch, roll, yaw, and vertical motion of the rotorcraft.

49. By amending § 29.729 by adding new introductory text; by replacing the word *"General."* with the words *"Locds."* in paragraph (a); by revising paragraph (f); and by adding a new paragraph (g) to read as follows:

§ 29.729 Retracting mechanism.

For rotorcraft with retractable landing gear, the following apply:

* * * * *

(f) *Control.* The location and operation of the retraction control must meet the requirements of §§ 29.777 and 29.779.

(g) *Landing gear warning.* An aural or equally effective landing gear warning device must be provided that functions continuously when the rotorcraft is in a normal landing mode and the landing gear is not fully extended and locked. A manual shutoff capability must be provided for the warning device and the warning system must automatically reset when the rotorcraft is no longer in the landing mode.

50. By revising the introductory paragraph to § 29.735 to read as follows:

§ 29.735 Brakes.

For rotorcraft with wheel-type landing gear, a braking device must be installed that is—

* * * * *

51. By revising § 29.771(b) to read as follows:

§ 29.771 Pilot compartment.

* * * * *

(b) If there is provision for a second pilot, the rotorcraft must be controllable with equal safety from either pilot position. Flight and powerplant controls must be designed to prevent confusion or inadvertent operation when the rotorcraft is piloted from either position;

* * * * *

52. By adding a new § 29.779 to read as follows:

§ 29.779 Motion and effect of cockpit controls.

Cockpit controls must be designed so that they operate in accordance with the following movements and actuation:

(a) Flight controls, including the collective pitch control, must operate with a sense of motion which corresponds to the effect on the rotorcraft.

(b) Twist-grip engine power controls must be designed so that, for lefthand operation, the motion of the pilot's hand is clockwise to increase power when the hand is viewed from the edge containing the index finger. Other engine power controls, excluding the collective control, must operate with a forward motion to increase power.

(c) Normal landing gear controls must operate downward to extend the landing gear.

53. By revising § 29.785(a), (b), and (c), and by adding new paragraphs (g) and (h) to read as follows:

§ 29.785 Seats, berth, safety belts, and harnesses.

(a) Each seat, berth, safety belt, harness, and adjacent part of the rotorcraft at each station designated for occupancy during takeoff and landing must be free of potentially injurious objects, sharp edges, protuberances, and hard surfaces and must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the inertia forces specified in § 29.561.

(b) Each occupant must be protected from head injury by—

(1) For each crewmember seat and each seat beside a crewmember front seat, a safety belt and harness that will

prevent the head from contacting any injurious object; and

(2) For each seat not covered under subparagraph (b)(1)—

(i) A safety belt plus the absence of injurious objects within striking radius of the head;

(ii) A safety belt, plus a shoulder harness that will prevent the head from contracting any injurious object; or

(iii) A safety belt plus an energy-absorbing rest that will support the arms, shoulders, head and spine.

(c) Each pilot's seat must have a combined safety belt and shoulder harness with a single-point release that allows the pilot, when seated with safety belt and shoulder harness fastened, to perform all of the pilot's necessary functions. There must be a means to secure belts and harnesses, when not in use, to prevent interference with the operation of the rotorcraft and with rapid egress in an emergency.

* * * * *

(g) When the safety belt and shoulder harness are combined, the rated strength of the safety belt and shoulder harness may not be less than that corresponding to the inertia forces specified in § 29.561, considering an occupant weight of at least 170 pounds, considering the dimensional characteristics of the restraint system installation, and using a distribution of at least 60 percent load to the safety belt and at least 60 percent load to the shoulder harness. If the safety belt is capable of being used without the shoulder harness, the inertia forces specified must be met by the safety belt alone.

(h) When a headrest is used, the headrest and its supporting structure must be designed to resist the inertia forces specified in § 29.561, with a 1.33 fitting factor and a head weight of at least 13 pounds.

§ 29.811 [Amended]

54. By amending § 29.811 by removing paragraphs (f) and (g) and redesignating paragraphs (h) and (i) as paragraphs (f) and (g), respectively.

55. By adding a new § 29.812 to read as follows:

§ 29.812 Emergency lighting.

For transport Category A rotorcraft, the following apply:

(a) A source of light with its power supply independent of the main lighting system must be installed to—

(1) Illuminate each passenger emergency exit marking and locating sign; and

(2) Provide enough general lighting in the passenger cabin so that the average illumination, when measured at 40-inch intervals at seat armrest height on the center line of the main passenger aisle, is at least 0.05 foot-candle.

(b) Exterior emergency lighting must be provided at each emergency exit. The illumination may not be less than 0.05 foot-candle (measured normal to the direction of incident light) for minimum width on the ground surface, with landing gear extended, equal to the width of the emergency exit where an evacuee is likely to make first contact with the ground outside the cabin. The exterior emergency lighting may be provided by either interior or exterior sources with light intensity measurements made with the emergency exits open.

(c) Each light required by paragraph (a) or (b) of this section must be operable manually from the cockpit station and from a point in the passenger compartment that is readily accessible. The cockpit control device must have an "on," "off," and "armed" position so that when turned on at the cockpit or passenger compartment station or when armed at the cockpit station, the emergency lights will either illuminate or remain illuminated upon interruption of the rotorcraft's normal electric power.

(d) Any means required to assist the occupants in descending to the ground must be illuminated so that the erected assist means is visible from the rotorcraft.

(1) The assist means must be provided with an illumination of not less than 0.03 foot-candle (measured normal to the direction of the incident light) at the ground end of the erected assist means where an evacuee using the established escape route would normally make first contact with the ground, with the rotorcraft in each of the attitudes corresponding to the collapse of one or more legs of the landing gear.

(2) If the emergency lighting subsystem illuminating the assist means is independent of the rotorcraft's main emergency lighting system, it—

(i) Must automatically be activated when the assist means is erected;

(ii) Must provide the illumination required by paragraph (d)(1); and

(iii) May not be adversely affected by stowage.

(e) The energy supply to each emergency lighting unit must provide the required level of illumination for at least 10 minutes at the critical ambient conditions after an emergency landing.

(f) If storage batteries are used as the energy supply for the emergency lighting system, they may be recharged from the rotorcraft's main electrical power system provided the charging circuit is designed to preclude inadvertent battery discharge into charging circuit faults.

§ 29.855 [Amended]

56. By amending § 29.855(d) by adding the words "or smoke" after the words "detection of fires".

57. By amending § 29.1303 by revising paragraph (a) and by adding a new paragraph (j) to read as follows:

§ 29.1303 Flight and navigation instruments.

* * * * *

(a) *An airspeed indicator.* For Category A rotorcraft with V_{NE} less than a speed at which unmistakable pilot cues provide overspeed warning, a maximum allowable airspeed indicator must be provided. If maximum allowable airspeed varies with weight, altitude, temperature, or r.p.m., the indicator must show that variation.

* * * * *

(j) For Category A rotorcraft, a speed warning device when V_{NE} is less than the speed at which unmistakable overspeed warning is provided by other pilot cues. The speed warning device must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots whenever the indicated speed exceeds V_{NE} plus 3 knots and must operate satisfactorily throughout the approved range of altitudes and temperatures.

58. By amending § 29.1309 by removing the phrase "*Functioning and reliability.*" from paragraph (a); by revising paragraphs (b), (c), (d), and (e); and by adding new paragraphs (f), (g), and (h) to read as follows:

§ 29.1309 Equipment, systems, and installations.

* * * * *

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

(1) For Category B rotorcraft, the equipment, systems, and installations must be designed to prevent hazards to the rotorcraft if they malfunction or fail; or

(2) For Category A rotorcraft—

(i) The occurrence of any failure condition which would prevent the continued safe flight and landing of the rotorcraft is extremely improbable; and

(ii) The occurrence of any other failure conditions which would reduce the capability of the rotorcraft 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 to minimize crew errors which could create additional hazards.

(d) Compliance with the requirements of paragraph (b)(2) of this section must be shown by analysis and, where necessary, by appropriate ground, flight, or 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 rotorcraft 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) For Category A rotorcraft, each installation whose functioning is required by this subchapter and which 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 rotorcraft with two engines; and

(ii) Any two engines, on rotorcraft with three or more engines.

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

(g) In showing compliance with paragraphs (a) and (b) of this section with regard to the electrical system and to 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 subchapter, 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.

(h) In showing compliance with paragraphs (a) and (b) of this section, the effects of lightning strikes on the rotorcraft must be considered in accordance with § 29.610.

59. By amending § 29.1323 by revising introductory paragraph (b), (b)(1), (c), and (d) to read as follows:

§ 29.1323 Airspeed indicating system.

* * * * *

(b) Each system must be calibrated to determine system error excluding airspeed instrument error. This calibration must be determined—

(1) In level flight at speeds of 20 knots and greater, and over an appropriate range of speeds for flight conditions of climb and autorotation; and

* * * * *

(c) For Category A rotorcraft—

(1) The indication must allow consistent definition of the critical decision point; and

(2) The system error, excluding the airspeed instrument calibration error, may not exceed—

(i) Three percent or 5 knots, whichever is greater, in level flight at speeds above 80 percent of takeoff safety speed; and

(ii) Ten knots in climb at speeds from 10 knots below takeoff safety speed to 10 knots above V_Y.

(d) For Category B rotorcraft, the system error, excluding the airspeed instrument calibration error, may not exceed 3 percent or 5 knots, whichever is greater, in level flight at speeds above 80 percent of the climbout speed attained at 50 feet when complying with § 29.63.

* * * * *

60. By revising § 29.1325(f) to read as follows:

§ 29.1325 Static pressure and pressure altimeter systems.

* * * * *

(f) Each system must be designed and installed so that an error in indicated pressure altitude, at sea level, with a standard atmosphere, excluding instrument calibration error, does not result in an error of more than ±30 feet per 100 knots speed. However, the error need not be less than ±30 feet.

* * * * *

61. By amending § 29.1329 by revising paragraph (a) and adding a new paragraph (e) to read as follows:

§ 29.1329 Automatic pilot system.

(a) Each automatic pilot system must be designed so that the automatic pilot can—

(1) Be sufficiently overpowered by one pilot to allow control of the rotorcraft; and

(2) Be readily and positively disengaged by each pilot to prevent it from interfering with the control of the rotorcraft.

* * * * *

(e) If the automatic pilot integrates signals from auxiliary controls of furnishes signals for operation or other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation.

62. By revising § 29.1331(a)(3) to read as follows:

§ 29.1331 Instruments using a power supply.

* * * * *

(a) * * *

(3) A visual means integral with each instrument to indicate when the 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 instrument. For electrical instruments, the power is considered to be adequate when the voltage is within the approved limits; and

* * * * *

63. By revising § 29.1333 to read as follows:

§ 29.1333 Instrument systems.

For systems that operate the required flight instruments which are located at each pilot's station, the following apply:

(a) Only the required flight instruments for the first pilot may be connected to that operating system.

(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 flight instruments remains available to a pilot, without additional crewmember action, after any single failure or combination of failures that are not shown to be extremely improbable.

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

64. By revising § 29.1355(b) to read as follows:

§ 29.1355 Distribution system.

* * * * *

(b) If two independent sources of electrical power for particular equipment or systems are required by

this chapter, in the event of the failure of one power source for such equipment or system, another power source (including its separate feeder) must be provided automatically or be manually selectable to maintain equipment or system operation.

65. By revising § 29.1357 (b), (d), and (e) and by adding a new paragraph (g) to read as follows:

§ 29.1357 Circuit protective devices.

* * * * *

(b) The protective and control devices in the generating system must be designed to de-energize and disconnect faulty power sources and power transmission equipment from their associated buses with sufficient rapidity to provide protection from hazardous overvoltage and other malfunctioning.

* * * * *

(d) If the ability to reset a circuit breaker or replace a fuse is essential to safety in flight, that circuit breaker or fuse must be located and identified so that it can be readily reset or replaced in flight.

(e) Each essential load must have individual circuit protection. However, individual protection for each circuit in an essential load system (such as each position light circuit in a system) is not required.

* * * * *

(g) Automatic reset circuit breakers may be used as integral protectors for electrical equipment provided there is circuit protection for the cable supplying power to the equipment.

66. By amending § 29.1505 by removing the word "or" at the end of paragraph (a)(2)(i); by removing the period from the end of paragraph (a)(2)(ii) and adding "; or" in its place; and by adding a new paragraph (a)(2)(iii) to read as follows:

§ 29.1505 Never-exceed speed.

(a) * * *

(2) * * *

(iii) 0.9 times the maximum speed substantiated for advancing blade tip mach number effects under critical altitude conditions.

* * * * *

67. By revising § 29.1525 to read as follows:

§ 29.1525 Kinds of operations.

The kinds of operations (such as VFR, IFR, day, night, or icing) for which the rotorcraft is approved are established by demonstrated compliance with the applicable certification requirements and by the installed equipment.

68. By revising § 29.1555(a) and adding a new paragraph (e) to read as follows:

§ 29.1555 Control markings.

(a) Each cockpit control, other than primary flight controls or control whose function is obvious, must be plainly marked as to its function and method of operation.

* * * * *

(e) For rotorcraft incorporating retractable landing gear, the maximum landing gear operating speed must be displayed in clear view of the pilot.

69. By revising § 29.1559 to read as follows:

§ 29.1559 Limitations placard.

There must be a placard in clear view of the pilot that specifies the kinds of operations (VFR, IFR, day, night, or icing) for which the rotorcraft is approved.

70. By amending § 29.1583 by revising paragraph (g) and by adding a new paragraph (i) to read as follows:

§ 29.1583 Operating limitations.

* * * * *

(g) *Maximum allowable wind.* For Category A rotorcraft, the maximum allowable wind for safe operation near the ground must be furnished.

* * * * *

(i) *Ambient temperature.* Maximum and minimum ambient temperature limitations must be furnished.

71. By adding a new § 29.1585(g) to read as follows:

§ 29.1585 Operating procedures.

* * * * *

(g) For Category B rotorcraft, the airspeeds and corresponding rotor speeds for minimum rate of descent and best glide angle as prescribed in § 29.71 must be provided.

* * * * *

72. By amending § 29.1587 by adding an introductory paragraph; by removing the word "and" from the end of paragraphs (a)(3) and (b)(6); by revising paragraph (a)(4); by adding new paragraphs (a)(5), (b)(7), (b)(8), by redesignating paragraphs (b)(7) to (b)(9), and by amending paragraph (b)(1) to read as follows:

§ 29.1587 Performance information.

Flight manual performance information which exceeds any operating limitation may be shown only to the extent necessary for presentation clarity or to determine the effects of approved optional equipment or procedures. When data beyond operating limits are shown, the limits must be clearly indicated. The following must be provided:

(a) * * *

(4) The rejected takeoff distance determined under § 29.59(b) and the takeoff distance determined under § 29.59(c); and

(5) The landing data determined under §§ 29.75 and 29.77.

(b) * * *

(1) The takeoff distance and the climbout speed together with the pertinent information defining the flight path with respect to autorotative landing if an engine fails, including the calculated effects of altitude and temperature;

* * * * *

(7) Glide distance as a function of altitude when autorotating at the speeds and conditions for minimum rate of descent and best glide angle, as determined in § 29.71;

(8) Maximum safe wind for hover operations out-of-ground effect if hover performance for that condition is provided; and

* * * * *

PART 91—GENERAL OPERATING AND FLIGHT RULES

73. By amending § 91.31 by revising the title and paragraph (a) and by removing paragraph (e) as follows:

§ 91.31 Civil aircraft flight manual, marking, and placard requirements.

(a) Except as provided in paragraph (d) of this section, no person may operate a civil aircraft without complying with the operating limitations specified in the approved Airplane or Rotorcraft Flight Manual, markings, and placards, or as otherwise prescribed by the certificating authority of the country of registry.

* * * * *

(Secs. 313(a), 601, and 603, Federal Aviation Act of 1958, as amended (40 U.S.C. 1354(a), 1421, 1423 and 1424); 49 U.S.C. 106(g) (revised, Pub. L. 97-449, January 12, 1983))

Note.—As summarized in the Supplementary Information, Discussion of Comments, Economic Summary, and Regulatory Flexibility Determination sections of this rulemaking action, the FAA has determined that the benefits of this amendment, in providing an increased level of safety to passengers traveling in rotorcraft

while at the same time recognizing and providing for the unique qualities and capabilities of rotorcraft, far outweigh the burdens and that this action: (1) Involves a regulation that is not a major rule under Executive Order 12291; and (2) is not a significant rule under Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). In addition, for reasons discussed above, I certify that under the criteria of the Regulatory Flexibility Act these amendments will not have a significant economic impact on a substantial number of small entities. Also, these amendments would have little or no impact on trade opportunities for U.S. firms doing business overseas or for foreign firms doing business in the United States. A final regulatory evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption **"FOR FURTHER INFORMATION CONTACT."**

Issued in Washington, D.C., on August 14, 1984.

Donald D. Engen,

Administrator.

[FR Doc. 84-29088 Filed 11-5-84; 8:45 am]

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[Docket No. 23266; Amdts. 1-32, 27-21, 29-24, and 91-185]

Rotorcraft Regulatory Review Program; Amendment No. 2

Correction

In FR Doc. 84-29088, beginning on page 44422, in the issue of Tuesday, November 6, 1984, make the following corrections:

1. On page 44424, column one, first full paragraph, line nineteen, "man" should read "mean".

2. On page 44433, column three, § 27.672 (b), in the last line, "failure" should read "failed".

3. On page 44437, column two, change No. 49., line three, "words" should read "word".

§ 29.1329(e) [Corrected]

4. On page 44439, third column in § 29.1329(e) on line two "of" should read "or" and on line three "or" should read "of".

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