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**Department of
Transportation**

Federal Aviation Administration

**14 CFR Parts 1, 27, 29, and 33
RIN 2120-AA28**

**Rotorcraft Regulatory Review Program;
Amdt. No. 3; Final Rule**

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 1, 27, 29, and 33

[Docket No. 24337; Amdts. 1-34, 27-23, 29-26, and 33-12]

RIN 2120-AA28

Rotorcraft Regulatory Review Program; Amdt. No. 3

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This rule adopts new and revised airworthiness standards for the powerplant and rotor drive aspects of type certification of normal and transport category rotorcraft. These new and revised standards are necessary because both the government and the rotorcraft industry recognize that the existing certification rules have been outdated by rapidly advancing rotorcraft technology. In addition, extensive experience with certification programs, based on the existing rules, has revealed a need for numerous clarifications in regulatory definitions and terminology, as well as the need for editorial corrections and regulatory simplifications which can materially reduce the burden that the current regulations impose on the rotorcraft industry without derogating safety.

EFFECTIVE DATE: October 3, 1988.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION: These amendments are the fourth in a series of amendments being issued as a part of the Rotorcraft Regulatory Review Program. The first of the series of amendments in this program addressed applicability and icing certification standards and was published in the *Federal Register* on January 31, 1983 (48 FR 4374). The second of the series of amendments dealt with rotorcraft flight characteristics and systems and equipment and was published in the *Federal Register* on November 6, 1984 (49 FR 44422). The third in the series, Rotorcraft Regulatory Review Program, Amendment No. 5, updated operations and maintenance and was published in the *Federal Register* on November 7, 1986 (51 FR 40692). The amendments in this fourth series involve the powerplant, rotor drive mechanism, and associated support and protective systems for the powerplant and the rotor drive mechanism.

These amendments are based on Notice of Proposed Rulemaking (NPRM) No. 84-19 published in the *Federal Register* on November 27, 1984 (49 FR 46670). 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 nonsubstantive changes and minor changes of an editorial and clarifying nature have been made to the proposals based upon relevant comments received and upon further review by the FAA. Except as indicated herein, the proposals contained in the notice have been adopted without change.

One general comment is worthy of special note. An industry association deplors the fact that some 20 percent of the proposals in the notice were not included in the agenda at the formal Rotorcraft Regulatory Review Program Conference held December 10-14, 1979, in New Orleans, Louisiana. However, as indicated in the preamble to the NPRM, additional proposals which were previously the subject of various rotorcraft certification program special conditions were included, as well as a number of proposals derived by the FAA from ongoing review and day-to-day application of the existing rules. The FAA's plans to amend the certification standards based on these activities were presented to the public at the earliest opportunity by way of the NPRM and every proposal adopted is within the scope of the notice.

A total of seven comments were received. The commenters represented airframe manufacturers, engine manufacturers, rotorcraft owners, and operators. The majority of the commenters agreed with the substance of the NPRM. Several recommended minor changes. These recommendations and their resolutions are contained in the discussion of comments.

Discussion of Comments

The following are keyed to like-numbered proposals in Notice No. 84-19 and are presented in the same order as the corresponding amendments found in the rules portion of this document.

Proposal 3-1. The notice proposed to amend § 1.1 of the Federal Aviation Regulations (FAR) to add a new definition for "rated continuous OEI power" and to revise the definition of existing "rated 30-minute power" and "rated 2½-minute power." This amendment is needed as a part of a program to introduce a new rotorcraft and engine one-engine-inoperative (OEI) rating and to clarify the limitations on the use of the existing 30-minute and 2½-minute power ratings. Two

commenters submitted identical objections to the addition of the term "OEI" in the definition of the 30-minute rating. They contend that this change would prevent designers, constructors, and operators of single-engine rotorcraft from taking advantage of this rating to provide extra power during abnormal or emergency operating conditions, and that such denial will reduce the utility and safety of these rotorcraft.

A review of the history and an examination of the qualification programs and the performance credit allowed for this 30-minute rating in both Parts 27 and 29 of the FAR clearly indicate that this rating is intended only as a rating to be used after failure of an engine in a multiengine turbine-powered rotorcraft. Hence, the term OEI is applicable, both from a definitive standpoint and for standardization of nomenclature that becomes apparent in subsequent definitions and usages in the regulations affected by this rule change.

Two commenters also question the need to add the term "OEI" to the "rated 2½-minute (OEI) power" definition of "rated 2½-minute power" since the limitations on the use of this rating are already clear in the current definition. The FAA concludes, as indicated above, that standardization of nomenclature will be achieved by this change and that it may preclude misinterpretation associated with an ongoing and expansive use of the FAR by the foreign rotorcraft community. Therefore, the proposal is adopted without change.

Proposal 3-2. The notice proposed to amend § 1.2 to include, as a new abbreviation, the term "OEI" meaning "one engine inoperative." This abbreviation has found widespread acceptance in the aviation community. No comments were received, and the proposal is adopted without change.

Proposal 3-3. The notice proposed to amend paragraph (b) of § 27.67 to permit rotorcraft climb performance to be determined at "continuous OEI" power for rotorcraft certificated for this power. In addition, the term "30-minute power" would be revised to read "30-minute OEI power." These changes are needed to coordinate and implement the use of the new "continuous one-engine-inoperative (OEI) rating" for rotorcraft and to implement the revision to the definition of "30-minute power" included in Proposal 3-1. This proposal is one of a series of revisions to Parts 1, 27, 29, and 33 which are directed at creating a new continuous OEI rotorcraft power rating. This rating would be available as an alternate to the existing 30-minute OEI rating presumably at a lower power, but without a time limitation. This rating

would enable rotorcraft dispatched on routes requiring en route stay-up ability for more than 30 minutes after an engine failure to carry a higher useful load and thus improve productivity. Rotorcraft operators servicing distant offshore petroleum industry facilities would particularly benefit by the availability of this rating. No comments were received, and the proposal is adopted without change.

Proposal 3-4. The notice proposed to amend § 27.361 to require design consideration of the engine torque loads associated with emergency operation of governor-controlled turboshaft engines and also torque reaction loads from sudden engine stoppage that may be expected with turbine engines. This amendment requires design features to ensure that the engine will remain in place and not jeopardize the continued safe operation of the rotorcraft in the event of these conditions.

One commenter objects to the proposal and contends that the term "sudden engine stoppage" is vague and could be interpreted to mean instant stoppage with the concurrent assumption of infinite loads and is, therefore, unrealistic. However, FAA experience with the application of similar wording regarding engine mount limit loads in corresponding subparts of Parts 23 and 25 indicates that the engine manufacturers can reasonably provide data on inertia of rotating parts and deceleration times to be expected in the event of sudden engine stoppage which generates critical loads. These data should be acceptable for design analysis in this amendment and should avoid the need to consider any concepts regarding infinite and unrealistic loads.

This same commenter objects to the last phrase in proposed paragraph (a)(5) which would have required engine torque limit load values for governor-controlled engines to include the "torque imposed by inadvertent or abnormal control motions to be expected in service." The objection is that this requirement would be unrealistic as well as impractical to apply. Upon reconsideration, the FAA agrees the proposed language could create undue burdens because of difficulty of interpretation or application and, accordingly, proposed paragraph (a)(5) is removed. A similar change to Proposal 3-40 for § 29.361 has been made. This proposal is adopted with these changes.

Proposal 3-5. The notice proposed to amend Part 27 to add a new § 27.833 which is a revised version of the lead-in paragraph of existing § 27.859(c) as it relates to the approval requirements for fuel heaters. This new section is needed

to facilitate the extensive changes adopted for § 27.859 in Proposal 3-6 and to achieve parallel rule construction with Part 29. This revision will ensure that all combustion heaters, not just those gasoline-operated, will be approved. No comments were received, and the proposal is adopted without change.

Proposal 3-6. The notice proposed to amend § 27.859 extensively by revising the existing combustion heater design and qualification standards to make them equivalent to those now prescribed in Part 29. This amendment will minimize the probability of hazardous fires from malfunction or failure of combustion heaters. No comments were received, and the proposal is adopted without change.

Proposal 3-7. The notice proposed to amend § 27.901(b)(1) to require satisfactory determination that the affected rotorcraft can operate safely throughout adverse environmental conditions, such as high altitude and temperature extremes. This amendment is needed to provide consistent application of environmental qualification aspects. The notice also proposed to add a new paragraph (b)(5) to require design precautions to minimize the potential for incorrect assembly of components and equipment essential to safe operation. Without such precautions, errors in the assembly and maintenance of the complex systems and equipment found in modern rotorcraft can introduce hazards. No comments were received, and the proposal is adopted without change.

Proposal 3-8. The notice proposed to amend § 27.903 to include a requirement that reciprocating engines must be qualified under § 33.49(d) to be eligible for approval in helicopters. Also, changes were included which prescribe tests and qualifications for powerplant, area cooling fans. This will serve to ensure that correct qualification procedures are used for helicopter engines and that all powerplant cooling fans are properly tested. No comments were received, and the proposal is adopted without change.

Proposal 3-9. Currently § 27.923(e), as it relates to the 2½-minute power rating, and § 27.923(j), as it relates to the 30-minute power rating, provide for only minimal testing of the capability of the rotor drive system to sustain these powers. The notice proposed to amend these paragraphs to extend the testing to adequately assure valid qualification tests. These changes ensure the integrity of the rotor drive system so that it will safely sustain the higher stresses expected with actual, repeated use of these power ratings.

New paragraph (k) provides a

qualification test schedule for the optional, continuous OEI rating introduced in the notice by proposed amendments to §§ 1.1, 1.2, and 27.67, and by similar proposed amendments to Parts 29 and 33. This new paragraph is needed to provide a basis for endurance testing qualification for this new rating.

The notice proposed to remove, where applicable, the reference to "engine power" to avoid confusion regarding whether the tests prescribed by this section must be conducted at powers corresponding to engine ratings established under Part 33 rather than rotorcraft powers which may be lower than those established under Part 33 but selected by the applicant as a limit on its product. Also, the notice proposed to add the abbreviation "OEL," where applicable, to coordinate the introduction of this term as defined in an amendment to Part 1.

No comments were received, and the proposal is adopted without change.

Proposal 3-10. The notice proposed to amend § 27.927 to add a requirement that the rotor drive system overtorque tests prescribed by paragraph (b) be conducted at the maximum rotational speed intended for the power condition of the test. The existing rule, which specifies only the torque to be applied to the rotor drive system during the overtorque test, does not otherwise completely define the applicable test requirements.

One commenter objects to the proposal, claiming that to specify the rotational speed as "maximum" would preclude the concept of reducing speed during the test to facilitate achieving required test torque. However, existing paragraph (b)(3) already provides relief from exacting test conditions if there is adequate substantiation. This proposal is, therefore, adopted without change. It is noted that this section, as revised, is not totally parallel with Part 29 but that inconsistency must be considered separately from this rulemaking action as it is beyond the scope of the notice.

Proposal 3-11. The notice proposed to add a new § 27.954 that sets forth requirements for design features to prevent ignition of fuel vapor in the fuel system due to lightning strike to the rotorcraft. Lightning strike and any subsequent strokes which might cause streamering, corona, and arcing associated with a lightning strike can result in catastrophic explosions in the rotorcraft's fuel system. No comments were received, and the proposal is adopted without change.

Proposal 3-12. The notice proposed to amend § 27.955 to reorganize and restate the rotorcraft fuel system flow performance requirements and to add new requirements for test conditions to

ensure that adequate fuel flow is available to the engine in critical combinations of adverse conditions which may be expected during operation of the rotorcraft. Additionally, the amendment requires a correlation between fuel filter blockage and the fuel filter warning device required by existing § 27.1305(q), and provides design and performance standards for auxiliary fuel tank and transfer tank fuel systems. These changes were proposed to ensure that all parameters associated with fuel supply to the engine are adequately addressed.

One commenter suggests that the fuel flow considerations in proposed paragraphs (a)(1) through (a)(7) require an excessive number of tests. Also, the commenter objects to the concept that all of the test conditions should be assumed to occur or exist simultaneously.

Aside from new requirements in this proposal pertaining to fuel filter blockage, the use of critical fuel properties, and critical pump and pump motive power or speed, the statement of flow requirement is not technically changed. The new requirements should be relatively easy to adopt into a carefully planned flow test. However, the FAA agrees that it may be unreasonable to expect all conditions which can adversely affect fuel flow to exist simultaneously, and a phrase allowing the exclusion of improbable combinations of conditions has been added in the final rule.

This same commenter offers without further comment alternate wording for the proposed revisions. Included in this was the suggestion that the fuel pressure (during the fuel flow test) may be allowed to fall below the minimum limit specified by the engine type certificate data sheet during transients for which only safe operation must be shown in flight. The FAA considers that this change would be confusing to the crew (e.g., fuel pressure below the red radial on the fuel pressure gauge) and may even compromise the safety margin established during the engine certification test program. This suggested change is inappropriate and is not included in the amendment.

Another suggested change to the proposal would, in effect, remove any requirement to have fuel flow capability to continue normal engine operation with fuel filter blockage in excess of the degree of filter blockage associated with activation of the indicator required by § 27.1305(q). After considering the success of fuel system performance based on previously approved fuel flow testing methods, the FAA concurs that the proposed requirement may be

excessive, and accordingly, the section is revised to only require an adequate flow with filter blockage associated with activation of the warning indicator required by the associated provisions of § 27.1305(g).

Another commenter states that the automatic fuel transfer provisions of new paragraph (b) and revised paragraph (c) are not justified by service experience and will introduce unnecessary complexity in the fuel system. An FAA review of presently certificated rotorcraft fuel systems indicates that most already employ the features of these proposals. Rotorcraft designs and operations often impose a high workload on the flightcrew; therefore, reasonable steps to alleviate this increasingly burdensome trend are not only appropriate but necessary.

The proposal is adopted with the change noted.

Proposal 3-13. The notice proposed to amend § 27.961 to restate the fuel system hot weather qualification requirements and to add a requirement for the system to be capable of providing adequate fuel during overpower transients to be expected. This amendment makes needed improvements to the existing wording of § 27.961 to assure adequate qualification testing. No comments were received, and the proposal is adopted without change.

Proposal 3-14. A new paragraph (b) to § 27.963 would have specified higher load factors in the design and retention of fuel tanks to provide better assurance that the tanks would retain their contents as a means of minimizing postcrash fuel fire hazards. A commenter objects to the higher load factors, stating that these factors will actually degrade fuel system crashworthiness in many cases. The commenter offers an alternate proposal for improved fuel system crash resistance which includes a fuel tank drop test, allowances for relative motion between fuel system components, and a requirement for fuel cells (presumably, bladder cells) to meet the puncture, tear rate, impact penetration, panel, and fitting strength of an unspecified technical standard order.

The drop test suggested by the commenter was previously presented as an FAA proposal at the Rotorcraft Regulatory Review Conference held at New Orleans, and received favorable comments. However, the proposal was not included in the notice because associated benefit/cost studies failed to show a positive beneficial result. Nevertheless, the FAA is interested in continuing efforts to develop regulatory criteria for rational fuel system

crashworthy designs for rotorcraft. The FAA is active in related programs in progress at its Technical Center and is also participating in the proceedings of the General Aviation Safety Panel (GASP) as well as studying the progress in this regard of foreign manufacturers. As a result of all of these activities, the FAA expects to develop, in the near future, an NPRM specifically for rotorcraft fuel system crash resistance that would be directly related to the survivability of the occupants. As a result and after further consideration, the portion of the proposal to add a new paragraph (b) is withdrawn, and existing paragraphs (a) through (d) of this section will remain unchanged.

The notice also proposed to add new paragraphs (f) and (g). These additions, now redesignated as paragraphs (e) and (f), respectively, require designs and tests to ensure that no exposed surface inside a fuel tank would, under normal or malfunction conditions, constitute an ignition source. They also set forth standards for the design and qualification of fuel tanks located in personnel compartments. These additions are needed to ensure freedom from the hazards of fuel tank internal explosions and to ensure that fuel tanks in passenger compartments are installed to present no hazards to the personnel or to the rotorcraft. No comments were received regarding this portion of the proposal.

The proposal is adopted with the changes discussed.

Proposal 3-15. The notice proposed to amend § 27.969 so that properly interconnected fuel tanks will not be required to have an expansion space for each tank if adequate expansion space is otherwise provided. This amendment will eliminate unnecessary design requirements when simpler designs have been proven satisfactory. No comments were received, and the proposal is adopted without change.

Proposal 3-16. The notice proposed to amend § 27.971 to prescribe finite, minimum values for fuel tank sump capacity, to authorize the use of a sediment bowl in lieu of a sump, and to require these sumps or sediment bowls to be effective in any ground attitude which can reasonably be expected in service.

A commenter objects to the fuel tank sump volume requirements on the basis that lower sump volumes acceptable under § 29.971 for transport category rotorcraft have been shown by service experience to be adequate for Part 27 rotorcraft. Also, the commenter questions the need for a larger capacity sump bowl than is required for Part 29

rotorcraft. The sump volume selected for the proposed rule is identical to that required for normal category airplanes (Part 23) and, as noted by the commenter, is larger than that required for transport category rotorcraft. In the FAA's view, this difference is warranted when it is considered that general aviation fuel supplies are likely to have more water and other contaminants than may be expected for fuel supplies for transport aircraft. However, the FAA concurs that the 2-ounce-for-every-20-gallons-sediment-bowl requirement of proposed § 27.971(a)(1) is not justified, and after reconsidering it has been changed to 1 ounce for every 20 gallons. The proposal is adopted with this change.

Proposal 3-17. The notice proposed to amend § 27.975 to add a new paragraph (b) which requires fuel tank vent systems to be designed to minimize spillage in the event of rollover of the rotorcraft during landing or ground operation. This is intended to reduce the potential for fuel fires when fuel escapes from a vent port after a rollover and encounters an ignition source. No comments were received, and the proposal is adopted without change.

Proposal 3-18. The notice proposed to amend § 27.991 to restate the existing fuel pump redundancy requirements, to remove unnecessary definitions and detail design requirements, and to extend the requirement for consideration of pump failure to include the fuel pump motivation device (such as a generator for electric pumps). These changes clarify the pump requirements and ensure that the intent of the rule is met; i.e., that fuel flow is adequate regardless of whether the failed component is a pump or the pump's motivating device. No comments were received, and the proposal is adopted without change.

Proposal 3-19. The notice proposed to amend § 27.993 to require fuel lines to be constructed and routed to withstand the same new higher load factors as discussed in Proposal 3-14 for § 27.963. A commenter objects to this new requirement citing the same reasons expressed for paragraph (b) of Proposal 3-14. For the reasons expressed in the discussion of Proposal 3-14, this proposal is withdrawn.

Proposal 3-20. The notice proposed to amend the introductory paragraph of § 27.997 to include a requirement that the fuel filter must be located in the fuel system to protect any component sensitive or susceptible to fuel contamination, including fuel metering devices or pumps. The intent of the proposed amendment has been clarified by inserting the words "but not limited

to" in the third line of § 27.997. This will ensure that any component sensitive to fuel contamination, not just fuel metering devices or an engine positive displacement pump, is protected.

A commenter objects to including fuel metering devices in the requirement, stating that fuel meter malfunction due to contaminants will have no effect on fuel flow. It is believed that the commenter is referring to fuel flow rate measuring devices whereas the proposal involves the fuel metering devices intended to control flow rate such as fuel injection devices. These latter items require filter protection from fuel contaminants.

The amendment to paragraph (d) will clarify and limit the scope of the existing rule to only provide for adequate filtration since the capacity aspect of the rule is addressed elsewhere by revisions to §§ 27.955 and 27.1305.

Accordingly, this proposal is adopted without substantive change.

Proposal 3-21. The notice proposed to amend § 27.999 to require fuel system drains to be effective with the rotorcraft in any ground attitude position. This change would ensure effective fuel drainage when the rotorcraft is parked on uneven terrain. In addition, the notice proposed to amend paragraph (b)(2) to require fuel drains to have means to ensure positive closure, as contrasted to positive locking, in the "off" position. This will accommodate designs that feature spring-loaded drain closures which have been found to be satisfactory. No comments were received, and the proposal is adopted without substantive change.

Proposal 3-22. The notice proposed to amend the title of § 27.1011 from "General" to "Engines: General" to reflect the concept that it applies specifically to engine oil systems and not to other systems such as those for transmissions and rotor drive system components. A new § 27.1027 provides standards for oil systems for transmissions and rotor drive systems. No comments were received, and the proposal is adopted without change.

Proposal 3-23. The notice proposed to relax what has been found to be an unduly restrictive requirement in current § 27.1019(a)(3) for an "indicator" to indicate the contamination level of oil filters. The amendment instead allows accepting a "means to indicate" the contaminate level to allow a wider range of acceptable methods of compliance. No comments were received, and the proposal is adopted without change.

Proposal 3-24. New § 27.1027, introduced in the notice, provides oil system standards for transmissions and

other drive system components. This amendment complements an amendment to § 27.1011 which limits its scope to engine oil systems. (See Proposal 3-22.) A commenter correctly notes that the reference to paragraph (a)(1) in paragraph (c) should be to paragraph (b). This correction and other minor editorial changes have been made to paragraph (c).

Another commenter suggests that the function of the screen required by paragraph (c) is only to protect the oil pump associated with pressurized lubrication systems. While that function is important, this screen should also serve to prevent any debris, regardless of its source, which could obstruct oil flow from the oil tank or sump, from entering the parts of the system not protected by the screen required by paragraph (b). Paragraph (c), revised as discussed, will accomplish this purpose.

After the consideration of comments received on the oil system proposal for transport rotorcraft (Proposal 3-62), it is apparent that compliance with § 27.1011, which after this amendment pertains only to engine oil systems, should not be required for transmissions and other rotor drive system components. Accordingly, new § 27.1027 is revised to remove reference to § 27.1011. The proposal is adopted with the changes discussed.

Proposal 3-25. The notice proposed to amend § 27.1041 to provide clarification and definition of powerplant components required to be considered when evaluating the performance of the powerplant cooling systems and arrangements. This amendment will minimize needless interpretation or extrapolation of the existing rule.

A commenter suggests that the general powerplant cooling system requirements of § 27.1041 or other appropriate rules should be revised to require the cooling arrangements for rotorcraft gearboxes to be capable of cooling the gearboxes at abnormally high "emergency" temperatures commensurate with continued cruise flight after a failure in the normal cooling system. The commenter claims that such arrangement could eliminate unnecessary and perhaps hazardous, unscheduled landings when the rotorcraft gearbox cooling system actually had the capability, although unknown to the crew, to continue flight. While there is some merit to this, there is adequate information on continued operation in failure modes found in the Emergency Procedures Section of the applicable Rotorcraft Flight Manual. Furthermore, rulemaking on this subject is beyond the scope of the notice. The

proposal is adopted without substantive change.

Proposal 3-26. The notice proposed to add to the powerplant cooling tests required by § 27.1045 an alternate acceptance criterion which may be appropriate if, during the cooling test, component temperatures peak and then decline rather than stabilize. In these instances, the current requirement to continue the test until "stabilization" occurs is unduly restrictive and should be eliminated. No comments were received, and this proposal is adopted without change.

Proposal 3-27. The notice proposed to amend § 27.1091 to remove paragraph (d) since the specific test defined by this paragraph may be meaningless or at least not critical for certain rotorcraft. Further, the turbine inlet foreign-object-ingestion protection provided by paragraph (d) is adequately evaluated by existing § 27.1091(e)(2). No comments were received, and the proposal is adopted without change.

Proposal 3-28. The notice proposed to amend § 27.1093 to relocate the phrase "within the limitations of the rotorcraft" from paragraph (b)(1) to paragraph (b)(1)(ii). This change will restore this phrase to its original and proper context; i.e., as pertinent to the requirements for demonstrating flight into snow. The existing location of the phrase may be read to imply that limitations may be established for the rotorcraft in lieu of demonstrating capability of the engine inlet to operate in icing meteorological conditions. This was not intended or justified by the editorial misplacement to this section made by Amendments 27-9 (39 FR 35461; October 1, 1974) and 27-12 (42 FR 15044; March 17, 1977).

A commenter objects to the proposal stating that the change would require the engine air inlet system to operate in a severe, possibly continuous, icing environment although the rotorcraft to be certificated may be otherwise completely unprotected and incapable of operation in icing conditions. Engine inlet ice protection is required whether or not the remainder of the rotorcraft is protected. This is the reason that engine power assurance during even an inadvertent icing encounter is of critical importance to continued safe flight. Thus, there is an independent requirement for engine air inlet operation in icing conditions regardless of the icing capability of the remainder of the rotorcraft.

Another commenter states that the requirements of § 27.1093(b)(2) for ground operation (taxiing) in certain meteorological conditions should be limited in applicability to rotorcraft which are qualified for flight into

atmospheric icing (ref. § 27.1419). A proposal for such a rule change of this order is beyond the scope of the notice and is, therefore, inappropriate in this rulemaking action.

The proposal included changing the reference in paragraph (b) from Appendix C of Part 25 to Appendix C of Part 29. These appendices are identical. This change is required to correlate the airframe icing requirements in § 27.1419 to the powerplant icing requirements of this section.

Accordingly, the proposal is adopted without change.

Proposal 3-29. The notice proposed to amend paragraph (c) of § 27.1141 to extend its applicability to any powerplant valve regardless of the location of the valve control, except that valves are excluded if their function is not required for safety. No comments were received, and this proposal is adopted without change.

Proposal 3-30. The notice proposed to amend paragraphs (a) through (d) of § 27.1143 to replace the terms "throttle control" and "thrust control," which are appropriate only to certain engines, with the more general term "power control." This change should preclude misconceptions regarding engine control arrangements when governor-controlled turboshaft engines are employed in rotorcraft. No comments were received, and this proposal is adopted without change.

Proposal 3-31. The notice proposed to amend paragraph (b) of § 27.1163 to restate the design requirement for accessory drive torque limiting devices in terms which will now allow the torque limiting device to be included in either the accessory or the rotor drive system. This will eliminate the ambiguity in the present rule which implies that the torque limiting device required for accessories must be in the design of the rotor drive system. No comments were received, and the proposal is adopted without change.

Proposal 3-32. The notice proposed to amend § 27.1189 to require flammable fluid shutoff devices and controls for these devices to be designed, located, and protected to function properly under conditions likely to result from a critical fire in a powerplant area. This change eliminates design arrangements wherein valves located outside the fire zone but in close contact to the firewall may be adversely affected by heat transfer through the firewall during a substantial powerplant fire and may interfere with the operation of these shutoff devices, thus, adding to the hazards of an engine fire. No comments were received, and this proposal is adopted without change.

Proposal 3-33. The notice proposed to amend § 27.1193 by adding a new paragraph (f) to require redundant retention means for each openable or readily removable panel, cowling, or engine or rotor drive system covering. Conventional fasteners for these devices are subject to frequent operation by maintenance personnel and are known to deteriorate or fail from wear or vibration. Such failure could be hazardous if it results in a loose panel, cowling, or covering striking or being struck by the rotors or by critical controls.

One commenter requests that proposed § 27.1193(f) be revised to reflect the single failure concept when evaluating the need for redundant cowling or panel retention devices. Such a limitation to the rule would be inappropriate since one failure can contribute directly to loads carried by other retention devices and thus result in multiple failures. The amendment provides relief from multiple failure considerations if such failure modes are extremely improbable. Therefore, the proposal is adopted without change.

Proposal 3-34. Paragraph (1) of § 27.1305 is revised to require a low fuel warning device for each tank that can be used to feed an engine, including single tank configurations. In addition, new wording is added to allow, if desired, a longer time between warning actuation and fuel exhaustion and to require the low fuel warning device to be independent of the normal fuel quantity indicating system. This change will clarify which tanks (i.e., any tank which directly feeds an engine) require low fuel warning devices and allow the designer flexibility to set the device to signal low fuel earlier than 5 minutes before fuel exhaustion if needed for operational reasons. A requirement for the low fuel warning device to be independent of the normal fuel quantity indicator is needed since without independence, errors or malfunctions of the normal indicators could mask the signal to the low fuel warning device and negate its value.

Paragraph (m) currently requires "a means to indicate to the pilot when each emergency pump is in operation." The existing rule was intended to alert crew members to the fact that the primary pump has failed so that appropriate precautions for continued flight in this failure mode may be instituted. Some rotorcraft configurations operate the main pump and the emergency pump simultaneously. Others rely on suction fuel feed systems after failure of the main pump, thus leading to possible confusion regarding acceptable means

of compliance. This proposal revises paragraph (m) to simply state that an indication of pump failure is required. Other rules require continued fuel feed in the event of this type of failure.

One commenter suggests that the proposed change to paragraph (m) should include, as a means of compliance, a preflight check to enable the crew to establish that all fuel pumps are functioning properly. The FAA does not concur because a preflight check would not provide the flightcrew with the in-flight failure indication needed to enable the crew to institute any appropriate precautions associated with continued operation on the remaining derogated fuel system.

The notice proposed to amend paragraph (q) to extend its application to all rotorcraft (not just those with turbine engines) and to require an indication to the crew of the degree of filter blockage established in conjunction with the fuel flow demonstrated in compliance with § 27.955. This change clarifies the intentions of the rule and correlates the setting of the indicator to the fuel system performance.

Paragraph (s), which currently requires an indicator to indicate the functioning of all fuel heaters, is revised to require function indicators only for selectable or controllable fuel heaters. Thermostatically modulated fuel heaters do not need crew attention and a requirement for an indicator for the function of heaters of this type is removed.

No other comments were received. For the foregoing reasons, this proposal is adopted without change.

Proposal 3-35. The notice proposed to amend § 27.1337 to add a new paragraph (e) to require rotor drive system transmissions and gearboxes to be equipped with magnetic chip detectors. These chip detectors are needed to alert the crew of impending failure of ferromagnetic components in these transmissions and gearboxes. No comments were received, and this proposal is adopted without change.

Proposal 3-36. The notice proposed to amend § 27.1521 to add new paragraphs (g), (h), and (i) which establish and define the powerplant limitations associated with OEI ratings. These new paragraphs will ensure proper recognition in the powerplant limitations listing required by § 27.1583(b). No comments were received, and this proposal is adopted without change.

Proposal 3-37. The notice proposed to amend § 27.1549 to add a new paragraph (e) which requires arrangement of instrument markings for OEI ratings to be clearly differentiated from the normal

operating limits. This will ensure that instruments are marked to avoid or minimize possible inadvertent use of OEI ratings when operation of the rotorcraft should be limited to the normal operating limits. No comments were received on this proposal; however, it was subsequently noted that the proposed wording would preclude use of the 2½-minute OEI power rating to achieve a safe one-engine-inoperative climbout after a balked landing or to avoid the hazardous zones of the HV diagram if the associated engine failure occurred in conjunction with flight conditions which dictate use of this power. This was not intended or justified, and a revision to this section eliminates this possibility. The revision is editorial only.

Proposal 3-38. The notice proposed to amend paragraph (c) of § 29.45 to require published rotorcraft performance to be adjusted conservatively to account for powerplant instrument error. One commenter objects stating that the proposed rule is unnecessary because the subject of powerplant instrument accuracy is already adequately addressed in the guidance contained in paragraph 55 of FAA Advisory Circular 29-2A, "Certification of Transport Category Rotorcraft," dated September 16, 1987. As a result, not just of this comment, but after a review of several similar discussions in Committee II—Propulsion, held at the New Orleans Rotorcraft Regulatory Review Conference, the FAA agrees that the current regulation is adequate on a standalone basis. Accordingly, this proposal is withdrawn.

Proposal 3-39. The notice proposed to introduce in § 29.67 a requirement to determine climb performance at the new "continuous" OEI rating discussed in detail in the explanation for Proposal 3-3 and to revise the term "30-minute power" to read "30-minute OEI power." The new wording of § 29.67 sets forth the requirements for performance at the continuous OEI rating as parallel, alternative performance available to rotorcraft which have met the corresponding component and system qualifications specified by this proposal. Subsequent to issuance of the NPRM, it was brought to the attention of the FAA that engine installations may be designed with a critical engine. The proposal, if adopted, would not account for this design although the original intent was to determine climb performance with loss of the engine in a "worst-case" situation; i.e., the most critical engine. As a result, the rule as adopted has been clarified to substitute "the critical engine inoperative" for "one

engine inoperative." These changes will clarify the eligibility and requirements associated with this new continuous one-engine-inoperative rating. No comments were received, and the proposal is adopted with only the change noted.

Proposal 3-40. The notice proposed to amend § 29.361 to set forth new and more realistic design limit torque requirements for turbine engine installations. For a discussion of this proposal, see the discussion under Proposal 3-4 pertaining to § 27.361. Comments received for this proposal are identical to comments received for Proposal 3-4. Accordingly, Proposal 3-40 is adopted with the same changes discussed in Proposal 3-4.

Proposal 3-41. The notice proposed to amend § 29.549(e) to add the term "OEI" to the existing term "2½-minute power." The term "OEI" is a new abbreviation added to § 1.2 by this amendment. This change standardizes and clarifies the title and limitations appropriate for the use of 2½-minute OEI power. No comments were received on this proposal. It is adopted without change.

Proposal 3-42. The notice proposed to amend § 29.901 by revising paragraph (b)(2), adding a new paragraph (b)(6), and revising paragraph (c).

For an explanation of the part of the proposal to revise paragraph (b)(2) and to add a new paragraph (b)(6), see Proposal 3-7. No comments were received, and this part of the proposal is adopted without change.

The proposed change to paragraph (c) would limit the scope of the powerplant systems fault analysis to "single failure or malfunction or probable combination of related secondary failures." Several commenters object to the new wording of paragraph (c) on the grounds that limiting the analysis to "related" secondary failures could result in a lower level of safety. These commenters, who have extensive experience with application of the corresponding rule in Part 25 for transport airplanes, deny that the wording as it now exists would cause a "proliferation of endless failure modes and effects analysis" as contended by the original proponents of the proposed wording. In view of these comments and the FAA's general objective of not lowering the level of safety, the proposed change to paragraph (c) of § 29.901 is withdrawn.

Proposal 3-43. The notice proposed several changes to § 29.903. The first change adds a requirement to paragraph (a) that reciprocating engines used in helicopters must be qualified in accordance with the special helicopter engine testing requirements in § 33.49(d).

This change is needed to ensure that this aspect is not overlooked when such engines are installed in Part 29 programs. No comments were received on this part of the proposal. It is adopted without change.

Another change revises paragraph (b)(2) to identify and clarify crew action; i.e., normal pilot action allowable with primary flight controls, in determining if adequate powerplant systems isolation is provided. Most, if not all, of the power lever motion for rotorcraft engines is mechanically or electronically affected by the flight controls, and this change eliminates any possible confusion that may exist regarding the acceptability of modifying optimum flight control manipulation to protect engine parameters. No comments were received on this part of the proposal. It is adopted as proposed.

New paragraph (c)(3) is added and changes existing paragraph (c) from simply requiring restart capability to requiring the restart capability to be available throughout a flight envelope appropriate to the rotorcraft. This will avoid the concept that an in-flight engine restart envelope which is minimal and impractical constitutes acceptable compliance with this rule.

Due to a printing error, the word "appropriate" was omitted from the Federal Register publication of Proposal 3-43. Paragraph (c)(3) should read, "Engine restart capability must be established throughout a flight envelope appropriate to the rotorcraft."

A commenter notes the omission and suggests that the engine restart capability should be established throughout a defined flight envelope. This alternate wording, however, could result in certification of rotorcraft with a restart capability so limited as to be of little or no use to the crew. Another commenter suggests that the requirement for an air restart envelope should include restart capability throughout the flight envelope of the rotorcraft. However, this wording could be interpreted to require restart at the extremes of the flight envelope. Neither of these suggestions are justified and, therefore, the proposal is adopted with the editorial change to paragraph (c)(3) as discussed.

Proposal 3-44. The notice proposed to amend paragraph (a) of § 29.908 to require the rotorcraft to have the capability of safe operation, including adequate cooling, following a cooling fan failure. Under the existing rule, fan failure modes could be accepted which may result in hazards to the rotorcraft caused by loss of cooling air to critical powerplant components. The notice also proposed a new paragraph (c) requiring

a determination that cooling fans which are not part of the rotor drive system are not subject to fan blade resonant conditions within the operating limits of the rotorcraft. This will ensure that cooling fans which by location or definition may not be included in other fatigue tests or evaluations are evaluated for possible fatigue failure. Finally, the title of this paragraph has been changed from "Failure Evaluation" to "Fatigue Evaluation" to be consistent with the subject material of the paragraph as revised. No comments were received, and this proposal is adopted without change.

Proposal 3-45. The notice proposed a number of amendments to § 29.923. These include editorial changes, additional endurance test criteria for a new continuous OEI rating, and clarification of the torque and r.p.m. relation intended for the various power ratings involved in the tests prescribed by this section.

Paragraph (a)(1) is amended to require the test cycle to be extended beyond 10 hours if OEI rating tests are included in the test program. This change is needed to maintain the cyclic aspect of the test if OEI ratings are included.

Paragraph (a)(3) is amended to include rotational speed as a part of the test because the term "torque" by itself does not adequately define the test.

Paragraph (a)(3)(ii) is amended for clarity.

Paragraphs (b)(2), (f), and (k) are amended to add the test requirements for the new continuous OEI rating and retain, as an alternate, the 30-minute OEI rating tests for those applicants who may request this rating. This change provides a regulatory test basis for qualifying the rotor drive system for optional OEI ratings.

Paragraph (g) is amended to remove the inference that the 2½-minute OEI runs must be repeated if the takeoff run is reconducted. Under these circumstances, additional testing for the 2½-minute rating is unnecessary for safety.

Additional amendments are made to paragraphs (b), (c), (d), (e), (f), (h), and (k) to clarify the provisions with respect to power parameters to ensure that appropriate torque and rotational speeds are used during the tests.

No comments were received on this proposal, and it is adopted without change.

Proposal 3-46. The notice proposed several amendments to § 29.927. Paragraph (c) is changed by revising and extending the rotor drive system lubrication failure test requirements for Category A rotorcraft and by clarifying the corresponding test requirements for

Category B rotorcraft. Category A aircraft must have significant continued flight capability after a failure in order to optimize eventual landing opportunities. However, indefinite flight following the lubrication system failure is not expected. The changes to the Category B rotorcraft drive system lubrication failure test requirements are largely for clarification and are not substantive.

A commenter notes that paragraph (c), as proposed, could be interpreted to preclude credit for auxiliary lubrication systems or to require consideration of lubricant failures to self-lubricated bearings. This was not intended, and the wording of paragraphs (c)(1) and (c)(2) has been revised to eliminate this possible ambiguity.

The change to the overspeed test requirements in paragraph (d) removes the arbitrary requirement of 120 percent and substitutes a more realistic one which will relate to the operating characteristics of the rotorcraft. This change is needed because the existing 120 percent overspeed requirement may be unnecessarily severe for some rotorcraft. An additional change eliminates the requirement for accomplishing the acceleration phase of the overspeed tests within 10 seconds when the maximum acceleration rate of the engine requires more time. This will avoid special engine fuel control modifications for test purposes which are unnecessary and may damage the engine.

One commenter suggests that the overspeed tests required by paragraph (d) should be limited to the speed associated with speed and torque limiting devices. The FAA concurs with this comment provided that the speed and torque limiting device is reliable and independent from the normal engine control for rotational speed, and the amendment reflects this concept. The same commenter also suggests that the overspeed tests required in paragraph (d) should be limited to 105 percent of the maximum rotational speed, not considering transients. The FAA does not concur since it is essential that overspeed above the maximum expected transient speed be demonstrated to assure a margin of safety for this condition.

Further change to § 27.927 is made to add a new paragraph (f) which requires each individual test specified by this section to be conducted without intervening disassembly and, except for the lubrication failure tests of paragraph (c), requires each part tested to be in a serviceable condition at the conclusion of the test. Intervening disassembly is

unacceptable since it can invalidate the required serviceability findings. The serviceability requirement is needed to ensure that only test results which are satisfactory may be used to show compliance.

One commenter incorrectly assumes that new paragraph (f) requires all tests under § 29.927 to be conducted in the sequence listed in the section and on the same test specimen. New paragraph (f) is intended to require, in part, the test specified by any selected paragraph, such as the 200 applications of torque specified by paragraph (b)(1) of this section, to be conducted without intervening disassembly on any one specimen of the rotor drive system.

This proposal is adopted with the changes discussed.

Proposal 3-47. For an explanation of new § 29.954, see the explanation for Proposal 3-11. No comments were received on this proposal, and it is adopted without change.

Proposal 3-48. For an explanation and a discussion of the comments related to the proposed changes to § 29.955, see the discussion of Proposal 3-12. As a result of the comments received for Proposal 3-12, corresponding changes have been incorporated into this proposal, and it is adopted with those changes.

Proposal 3-49. The notice proposed an amendment to § 29.961 to simplify and restate the fuel system hot weather qualification requirements. This would eliminate detail requirements in the existing rule which were to some extent redundant or not necessarily critical for some rotorcraft. No comments were received on this proposal. The phrase "including, if applicable, the engine operating conditions defined by §§ 29.927 (b)(1) and (b)(2)" is added in the amendment to be consistent with the corresponding amendment being made to § 27.961 and to ensure that certain critical qualification aspects are properly considered. This change is clarifying in nature and falls within the scope of the notice. The proposal is adopted with only this editorial addition.

Proposal 3-50. For comments related to the proposed revision to paragraph (b) of § 29.963, see the discussion of Proposal 3-14. As indicated in that discussion, the higher load factor requirements for fuel tanks may not be appropriate and, therefore, the proposed change to paragraph (b) is withdrawn.

For an explanation of the proposal to add a new paragraph (e) to § 29.963, see the discussion for Proposal 3-14. No comments were received on this part of the proposal, and it is adopted as proposed.

Proposal 3-51. The notice proposed an amendment to remove paragraph (f) from § 29.967. The requirements of paragraph (f) are adequately covered by § 29.963. No comments were received, and the proposal is adopted without change.

Proposal 3-52. For an explanation of this proposal to amend § 29.969, see the explanation for Proposal 3-15. No comments were received, and the proposal is adopted without change.

Proposal 3-53. The notice proposed to amend § 29.971 to require that fuel tank sump designs be arranged so that drainage to the sump area will occur with the rotorcraft parked in any ground attitude which can reasonably be expected in service. Current § 29.971, which requires only that drainage to the sump be effective with the rotorcraft parked in the "normal" attitude, may not accomplish its intended purpose when rotorcraft are parked on uneven terrain. No comments were received, and the proposal is adopted without change.

Proposal 3-54. For an explanation of this proposal to amend § 29.975, see Proposal 3-17. No comments were received, and the proposal is adopted without change.

Proposal 3-55. For an explanation of this proposal which amends § 29.991, see Proposal 3-18. No comments were received, and the proposal is adopted without change.

Proposal 3-56. The proposal to amend § 29.993 has been withdrawn. For an explanation, see the discussion of Proposal 3-19.

Proposal 3-57. The notice proposed to amend § 29.997 in a manner similar to Proposal 3-20 for § 27.997. For a discussion of the comments received, see Proposal 3-20. The proposal is adopted without substantive change.

Proposal 3-58. For an explanation of this proposal to amend § 29.999, see Proposal 3-21. No comments were received, and the proposal is adopted without change.

Proposal 3-59. The notice proposed to add a new § 29.1001 to set forth certification safety standards for fuel jettisoning systems. While these systems are optional, this new section establishes the minimum safety precautions which designers must consider when choosing to produce systems of this type.

A commenter suggests that demonstration of fuel jettisoning during "emergency descent" should not be required since it is not a condition that can be quantified and is not a normal flight regime. The FAA agrees that a requirement for fuel jettisoning during emergency descent is unnecessary and that flight limitations prescribed for use

of the fuel jettisoning system are adequate to ensure safety. Another commenter suggests that jettisoned fuel should be allowed to impinge on certain parts of the rotorcraft if no hazard is involved. Such a finding, if established, should be allowed for credit toward meeting this rule. The rule, as adopted, incorporates both of these changes.

Proposal 3-60. The notice proposed to amend § 29.1011 by revising its title from "General" to "Engines: General," by removing existing paragraph (b), and by redesignating paragraphs (c), (d), and (e) as (b), (c), and (d), respectively. To be consistent with the restructuring of § 29.1011, this amendment includes an editorial change to redesignated paragraph (d) to remove the words "* * * and rotor drive system * * *." These changes will also coordinate the requirements of this section with new § 29.1027. No comments were received, and except for the deletion noted, the proposal is adopted without change.

Proposal 3-61. For an explanation of this proposal to amend § 29.1019, see the explanation for Proposal 3-23. No comments were received, and the proposal is adopted without change.

Proposal 3-62. The notice proposed to add a new § 29.1027, "Transmissions and Gearboxes: General," which contains the requirements removed from § 29.1011 by Proposal 3-60 plus additional lubrication system requirements appropriate for transmissions and gearboxes. These requirements are derived from existing engine oil system requirements which have been adjusted or modified to suit the needs of transmissions and gearboxes.

A commenter suggests that paragraph (b) should apply only to oil systems which employ separate tanks and not to systems which employ gearbox sump type oil reservoirs. In response to the comment, the FAA has determined that the relevant oil system requirements are those relating to strength, including pressure tests, lines and fittings, vent arrangements, drains, vibration, and fire protection and that these requirements are valid for pressure lubrication systems regardless of the oil storage configuration. Nonpressurized splash lubrication arrangements are usually free from the problems of pressurized systems and, therefore, should be exempt from the detail requirements addressed above. This commenter's suggestion is, therefore, not incorporated.

A second commenter suggests that paragraph (b) of the proposal is confusing and should be clarified to ensure proper application. The FAA

concur and, accordingly, has made several changes to identify specifically the pertinent parts of other oil system rules referenced in this proposal as well as to remove apparent redundancies.

The third commenter suggests that paragraph (b)(2) should be revised to require a coarse mesh screen in the scavenge to the oil pump rather than the tank or sump outlet screen specified by the proposal. The FAA does not concur since this would, in effect, remove the protection a tank outlet screen provides from trash, paper, or other objects which might enter the system via the tank filler opening.

The proposal is adopted with the changes discussed.

Proposal 3-63. The notice proposed to amend § 29.1041 to revise paragraph (a) to include the phrase "for which certification is requested." This change is needed to clarify and identify the range of operating conditions for which powerplant cooling provisions must be effective. In addition, the notice proposed to amend paragraph (c) to exempt ground-use-only auxiliary power units from the requirement for in-flight cooling tests. No comments were received, and the proposal is adopted without change.

Proposal 3-64. The notice proposed to add a new paragraph (a)(5) to § 29.1043 which includes a definition of "stabilization" as it pertains to powerplant systems cooling tests. This will define more clearly the extent of cooling tests and eliminate prolonged and unnecessary extension of cooling tests which may be interpreted as required if test parameters continue to change slightly during the cooling test. No comments were received and this proposal is adopted without change.

Proposal 3-65. The notice proposed to revise paragraph (c) of § 29.1045 to include requirements for the OEI en route climb cooling tests applicable to the new "continuous OEI" rating introduced in this rulemaking. The existing OEI en route climb cooling test requirements are not adequate to ensure proper evaluation of powerplant cooling parameters during operation at this power rating. No comments were received, and this proposal is adopted without change.

Proposal 3-66. The notice proposed to revise paragraph (a) of § 29.1047 to include requirements for the OEI takeoff/climb cooling tests applicable to the new "continuous OEI" rating for reasons similar to those in Proposal 3-65. No comments were received, and this proposal is adopted without change.

Proposal 3-67. The notice proposed to restate paragraph (b)(1) of § 29.1093 so that the phrase "within the limitations

established for the rotorcraft" applies only to the requirement in paragraph (b)(1)(ii) for demonstrating flight in falling and blowing snow. For an explanation of this proposal and a discussion of the comments received from the public, see Proposal 3-28.

The notice also proposed to change the reference in paragraph (b) from Appendix C of Part 25 to Appendix C of Part 29 to correlate the airframe icing requirements of § 29.1419 to the powerplant icing requirements of this section. These appendices are identical.

The proposal is adopted without change.

Proposal 3-68. For an explanation of this proposal to amend § 29.1141, see the discussion for Proposal 3-29. No comments were received, and this proposal is adopted without change.

Proposal 3-69. The notice proposed to amend paragraphs (a) through (e) of § 29.1143 to replace the terms "throttle control" and "thrust control" with the more general term "power control." For an explanation of these changes, see the discussion for Proposal 3-30. No comments were received, and this proposal is adopted without change.

Proposal 3-70. The notice proposed to amend paragraph (d) of § 29.1163 to rephrase the design requirement for accessory drive torque limiting devices so that the torque limiting device may be included in either the accessory or the rotor drive system. For an explanation of this proposal, see the discussion for Proposal 3-31. No comments were received, and the proposal is adopted without change.

Proposal 3-71. The notice proposed to add a new paragraph (b) to § 29.1181. Paragraph (b) reinstates a requirement pertaining to powerplant fire zones which was inadvertently dropped by Amendment 29-3 (33 FR 956; January 26, 1968). Paragraph (b) requires that fire zones, as defined in this section, must be protected from powerplant fires in accordance with specific protective systems defined in other associated rules in the Part. No comments were received on this proposal, and it is adopted without change.

Proposal 3-72. The notice proposed to amend paragraph (e) of § 29.1189 to require flammable fluid shutoff devices and controls for these devices to be designed, located, and protected to function properly under conditions likely to result from a critical powerplant area fire. This change is needed to preclude approval of design arrangements wherein heat from an engine compartment fire is conducted through the firewall to the extent that it jeopardizes the operation of these shutoff devices.

The notice also proposed to amend paragraph (f) to exempt ground-use-only auxiliary power unit shutoff devices from the requirement for a guarded control. This eliminates the need for a design feature when no flight or ground safety objective is involved.

No comments were received, and this proposal is adopted without change.

Proposal 3-73. This proposal adds a new paragraph (f) to § 29.1193 which would, in effect, require redundant retention means for each openable or readily removable panel, cowling, engine, or rotor drive system covering. For an explanation of this proposal and the comment received, see the discussion for Proposal 3-33. This proposal is adopted without change.

Proposal 3-74. The notice proposed to revise, edit, and add new powerplant instrument requirements to § 29.1305.

For a discussion of the revisions to paragraphs (a)(4), (a)(17), and (a)(19), see Proposal 3-34.

New paragraph (a)(20) combines into one rule, without substantive change, the existing identical requirements for fuel pressure indicators currently contained in paragraphs (b)(2) and (c)(2) of this section and further modifies the applicability of this requirement to only those fuel systems with devices or components which, in the event of failure, could adversely affect fuel pressure at the engine. These changes are needed to simplify the presentation in this section for fuel pressure indicators and to eliminate the requirement for fuel pressure indicators in fuel systems such as suction or gravity feed systems which do not incorporate pumps, filters, etc., subject to deterioration which could be reflected on a fuel pressure indicator.

New paragraph (a)(21) requires a warning device to indicate the failure of any fuel pump required for adequate fuel flow to the engine. This alerts the flightcrew that fuel flow and engine operation are now dependent on the emergency system and to institute precautionary operating procedures.

New paragraph (a)(22) adds a requirement for a warning or caution device to alert the flightcrew when particles are detected by the chip detector required by new § 29.1337(d) proposed as another amendment to this part. This amendment is one of a two-part amendment to require chip detectors and associated warning signals to alert the crew to possible impending failures in rotorcraft transmissions and gearboxes. These devices have been found to be a relatively inexpensive method of

significantly improving the safety of rotorcraft in these respects.

New paragraph (a)(23) adds a requirement for powerplant instruments or warning devices for auxiliary power units installed in rotorcraft. This ensures that flightcrews will have indicators or warning devices needed to avoid possible unsafe conditions which may be expected during operation of auxiliary power units.

Additional editorial changes to existing paragraphs (b)(2) and (c)(2) have been added to integrate new paragraph (a)(20) with these other provisions.

No comments were received, and this proposal is adopted without change.

Proposal 3-75. The notice proposed to amend § 29.1337 to add a new paragraph (e) to require certain rotor drive system transmissions and gearboxes to be equipped with chip detector systems which detect and signal the presence of ferromagnetic particles to the flightcrew. Also, the amendment requires a means to permit crewmembers to check, in flight, the function of each detector's electrical circuit and signal. Because not all chips generated in a transmission or gearbox will be detected by these magnetic detectors, the amendment does not include extensive performance requirements for these systems. However, these devices have been found to be a relatively inexpensive and effective method of detecting impending mechanical failures in gearboxes. This amendment will improve the level of safety available with the installation of chip detector systems.

A commenter notes that in Proposal 3-35 (§ 27.1337), chip detectors would be required for "rotor drive system transmissions and gearboxes," whereas in this proposal, affecting Part 29, chip detectors would be required only for "transmission gearboxes." This inconsistency between the two parts is not intended and paragraph (e) is changed to agree with the amendment to § 27.1337(c). This commenter also suggests removal of the phrase "when ferromagnetic particles exist in the vicinity of the detector." The FAA agrees that these words are unnecessary, and this phrase has been removed.

Accordingly, this proposal is adopted with the changes discussed.

Proposal 3-76. The notice proposed to revise paragraphs (f) and (g) and add a new paragraph (h) to § 29.1521. The changes to paragraphs (f) and (g) introduce the term "OEI" to emphasize and clarify the limitations on the use of the 2½-minute and 30-minute power ratings as defined in this section. This amendment also correlates the title of

these ratings to their definitions in Part 1, as revised by this amendment. Additionally, these changes add the introductory phrase "unless otherwise authorized," in order to authorize use of these ratings when appropriate, additional qualification testing or other adequate safety measures have been instituted. Also, both paragraphs (f) and (g) have been reworded to set forth specifically the limitations on the use of these ratings. These changes are intended to assist the public in avoiding misconceptions regarding the eligibility of these ratings.

New paragraph (h) establishes and defines a new continuous OEI power rating using terminology similar to that developed by this amendment for the 2½-minute and 30-minute power ratings. This change ensures proper recognition in the powerplant limitations listing required by § 29.1583.

No comments were received on this proposal; however, it was subsequently noted that the proposed wording would preclude use of the 2½-minute OEI power rating to achieve a safe one-engine-inoperative climbout after a balked landing or to avoid the hazardous zones of the HV diagram if the associated engine failure occurred in conjunction with flight conditions which dictate use of this power. This was not intended or justified and this section, as adopted, clarifies this aspect.

Proposal 3-77. The notice proposed to add a new paragraph (e) and make associated editorial changes to § 29.1549 to set forth requirements for powerplant instrument markings applicable to the OEI ratings eligible on certain rotorcraft. For an explanation of this proposal and its disposition, see the explanation for Proposal 3-37.

Proposal 3-78. The notice proposed to revise paragraph (c)(1)(iii) of § 29.1557 to permit, for turbine-powered rotorcraft, the use of flight manual listings of approved fuels in lieu of decals and placards at the fuel filler openings, as required by the existing rule. The listing of approved fuels is, in some instances, too extensive to include on decals or placards in the space available. No comments were received, and the proposal is adopted without change.

Proposal 3-79. The notice proposed to revise paragraph (c) of § 33.7 to add to the list of ratings and limitations the new "continuous OEI power" rating discussed in Proposal 3-3. This amendment will ensure recognition and correlation of this new rating to Part 33 test requirements. Paragraphs (c)(1)(v) and (c)(1)(vi) have been revised in the amendment by adding the term "OEI" to the phrases "rated 30-minute power" and "rated 2½-minute power" to be

consistent with the addition of this term to other appropriate sections of this part. No comments were received, and this proposal is adopted with the editorial changes noted.

Proposal 3-80. The notice proposed to amend § 33.87 as follows:

Paragraphs (a) and (b) are revised to include reference to the test run necessary to qualify rotorcraft engines for the new continuous OEI rating consistent with amendments to other sections of this subpart. Additionally, paragraph (b)(2) is restated for clarification, without substantive change.

Paragraph (d) is revised and redesignated as paragraph (e) and a new paragraph (d) is added to prescribe the test requirements for the new continuous OEI rating.

Newly redesignated paragraph (e), pertaining to the 2½-minute OEI rating, is revised to incorporate the option of combining this rating with the conventional takeoff and maximum continuous power ratings or with either of the en route OEI ratings. The reference in the last sentence of (e)(1) is changed from (c)(5) to (d)(6) for consistency in paragraph numbering.

The word "rotorcraft" is substituted for "helicopter" throughout § 33.87 to be consistent with the broader installation applications of turboshaft engines. The term "OEI" is added to existing "30-minute power" and "2½-minute power" phrases used in paragraphs (c), new (d), and (e). In addition, the words "and thrust" are removed from the phrase "power and thrust" in paragraphs (c), (d), and (e) since rotorcraft engines are not normally thrust-rated.

These changes coordinate the test requirements related to the new continuous OEI power rating and eliminate unnecessarily restrictive requirements for qualification for the 2½-minute OEI power rating.

A commenter expresses concern that the proposed block test schedule for the continuous OEI power rating differs unnecessarily from the block test schedule prescribed for engines by the Joint Airworthiness Requirements (JAR) for the similarly used intermediate contingency power rating. The commenter indicates that these differences exist in the maximum continuous power run and the incremental power run and recommends a 12½-hour increase in incremental power running at the expense of time spent testing at maximum continuous power. The FAA disagrees. In this proposal, the time of testing at incremental power for the continuous OEI power rating is the same (50 hours)

as that which has been found satisfactory for the 30-minute OEI power rating. The redistribution of test time at maximum continuous power and above is introduced to account for the fact that the continuous OEI power rating is not time limited (as is the 30-minute OEI power rating) and thus, should have a proportionate amount of associated qualification test time.

The same commenter notes that in the Federal Register publication of the NPRM, the sentence, "For engines tested under paragraph (b), (c), (d), or (e) of this section, the prescribed 6-hour test sequence must be conducted 25 times to complete the required 150 hours of operation," was inadvertently omitted from § 33.87(a). The same commenter also notes that in the Federal Register publication, the title line of proposed § 33.87(c) should have read "* * * for which a 30-minute OEI power * * *"; and that the word "hour" was omitted from the first sentence of proposed § 33.87(e)(1). These changes with corrected wording have been made in the amendment.

This commenter finally notes that Amendment 33-10 (49 FR 6852; February 23, 1984) added 5 minutes to the endurance test requirements of § 33.87(d) for certification of the 2½-

minute OEI rating. He contends this further jeopardizes the uniformity of requirements between the FAR and the JAR. This change to Part 33 was introduced as part of the Engine Regulatory Review Program, NPRM No. 80-21, Docket No. 16919, and became effective in February 1984. This comment is, therefore, beyond the scope of the notice and cannot be considered in this rulemaking.

This proposal is adopted with the changes discussed.

Economic Summary

A regulatory evaluation of the amendments published herein has been prepared and filed in the docket. This evaluation addresses the pertinent requirements of the Regulatory Flexibility Act of 1980, Executive Order 12291, Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979) and the impact on international trade. A summary of this evaluation follows.

Seventy of the amendments reflect current rotorcraft industry practice or clarify existing rules and, therefore, impose negligible or no additional costs and in some cases will result in savings. Amendments in this category are listed in Table 1.

A second group of 12 amendments, listed in Table II, pertain to safety standards for optional equipment or to new optional rotorcraft powerplant operating limitations. The FAA assumes that since these equipment items and powerplant ratings are optional, they will only be introduced into any model rotorcraft if the manufacturer of that rotorcraft determines that the benefits of such action will exceed the costs. One option that may result in an economic benefit is the introduction of a new continuous one-engine-inoperative rating which will permit rotorcraft manufacturers to qualify certain rotorcraft to perform long-range missions at gross weights approaching those now associated with use of the existing 30-minute OEI rating. Corresponding improvements in productivity should also be expected.

A third group of proposals listed in Table III was identified as having significant cost impact. For these proposals, the FAA's analysis of the costs and benefits failed to show that the imposition of these proposals was justified. These proposals were not included in the final rule and are being deferred for further study. They may appear in subsequent notices if they are found to be warranted.

TABLE I.—RULE CHANGES WITH ZERO OR NEGLIGIBLE COMPLIANCE COSTS

Item No.	FAR Section	Subject	Evaluation
2	1.1	30-minute rating	Definition.
3	1.2	Definition	Definition.
6	27.361(a)	Design torque limitations	Current practice.
7	27.833	Combustion heaters	Current practice.
8	27.859(c) thru (k)	Combustion heaters	Current practice.
9	27.901	Powerplant installation	Current practice.
10	27.903(a), (b)	Powerplant cooling fans	Negligible cost.
11	27.923(c), (d), (e), (j), (k)	Drive system tests	Negligible cost.
12	27.927(b)	Drive systems	Clarification.
13	27.954	Fuel system lightning protection	Current practice.
14	27.955	Fuel flow requirements	Current practice.
15	27.961	Fuel system hot weather tests	Current practice.
16	27.963(e), (f)	Fuel tank safety	Current practice.
17	27.969	Fuel expansion space	Negligible savings.
18	27.971	Fuel tank sump	Negligible cost.
19	27.975	Fuel tank vent arrangement	Current practice.
20	27.991	Fuel pump	Current practice.
21	27.997	Fuel strainer	Current practice.
22	27.999	Fuel system drains	Current practice.
23	27.1011	Engine oil systems	Clarification.
24	27.1019	Oil strainer contamination indicator	Negligible savings.
25	27.1027	Transmission oil systems	Current practice.
26	27.1041	Powerplant cooling	Current practice.
27	27.1045	Powerplant cooling	Clarification.
28	27.1091	Engine induction system	Negligible savings.
29	27.1093	Engine ice and snow protection	Negligible savings.
30	27.1141	Powerplant valves	Current practice.
31	27.1143	Engine controls	Clarification.
32	27.1163	Powerplant accessories	Negligible savings.
33	27.1189	Flammable fluid shutoff valves	Current practice.
34	27.1193	Cowling retention	Current practice.

TABLE I.—RULE CHANGES WITH ZERO OR NEGLIGIBLE COMPLIANCE COSTS—Continued

Item No.	FAR Section	Subject	Evaluation
35.....	27.1305(l), (m), (q), (s).....	Powerplant instruments.....	Negligible savings.
36.....	27.1337.....	Magnetic chip detectors.....	Negligible cost.
37.....	27.1521(g), (h).....	Powerplant limitations.....	Clarification.
38.....	27.1549(e).....	Powerplant instrument markings.....	Current practice.
41.....	29.361(a), (b).....	Design torque limitations.....	Negligible cost.
42.....	29.549(e).....	Fuselage structural loads.....	Clarification.
43.....	29.901(b)(2), (b)(6).....	Powerplant installation.....	Negligible cost.
44.....	29.903(a), (b)(2), (c)(3).....	Powerplant installation.....	Clarification.
45.....	29.908(a), (c).....	Powerplant cooling fans.....	Negligible cost.
46.....	29.923(a) thru (h), (k)(l).....	Drive system tests.....	Clarification.
47.....	29.927(c), (d), (f).....	Drive system tests.....	Clarification.
48.....	29.954.....	Fuel system lightning protection.....	Current practice.
49.....	29.955.....	Fuel flow requirements.....	Current practice.
50.....	29.961.....	Fuel system hot weather tests.....	Current practice.
51.....	29.963(e).....	Fuel tank safety.....	Negligible cost.
52.....	29.967(f).....	Fuel tank installation requirements.....	Clarification.
53.....	29.969.....	Fuel expansion space arrangements.....	Negligible savings.
54.....	29.971.....	Fuel tank sump.....	Current practice.
55.....	29.975.....	Fuel tank vent arrangements.....	Current practice.
56.....	29.991.....	Fuel pumps.....	Current practice.
57.....	29.997.....	Fuel strainer.....	Current practice.
58.....	29.999.....	Fuel system drains.....	Current practice.
60.....	29.1011.....	Engine oil systems.....	Clarification.
61.....	29.1019(a).....	Oil strainer contamination indicator.....	Negligible savings.
62.....	29.1027.....	Transmission oil systems.....	Negligible savings.
63.....	29.1041.....	Powerplant cooling.....	Clarification.
64.....	29.1043.....	Powerplant cooling.....	Clarification.
67.....	29.1093.....	Engine ice and snow protection.....	Negligible savings.
68.....	29.1141.....	Powerplant valves.....	Current practice.
69.....	29.1143.....	Engine controls.....	Clarification.
70.....	29.1163.....	Powerplant accessories.....	Current practice.
71.....	29.1181.....	Designated fire zones.....	Definition.
72.....	29.1189(e), (f).....	Flammable fluid shutoffs.....	Current practice.
73.....	29.1193(f).....	Powerplant cowling retention.....	Negligible cost.
74.....	29.1305(a)(4), (a)(17), (a)(19) thru (a)(23), (b)(2), (c)(1) and (c)(2).....	Powerplant instruments.....	Negligible cost.
75.....	29.1337(e).....	Magnetic chip detectors.....	Negligible cost.
76.....	29.1521(f), (g).....	Powerplant limitations.....	No cost.
77.....	29.1549(e).....	Powerplant instrument markings.....	Current practice.
78.....	29.1557(c).....	Markings and placards.....	Negligible cost.

TABLE II.—RULE CHANGES FOR OPTIONAL RATINGS OR EQUIPMENT

Item No.	FAR Section	Subject
5.....	27.67(a)(2), (a)(3), (b).....	Continuous OEI power.
11.....	27.923(d), (e), (j), (k).....	Continuous OEI power.
16.....	27.963(g).....	Cabin fuel tanks
37.....	27.1521(f).....	Continuous OEI power.
40.....	29.67(a)(2), (a)(3), (b).....	Continuous OEI power.
45.....	29.923(k)(2).....	Continuous OEI power.
59.....	29.1001.....	Fuel jettisoning system.
65.....	29.1045(a)(4), (c).....	Continuous OEI power.
66.....	29.1047(a).....	Continuous OEI power.
76.....	29.1521(h).....	Continuous OEI power.
80.....	33.7(c).....	Continuous OEI power.
81.....	33.87(d).....	Continuous OEI power.

TABLE III.—PROPOSALS DEFERRED FOR FURTHER STUDY

Proposal No. ¹	FAR Section	Subject
103.....	27.964.....	Fuel cell crashworthiness.
284.....	29.903.....	Engine rotor containment.
303.....	29.927.....	Overrunning clutch test.
316.....	29.964.....	Fuel cell crashworthiness.
358.....	29.1305.....	Engine failure warning.

¹ Numbering corresponds with proposal as presented to the New Orleans Rotorcraft Regulatory Review Conference, December 1979.

Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) of 1980 was enacted by Congress to ensure that small entities are not disproportionately affected by Government regulations. The RFA requires agencies to review rules which may have a "significant economic

impact" on a substantial number of small entities.

Within the context of these amendments, the FAA definition of a small entity is a small rotorcraft manufacturer with less than 75 employees. Under these "small entity" size standard criteria, only three of eleven helicopter manufacturers in business today is a small entity.

The FAA estimates that there will be six new helicopters certificated before the year 2000. Three are expected to be Part 27 helicopters and three Part 29 helicopters. The three new Part 29 helicopters are expected to be certificated by three of eight large firms. Of the three new Part 27 helicopters, two are expected to be certificated by large firms and one by a small firm.

Clearly, the final rule changes will not impact a substantial number of small entities.

Trade Impact Analysis

This section discusses the impact of these amendments on the sale of foreign rotorcraft in the United States and the sale of U.S. rotorcraft in foreign countries.

Since the certification rules are applicable to both foreign and domestic entities which manufacture rotorcraft to sell in the United States, there will be no competitive advantage to either. Because of the large U.S. market, foreign manufacturers are likely to certify their rotorcraft to U.S. rules and, therefore, U.S. manufacturers would not suffer a disadvantage in foreign markets.

Those amendments which reduce the life cycle cost of rotorcraft should aid in developing increased sales in the United States since it can be expected that a decrease in price should stimulate sales. Because many foreign countries follow U.S. certification rules, foreign sales by U.S. manufacturers should also increase.

Federalism Implications

The regulations set forth in this amendment are promulgated pursuant to the authority in the Federal Aviation Act of 1958, as amended (49 U.S.C. 1301 et seq.), which statute is construed to preempt State law regulating the same subject. Thus, in accordance with Executive Order 12612, it is determined that such regulation does not have federalism implications warranting the preparation of a Federalism Assessment.

Conclusion

In the context of these analyses, it is concluded that this rule is not major under Executive Order 12291 or significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). Further, based on the findings made with respect to the Regulatory Flexibility Act, I certify that this rule will not have a significant economic impact, positive or negative, on a substantial number of small entities.

List of Subjects

14 CFR Part 1

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

14 CFR Part 27

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

14 CFR Part 29

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

14 CFR Part 33

Engines, Air transportation, Aircraft, Aviation safety, Safety.

Adoption of the Amendment

Accordingly, Parts 1, 27, 29, and 33 of the Federal Aviation Regulations (14 CFR Parts 1, 27, 29, and 33) are amended as follows:

PART 1—DEFINITIONS AND ABBREVIATIONS

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

Authority: 49 U.S.C. 1347, 1348, 1354(a), 1357(d)(2), 1372, 1421 through 1430, 1432, 1442, 1443, 1472, 1510, 1522, 1652(e), 1655(c), 1657(f); 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

2. By amending § 1.1 by adding the definition of "Rated continuous OEI power" after the definition of "Public aircraft," and by removing the definitions "Rated 30-minute power" and "Rated 2½-minute power" and substituting in place thereof the definitions of "Rated 30-minute OEI power" and "Rated 2½-minute OEI power."

§ 1.1 General definitions.

"Rated continuous OEI power," with respect to rotorcraft turbine engines, means the approved brake horsepower developed under static conditions at specified altitudes and temperatures within the operating limitations established for the engine under Part 33 of this chapter, and limited in use to the time required to complete the flight after the failure of one engine of a multiengine rotorcraft.

"Rated 30-minute OEI power," with respect to rotorcraft turbine engines, means the approved brake horsepower developed under static conditions at specified altitudes and temperatures within the operating limitations established for the engine under Part 33 of this chapter, and limited in use to a period of not more than 30 minutes after the failure of one engine of a multiengine rotorcraft.

"Rated 2½-minute OEI power," with respect to rotorcraft turbine engines, means the approved brake horsepower developed under static conditions at specified altitudes and temperatures within the operating limitations established for the engine under Part 33 of this chapter, and limited in use to a period of not more than 2½ minutes after the failure of one engine of a multiengine rotorcraft.

3. By amending § 1.2 by adding the definition of "OEI" after the definition of "NOPT" as follows:

§ 1.2 Abbreviations and symbols.

"OEI" means one engine inoperative.

PART 27—AIRWORTHINESS STANDARDS: NORMAL CATEGORY ROTORCRAFT

4. The authority citation for Part 27 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

5. By amending § 27.67 by removing paragraph (c) and by revising paragraph (b) to read as follows:

§ 27.67 Climb: One engine inoperative.

(b) The critical engine inoperative and the remaining engines at either—

- (1) Maximum continuous power and, for helicopters for which certification for the use of 30-minute OEI power is requested, at 30-minute OEI power; or
(2) Continuous OEI power for helicopters for which certification for the use of continuous OEI power is requested.

6. By revising § 27.361 to read as follows:

§ 27.361 Engine torque.

(a) For turbine engines, the limit torque may not be less than the highest of—

- (1) The mean torque for maximum continuous power multiplied by 1.25;
(2) The torque required by § 27.923;
(3) The torque required by § 27.927; or
(4) The torque imposed by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming).

(b) For reciprocating engines, the limit torque may not be less than the mean torque for maximum continuous power multiplied by—

- (1) 1.33, for engines with five or more cylinders; and
(2) Two, three, and four, for engines with four, three, and two cylinders, respectively.

7. By adding a new § 27.833 following § 27.831 and before the heading, Fire Protection, to read as follows:

§ 27.833 Heaters.

Each combustion heater must be approved.

8. By amending § 27.859 by revising paragraph (c) and by adding new

paragraphs (d) through (k) to read as follows:

§ 27.859 Heating systems.

(c) *Combustion heater fire protection.* Except for heaters which incorporate designs to prevent hazards in the event of fuel leakage in the heater fuel system, fire within the ventilating air passage, or any other heater malfunction, each heater zone must incorporate the fire protection features of the applicable requirements of §§ 27.1183, 27.1185, 27.1189, 27.1191, and be provided with—

- (1) Approved, quick-acting fire detectors in numbers and locations ensuring prompt detection of fire in the heater region.
- (2) Fire extinguisher systems that provide at least one adequate discharge to all areas of the heater region.
- (3) Complete drainage of each part of each zone to minimize the hazards resulting from failure or malfunction of any component containing flammable fluids. The drainage means must be—
 - (i) Effective under conditions expected to prevail when drainage is needed; and
 - (ii) Arranged so that no discharged fluid will cause an additional fire hazard.
- (4) Ventilation, arranged so that no discharged vapors will cause an additional fire hazard.

(d) *Ventilating air ducts.* Each ventilating air duct passing through any heater region must be fireproof.

(1) Unless isolation is provided by fireproof valves or by equally effective means, the ventilating air duct downstream of each heater must be fireproof for a distance great enough to ensure that any fire originating in the heater can be contained in the duct.

(2) Each part of any ventilating duct passing through any region having a flammable fluid system must be so constructed or isolated from that system that the malfunctioning of any component of that system cannot introduce flammable fluids or vapors into the ventilating airstream.

(e) *Combustion air ducts.* Each combustion air duct must be fireproof for a distance great enough to prevent damage from backfiring or reverse flame propagation.

(1) No combustion air duct may connect with the ventilating airstream unless flames from backfires or reverse burning cannot enter the ventilating airstream under any operating condition, including reverse flow or malfunction of the heater or its associated components.

(2) No combustion air duct may restrict the prompt relief of any backfire

that, if so restricted, could cause heater failure.

(f) *Heater control: General.* There must be means to prevent the hazardous accumulation of water or ice on or in any heater control component, control system tubing, or safety control.

(g) *Heater safety controls.* For each combustion heater, safety control means must be provided as follows:

(1) Means independent of the components provided for the normal continuous control of air temperature, airflow, and fuel flow must be provided for each heater to automatically shut off the ignition and fuel supply of that heater at a point remote from that heater when any of the following occurs:

- (i) The heat exchanger temperature exceeds safe limits.
 - (ii) The ventilating air temperature exceeds safe limits.
 - (iii) The combustion airflow becomes inadequate for safe operation.
 - (iv) The ventilating airflow becomes inadequate for safe operation.
- (2) The means of complying with paragraph (g)(1) of this section for any individual heater must—
- (i) Be independent of components serving any other heater, the heat output of which is essential for safe operation; and
 - (ii) Keep the heater off until restarted by the crew.
- (3) There must be means to warn the crew when any heater, the heat output of which is essential for safe operation, has been shut off by the automatic means prescribed in paragraph (g)(1) of this section.

(h) *Air intakes.* Each combustion and ventilating air intake must be located so that no flammable fluids or vapors can enter the heater system—

- (1) During normal operation; or
- (2) As a result of the malfunction of any other component.

(i) *Heater exhaust.* Each heater exhaust system must meet the requirements of §§ 27.1121 and 27.1123.

(1) Each exhaust shroud must be sealed so that no flammable fluids or hazardous quantities of vapors can reach the exhaust system through joints.

(2) No exhaust system may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.

(j) *Heater fuel systems.* Each heater fuel system must meet the powerplant fuel system requirements affecting safe heater operation. Each heater fuel system component in the ventilating airstream must be protected by shrouds so that no leakage from those components can enter the ventilating airstream.

(k) *Drains.* There must be means for safe drainage of any fuel that might

accumulate in the combustion chamber or the heat exchanger.

(1) Each part of any drain that operates at high temperatures must be protected in the same manner as heater exhausts.

(2) Each drain must be protected against hazardous ice accumulation under any operating condition.

9. By amending § 27.901 by revising paragraph (b)(1); by removing the word "and" after the semicolon in (b)(2); by removing the period at the end of (b)(3) and inserting a semicolon in its place; by removing the period at the end of (b)(4) and inserting "; and" in its place; and by adding a new paragraph (b)(5) to read as follows:

§ 27.901 Installation.

(b) * * *

(1) Each component of the installation must be constructed, arranged, and installed to ensure its continued safe operation between normal inspections or overhauls for the range of temperature and altitude for which approval is requested;

(5) Design precautions must be taken to minimize the possibility of incorrect assembly of components and equipment essential to safe operation of the rotorcraft, except where operation with the incorrect assembly can be shown to be extremely improbable.

10. By amending § 27.903 by revising paragraphs (a) and (b) to read as follows:

§ 27.903 Engines.

(a) *Engine type certification.* Each engine must have an approved type certificate. Reciprocating engines for use in helicopters must be qualified in accordance with § 33.49(d) of this chapter or be otherwise approved for the intended usage.

(b) *Engine or drive system cooling fan blade protection.* (1) If an engine or rotor drive system cooling fan is installed, there must be a means to protect the rotorcraft and allow a safe landing if a fan blade fails. This must be shown by showing that—

- (i) The fan blades are contained in case of failure;
- (ii) Each fan is located so that a failure will not jeopardize safety; or
- (iii) Each fan blade can withstand an ultimate load of 1.5 times the centrifugal force resulting from operation limited by the following:

(A) For fans driven directly by the engine—

(1) The terminal engine r.p.m. under uncontrolled conditions; or

(2) An overspeed limiting device.

(B) For fans driven by the rotor drive system, the maximum rotor drive system rotational speed to be expected in service, including transients.

(2) Unless a fatigue evaluation under § 27.571 is conducted, it must be shown that cooling fan blades are not operating at resonant conditions within the operating limits of the rotorcraft.

11. By amending § 27.923 by revising paragraphs (c), (d), (e), and (i) and by adding new paragraph (k) to read as follows:

§ 27.923 Rotor drive system and control mechanism tests.

(c) A 60-hour part of the test prescribed in paragraph (b) of this section must be run at not less than maximum continuous torque and the maximum speed for use with maximum continuous torque. In this test, the main rotor controls must be set in the position that will give maximum longitudinal cyclic pitch change to simulate forward flight. The auxiliary rotor controls must be in the position for normal operation under the conditions of the test.

(d) A 30-hour or, for rotorcraft for which the use of either 30-minute OEI power or continuous OEI power is requested, a 25-hour part of the test prescribed in paragraph (b) of this section must be run at not less than 75 percent of maximum continuous torque and the minimum speed for use with 75 percent of maximum continuous torque. The main and auxiliary rotor controls must be in the position for normal operation under the conditions of the test.

(e) A 10-hour part of the test prescribed in paragraph (b) of this section must be run at not less than takeoff torque and the maximum speed for use with takeoff torque. The main and auxiliary rotor controls must be in the normal position for vertical ascent. For multiengine helicopters for which the use of 2½-minute OEI power is requested, 12 runs during the 10-hour test must be conducted as follows:

(1) Each run must consist of at least one period of 2½ minutes with takeoff torque and the maximum speed for use with takeoff torque on all engines.

(2) Each run must consist of at least one period, for each engine in sequence, during which that engine simulates a power failure and the remaining engines are run at 2½-minute OEI torque and the maximum speed for use with 2½-minute OEI torque for 2½ minutes.

(j) For multiengine rotorcraft for which the use of 30-minute OEI power is requested, five runs must be made at 30-minute OEI torque and the maximum speed for use with 30-minute OEI torque, in which each engine, in sequence, is made inoperative and the remaining engine(s) is run for a 30-minute period.

(k) For multiengine rotorcraft for which the use of continuous OEI power is requested, five runs must be made at continuous OEI torque and the maximum speed for use with continuous OEI torque, in which each engine, in sequence, is made inoperative and the remaining engine(s) is run for a 1-hour period.

12. By amending § 27.927 by revising paragraph (b)(3) to read as follows:

§ 27.927 Additional tests.

(b) * * *

(3) The tests prescribed in this paragraph must be conducted on the rotorcraft at the maximum rotational speed intended for the power condition of the test and the torque must be absorbed by the rotors to be installed, except that other ground or flight test facilities with other appropriate methods of torque absorption may be used if the conditions of support and vibration closely simulate the conditions that would exist during a test on the rotorcraft.

13. By adding a new § 27.954 to read as follows:

§ 27.954 Fuel system lightning protection.

The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by—

(a) Direct lightning strikes to areas having a high probability of stroke attachment;

(b) Swept lightning strokes to areas where swept strokes are highly probable; or

(c) Corona and streamering at fuel vent outlets.

14. By revising § 27.955 to read as follows:

§ 27.955 Fuel flow.

(a) *General.* The fuel system for each engine must be shown to provide the engine with at least 100 percent of the fuel required under each operating and maneuvering condition to be approved for the rotorcraft including, as applicable, the fuel required to operate the engine(s) under the test conditions required by § 27.927. Unless equivalent methods are used, compliance must be shown by test during which the following provisions are met except that combinations of conditions which are

shown to be improbable need not be considered.

(1) The fuel pressure, corrected for critical accelerations, must be within the limits specified by the engine type certificate data sheet.

(2) The fuel level in the tank may not exceed that established as the unusable fuel supply for that tank under § 27.959, plus the minimum additional fuel necessary to conduct the test.

(3) The fuel head between the tank outlet and the engine inlet must be critical with respect to rotorcraft flight attitudes.

(4) The critical fuel pump (for pumped systems) is installed to produce (by actual or simulated failure) the critical restriction to fuel flow to be expected from pump failure.

(5) Critical values of engine rotation speed, electrical power, or other sources of fuel pump motive power must be applied.

(6) Critical values of fuel properties which adversely affect fuel flow must be applied.

(7) The fuel filter required by § 27.997 must be blocked to the degree necessary to simulate the accumulation of fuel contamination required to activate the indicator required by § 27.1305(q).

(b) *Fuel transfer systems.* If normal operation of the fuel system requires fuel to be transferred to an engine feed tank, the transfer must occur automatically via a system which has been shown to maintain the fuel level in the engine feed tank within acceptable limits during flight or surface operation of the rotorcraft.

(c) *Multiple fuel tanks.* If an engine can be supplied with fuel from more than one tank, the fuel systems must, in addition to having appropriate manual switching capability, be designed to prevent interruption of fuel flow to that engine, without attention by the flightcrew, when any tank supplying fuel to that engine is depleted of usable fuel during normal operation, and any other tank that normally supplies fuel to the engine alone contains usable fuel.

15. By revising § 27.961 to read as follows:

§ 27.961 Fuel system hot weather operation.

Each suction lift fuel system and other fuel systems with features conducive to vapor formation must be shown by test to operate satisfactorily (within certification limits) when using fuel at a temperature of 110 °F under critical operating conditions including, if applicable, the engine operating conditions defined by §§ 27.927 (b)(1) and (b)(2).

16. By amending § 27.963 by adding new paragraphs (e) and (f) to read as follows:

§ 27.953 Fuel tanks: General.

(e) The maximum exposed surface temperature of any component in the fuel tank must be less, by a safe margin as determined by the Administrator, than the lowest expected autoignition temperature of the fuel or fuel vapor in the tank. Compliance with this requirement must be shown under all operating conditions and under all failure or malfunction conditions of all components inside the tank.

(f) Each fuel tank installed in personnel compartments must be isolated by fume-proof and fuel-proof enclosures that are drained and vented to the exterior of the rotorcraft. The design and construction of the enclosure must provide necessary protection for the tank and be adequate to withstand loads and abrasions to be expected in personnel compartments.

17. By revising § 27.969 to read as follows:

§ 27.969 Fuel tank expansion space.

Each fuel tank or each group of fuel tanks with interconnected vent systems must have an expansion space of not less than 2 percent of the tank capacity. It must be impossible to fill the fuel tank expansion space inadvertently with the rotorcraft in the normal ground attitude.

18. By revising § 27.971 to read as follows:

§ 27.971 Fuel tank sump.

(a) Each fuel tank must have a drainable sump with an effective capacity in any ground attitude to be expected in service of 0.25 percent of the tank capacity or 1/16 gallon, whichever is greater, unless—

(1) The fuel system has a sediment bowl or chamber that is accessible for preflight drainage and has a minimum capacity of 1 ounce for every 20 gallons of fuel tank capacity; and

(2) Each fuel tank drain is located so that in any ground attitude to be expected in service, water will drain from all parts of the tank to the sediment bowl or chamber.

(b) Each sump, sediment bowl, and sediment chamber drain required by this section must comply with the drain provisions of § 27.999(b).

19. By amending § 27.975 by designating the existing text as paragraph (a) and by adding a new paragraph (b) to read as follows:

§ 27.975 Fuel tank vents.

(b) The venting system must be designed to minimize spillage of fuel through the vents to an ignition source in the event of a rollover during landing or ground operation unless such an event is extremely remote.

20. By revising § 27.991 to read as follows:

§ 27.991 Fuel pumps.

Compliance with § 27.955 may not be jeopardized by failure of—

(a) Any one pump except pumps that are approved and installed as parts of a type certificated engine; or

(b) Any component required for pump operation except, for engine driven pumps, the engine served by that pump.

21. By amending § 27.997 by revising the introductory text and paragraph (d) to read as follows:

§ 27.997 Fuel strainer or filter.

There must be a fuel strainer or filter between the fuel tank outlet and the inlet of the first fuel system component which is susceptible to fuel contamination, including but not limited to the fuel metering device or an engine positive displacement pump, whichever is nearer the fuel tank outlet. This fuel strainer or filter must—

(j) Provide a means to remove from the fuel any contaminant which would jeopardize the flow of fuel through rotorcraft or engine fuel system components required for proper rotorcraft fuel system or engine fuel system operation.

22. By amending § 27.999 by revising paragraphs (a) and (b)(2) to read as follows:

§ 27.999 Fuel system drains.

(a) There must be at least one accessible drain at the lowest point in each fuel system to completely drain the system with the rotorcraft in any ground attitude to be expected in service.

(b) * * *

(2) Have manual or automatic means to assure positive closure in the off position; and

23. By revising the title of § 27.1011 to read as follows:

§ 27.1011 Engines: General.

24. By amending § 27.1019 by revising paragraph (a)(3) to read as follows:

§ 27.1019 Oil strainer or filter.

(a) * * *

(3) The oil strainer or filter, unless it is installed at an oil tank outlet, must incorporate a means to indicate contamination before it reaches the

capacity established in accordance with paragraph (a)(2) of this section.

25. By adding a new § 27.1027 after § 27.1021 and before the heading Cooling to read as follows:

§ 27.1027 Transmissions and gearboxes: General.

(a) Pressure lubrication systems for transmissions and gearboxes must comply with the engine oil system requirements of §§ 27.1013 (except paragraph (c)), 27.1015, 27.1017, 27.1021, and 27.1337(d).

(b) Each pressure lubrication system must have an oil strainer or filter through which all of the lubricant flows and must—

(1) Be designed to remove from the lubricant any contaminant which may damage transmission and drive system components or impede the flow of lubricant to a hazardous degree;

(2) Be equipped with a means to indicate collection of contaminants on the filter or strainer at or before opening of the bypass required by paragraph (b)(3) of this section; and

(3) Be equipped with a bypass constructed and installed so that—

(i) The lubricant will flow at the normal rate through the rest of the system with the strainer or filter completely blocked; and

(ii) The release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flowpath.

(c) For each lubricant tank or sump outlet supplying lubrication to rotor drive systems and rotor drive system components, a screen must be provided to prevent entrance into the lubrication system of any object that might obstruct the flow of lubricant from the outlet to the filter required by paragraph (b) of this section. The requirements of paragraph (b) do not apply to screens installed at lubricant tank or sump outlets.

(d) Splash-type lubrication systems for rotor drive system gearboxes must comply with §§ 27.1021 and 27.1337(d).

26. By amending § 27.1041 by revising paragraph (a) to read as follows:

§ 27.1041 General.

(a) Each powerplant cooling system must be able to maintain the temperatures of powerplant components within the limits established for these components under critical surface (ground or water) and flight operating conditions for which certification is required and after normal shutdown. Powerplant components to be

considered include but may not be limited to engines, rotor drive system components, auxiliary power units, and the cooling or lubricating fluids used with these components.

27. By amending § 27.1045 by revising paragraph (c)(1) to read as follows:

§ 27.1045 Cooling test procedures.

(c) ***

(1) The temperatures stabilize or 5 minutes after the occurrence of the highest temperature recorded, as appropriate to the test condition;

§ 27.1091 [Amended]

28. By amending § 27.1091 by removing paragraph (d) in its entirety and by redesignating paragraph (e) as paragraph (d).

29. By amending § 27.1093 by revising paragraph (b)(1) to read as follows:

§ 27.1093 Induction system icing protection.

(b) ***

(1) It must be shown that each turbine engine and its air inlet system can operate throughout the flight power range of the engine (including idling)—

(i) Without accumulating ice on engine or inlet system components that would adversely affect engine operation or cause a serious loss of power under the icing conditions specified in Appendix C of Part 29 of this chapter; and

(ii) In snow, both falling and blowing, without adverse effect on engine operation, within the limitations established for the rotorcraft.

30. By amending § 27.1141 by revising the introductory text of paragraph (c) to read as follows:

§ 27.1141 Powerplant controls: General.

(c) Controls of powerplant valves required for safety must have—

31. By amending § 27.1143 by revising paragraphs (a) and (c) and the introductory texts of paragraphs (b) and (d) to read as follows:

§ 27.1143 Engine controls.

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

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

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

(d) If a power control incorporates a fuel shutoff feature, the control must have a means to prevent the inadvertent movement of the control into the shutoff position. The means must—

32. By amending § 27.1163 by revising paragraph (b) to read as follows:

§ 27.1163 Powerplant accessories.

(b) Unless other means are provided, torque limiting means must be provided for accessory drives located on any component of the transmission and rotor drive system to prevent damage to these components from excessive accessory load.

33. By amending § 27.1189 by revising paragraph (c) to read as follows:

§ 27.1189 Shutoff means.

(c) Each shutoff valve and its control must be designed, located, and protected to function properly under any condition likely to result from an engine fire.

34. By amending § 27.1193 by adding a new paragraph (f) to read as follows:

§ 27.1193 Cowling and engine compartment covering.

(f) A means of retaining each openable or readily removable panel, cowling, or engine or rotor drive system covering must be provided to preclude hazardous damage to rotors or critical control components in the event of structural or mechanical failure of the normal retention means, unless such failure is extremely improbable.

35. By amending § 27.1305 by revising paragraphs (l), (m), (q), and (s) to read as follows:

§ 27.1305 Powerplant instruments.

(l) A low fuel warning device for each fuel tank which feeds an engine. This device must—

(1) Provide a warning to the flightcrew when approximately 10 minutes of usable fuel remains in the tank; and

(2) Be independent of the normal fuel quantity indicating system.

(m) Means to indicate to the flightcrew the failure of any fuel pump installed to show compliance with § 27.955.

(q) An indicator for the fuel filter required by § 27.997 to indicate the occurrence of contamination of the filter at the degree established by the applicant in compliance with § 27.955.

(s) An indicator to indicate the functioning of any selectable or controllable heater used to prevent ice clogging of fuel system components.

36. By amending § 27.1337 by adding a new paragraph (e) to read as follows:

§ 27.1337 Powerplant instruments.

(e) Rotor drive system transmissions and gearboxes utilizing ferromagnetic materials must be equipped with chip detectors designed to indicate or reveal the presence of ferromagnetic particles resulting from damage or excessive wear. Chip detectors must—

(1) Incorporate means to indicate the accumulation of ferromagnetic particles on the magnetic poles; or

(2) Be readily removable for inspection of the magnetic poles for metallic chips. Means must be provided to prevent loss of lubricant in the event of failure of the retention device for removable chip detector components.

37. By amending § 27.1521 by adding new paragraphs (g), (h), and (i) to read as follows:

§ 27.1521 Powerplant limitations.

(g) *Two and one-half-minute OEI power operation.* Unless otherwise authorized, the use of 2½-minute OEI power must be limited to engine failure operation of multiengine, turbine-powered rotorcraft for not longer than 2½ minutes after failure of an engine. The use of 2½-minute OEI power must also be limited by—

(1) The maximum rotational speed, which may not be greater than—

(i) The maximum value determined by the rotor design; or

(ii) The maximum demonstrated during the type tests;

(2) The maximum allowable gas temperature; and

(3) The maximum allowable torque.

(h) *Thirty-minute OEI power operation.* Unless otherwise authorized, the use of 30-minute OEI power must be limited to multiengine, turbine-powered rotorcraft for not longer than 30 minutes after failure of an engine. The use of 30-minute OEI power must also be limited by—

(1) The maximum rotational speed, which may not be greater than—

(i) The maximum value determined by the rotor design; or

(ii) The maximum value demonstrated during the type tests;

(2) The maximum allowable gas temperature; and

(3) The maximum allowable torque.

(i) *Continuous OEI power operation.* Unless otherwise authorized, the use of

continuous OEI power must be limited to multiengine, turbine-powered rotorcraft for continued flight after failure of an engine. The use of continuous OEI power must also be limited by—

(1) The maximum rotational speed, which may not be greater than—

(i) The maximum value determined by the rotor design; or

(ii) The maximum value demonstrated during the type tests;

(2) The maximum allowable gas temperature; and

(3) The maximum allowable torque.

38. By amending § 27.1549 by removing the word "and" at the end of paragraph (c); by removing the period at the end of paragraph (d) and inserting "; and" in its place; and by adding a new paragraph (e) to read as follows:

§ 27.1549 Powerplant instruments.

(e) Each OEI limit or approved operating range must be marked to be clearly differentiated from the markings of paragraphs (a) through (d) of this section.

PART 29—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT

39. The authority citation for Part 29 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

40. By amending § 29.67 by revising paragraphs (a)(2)(i), (a)(3)(i) and (b) to read as follows:

§ 29.67 Climb: One engine inoperative.

(a) * * *
(2) * * *

(i) The critical engine inoperative and the remaining engines at—

(A) Maximum continuous power;

(B) Thirty-minute OEI power (for helicopters for which certification for the use of 30-minute OEI power is requested); or

(C) Continuous OEI power (for helicopters for which certification for the use of continuous OEI power is requested);

(3) * * *

(i) The critical engine inoperative and the remaining engines at—

(A) Maximum continuous power and at 30-minute OEI power (for helicopters for which certification for use of 30-minute OEI power is requested); or

(B) Continuous OEI power (for helicopters for which certification for

the use of continuous OEI power is requested);

(b) For multiengine Category B helicopters meeting the requirements for Category A in § 29.79, the steady rate of climb (or descent) must be determined at the speed for the best rate of climb (or minimum rate of descent) with the critical engine inoperative and the remaining engines at either—

(1) Maximum continuous power and at 30-minute OEI power (for helicopters for which certification for the use of 30-minute OEI power is requested); or

(2) Continuous OEI power (for helicopters for which certification for the use of continuous OEI power is requested).

41. By revising § 29.361 to read as follows:

§ 29.361 Engine torque.

The limit engine torque may not be less than the following:

(a) For turbine engines, the highest of—

- (1) The mean torque for maximum continuous power multiplied by 1.25;
- (2) The torque required by § 29.923;
- (3) The torque required by § 29.927; or
- (4) The torque imposed by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming).

(b) For reciprocating engines, the mean torque for maximum continuous power multiplied by—

- (1) 1.33, for engines with five or more cylinders; and
- (2) Two, three, and four, for engines with four, three, and two cylinders, respectively.

42. By amending § 29.549 by revising paragraph (e) to read as follows:

§ 29.549 Fuselage and rotor pylon structures.

(e) If approval for the use of 2½-minute OEI power is requested, each engine mount and adjacent structure must be designed to withstand the loads resulting from a limit torque equal to 1.25 times the mean torque for 2½-minute OEI power combined with 1g flight loads.

43. By amending § 29.901 by revising paragraph (b)(2) and by adding new paragraph (b)(6) to read as follows:

§ 29.901 Installation.

(2) Each component of the installation must be constructed, arranged, and installed to ensure its continued safe operation between normal inspections or overhauls for the range of

temperature and altitude for which approval is requested.

(6) Design precautions must be taken to minimize the possibility of incorrect assembly of components and equipment essential to safe operation of the rotorcraft, except where operation with the incorrect assembly can be shown to be extremely improbable.

44. By amending § 29.903 by revising paragraphs (a) and (b)(2); by removing the "or" at the end of paragraph (c)(1); by removing the period at the end of paragraph (c)(2) and inserting "; or" in its place; and by adding a new paragraph (c)(3) to read as follows:

§ 29.903 Engines.

(a) *Engine type certification.* Each engine must have an approved type certificate. Reciprocating engines for use in helicopters must be qualified in accordance with § 33.49(d) of this chapter or be otherwise approved for the intended usage.

(2) Require immediate action, other than normal pilot action with primary flight controls, by any crewmember to maintain safe operation.

(3) Engine restart capability must be established throughout a flight envelope appropriate to the rotorcraft.

45. By amending § 29.908 by revising paragraph (a) and by adding a new paragraph (c) to read as follows:

§ 29.908 Cooling fans.

(a) *Category A.* For cooling fans installed in Category A rotorcraft, it must be shown that a fan blade failure will not prevent continued safe flight either because of damage caused by the failed blade or loss of cooling air.

(c) *Fatigue evaluation.* Unless a fatigue evaluation under § 29.571 is conducted, it must be shown that cooling fan blades are not operating at resonant conditions within the operating limits of the rotorcraft.

46. By amending § 29.923 by revising paragraphs (a)(1), (a)(3) (introductory text), (a)(3)(ii), (b), (c) (introductory text), (d) through (h), and (k) to read as follows:

§ 29.923 Rotor drive system and control mechanism tests.

(1) Ten-hour test cycles must be used, except that the test cycle must be extended to include the OEI test of

paragraphs (b)(2) and (k), of this section if OEI ratings are requested.

(3) The test torque and rotational speed must be—

(ii) Absorbed by the rotors to be approved for the rotorcraft.

(b) *Endurance tests; takeoff run.* The takeoff run must be conducted as follows:

(1) Except as prescribed in paragraph (b)(2) of this section, the takeoff run must consist of 1 hour of alternate runs of 5 minutes each at takeoff torque and the maximum speed for use with takeoff torque, and 5 minutes each at as low an engine idle speed as practicable. The engine must be declutched from the rotor drive system, and the rotor brake, if furnished and so intended, must be applied during the first minute of the idle run. During the remaining 4 minutes of the idle run, the clutch must be engaged so that the engine drives the rotor at the minimum practical r.p.m. The engine and the rotor drive system must be accelerated at the maximum rate. When declutching the engine, it must be decelerated rapidly enough to allow the operation of the overrunning clutch.

(2) For helicopters for which the use of a 2½-minute OEI rating is requested, the takeoff run must be conducted as prescribed in paragraph (b)(1) of this section, except for the third and sixth runs for which the takeoff torque and the maximum speed for use with takeoff torque are prescribed in that paragraph. For these runs, the following apply:

(i) Each run must consist of at least one period of 2½ minutes with takeoff torque and the maximum speed for use with takeoff torque on all engines.

(ii) Each run must consist of at least one period, for each engine in sequence, during which that engine simulates a power failure and the remaining engines are run at the 2½-minute OEI torque and the maximum speed for use with 2½-minute OEI torque for 2½ minutes.

(c) *Endurance tests; maximum continuous run.* Three hours of continuous operation at maximum continuous torque and the maximum speed for use with maximum continuous torque must be conducted as follows:

(d) *Endurance tests; 90 percent of maximum continuous run.* One hour of continuous operation at 90 percent of maximum continuous torque and the maximum speed for use with 90 percent of maximum continuous torque must be conducted.

(e) *Endurance tests; 80 percent of maximum continuous run.* One hour of

continuous operation at 80 percent of maximum continuous torque and the minimum speed for use with 80 percent of maximum continuous torque must be conducted.

(f) *Endurance tests; 60 percent of maximum continuous run.* Two hours or, for helicopters for which the use of either 30-minute OEI power or continuous OEI power is requested, 1 hour of continuous operation at 60 percent of maximum continuous torque and the minimum speed for use with 60 percent of maximum continuous torque must be conducted.

(g) *Endurance tests; engine malfunctioning run.* It must be determined whether malfunctioning of components, such as the engine fuel or ignition systems, or whether unequal engine power can cause dynamic conditions detrimental to the drive system. If so, a suitable number of hours of operation must be accomplished under those conditions, 1 hour of which must be included in each cycle, and the remaining hours of which must be accomplished at the end of the 20 cycles. If no detrimental condition results, an additional hour of operation in compliance with paragraph (b) of this section must be conducted in accordance with the run schedule of paragraph (b)(1) of this section without consideration of paragraph (b)(2) of this section.

(h) *Endurance tests; overspeed run.* One hour of continuous operation must be conducted at maximum continuous torque and the maximum power-on overspeed expected in service, assuming that speed and torque limiting devices, if any, function properly.

(k) *Endurance tests; OEI power run.—*
(1) *30-minute OEI power run.* For rotorcraft for which the use of 30-minute OEI power is requested, a run at 30-minute OEI torque and the maximum speed for use with 30-minute OEI torque must be conducted as follows: For each engine, in sequence, that engine must be inoperative and the remaining engines must be run for a 30-minute period.

(2) *Continuous OEI power run.* For rotorcraft for which the use of continuous OEI power is requested, a run at continuous OEI torque and the maximum speed for use with continuous OEI torque must be conducted as follows: For each engine, in sequence, that engine must be inoperative and the remaining engines must be run for 1 hour.

(3) The number of periods prescribed in paragraph (k)(1) or (k)(2) of this

section may not be less than the number of engines, nor may it be less than two.

47. By amending § 29.927 by revising paragraphs (c), (d) (introductory text), and (d)(2), and by adding new paragraph (f) to read as follows:

§ 29.927 Additional test,

(c) *Lubrication system failure.* For lubrication systems required for proper operation of rotor drive systems, the following apply:

(1) *Category A.* Unless such failures are extremely remote, it must be shown by test that any failure which results in loss of lubricant in any normal use lubrication system will not prevent continued safe operation, although not necessarily without damage, at a torque and rotational speed prescribed by the applicant for continued flight, for at least 30 minutes after perception by the flightcrew of the lubrication system failure or loss of lubricant.

(2) *Category B.* The requirements of Category A apply except that the rotor drive system need only be capable of operating under autorotative conditions for at least 15 minutes.

(d) *Overspeed test.* The rotor drive system must be subjected to 50 overspeed runs, each 30±3 seconds in duration, at not less than either the higher of the rotational speed to be expected from an engine control device failure or 105 percent of the maximum rotational speed, including transients, to be expected in service. If speed and torque limiting devices are installed, are independent of the normal engine control, and are shown to be reliable, their rotational speed limits need not be exceeded. These runs must be conducted as follows:

(2) Acceleration and deceleration must be accomplished in a period not longer than 10 seconds (except where maximum engine acceleration rate will require more than 10 seconds), and the time for changing speeds may not be deducted from the specified time for the overspeed runs.

(f) Each test prescribed by this section must be conducted without intervening disassembly and, except for the lubrication system failure test required by paragraph (c) of this section, each part tested must be in a serviceable condition at the conclusion of the test.

48. By adding a new § 29.954 to read as follows:

§ 29.954 Fuel system lightning protection.

The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by—

- (a) Direct lightning strikes to areas having a high probability of stroke attachment;
- (b) Swept lightning strokes to areas where swept strokes are highly probable; and
- (c) Corona and streamering at fuel vent outlets.

49. By revising § 29.955 to read as follows:

§ 29.955 Fuel flow.

(a) *General.* The fuel system for each engine must provide the engine with at least 100 percent of the fuel required under all operating and maneuvering conditions to be approved for the rotorcraft, including, as applicable, the fuel required to operate the engines under the test conditions required by § 29.927. Unless equivalent methods are used, compliance must be shown by test during which the following provisions are met, except that combinations of conditions which are shown to be improbable need not be considered.

- (1) The fuel pressure, corrected for accelerations (load factors), must be within the limits specified by the engine type certificate data sheet.
- (2) The fuel level in the tank may not exceed that established as the unusable fuel supply for that tank under § 29.959, plus that necessary to conduct the test.
- (3) The fuel head between the tank and the engine must be critical with respect to rotorcraft flight attitudes.
- (4) The fuel flow transmitter, if installed, and the critical fuel pump (for pump-fed systems) must be installed to produce (by actual or simulated failure) the critical restriction to fuel flow to be expected from component failure.
- (5) Critical values of engine rotational speed, electrical power, or other sources of fuel pump motive power must be applied.
- (6) Critical values of fuel properties which adversely affect fuel flow are applied during demonstrations of fuel flow capability.
- (7) The fuel filter required by § 29.997 is blocked to the degree necessary to simulate the accumulation of fuel contamination required to activate the indicator required by § 29.1305(a)(17).

(b) *Fuel transfer system.* If normal operation of the fuel system requires fuel to be transferred to another tank, the transfer must occur automatically via a system which has been shown to maintain the fuel level in the receiving tank within acceptable limits during flight or surface operation of the rotorcraft.

(c) *Multiple fuel tanks.* If an engine can be supplied with fuel from more than one tank, the fuel system, in addition to having appropriate manual switching capability, must be designed to prevent interruption of fuel flow to that engine, without attention by the flightcrew, when any tank supplying fuel to that engine is depleted of usable fuel during normal operation and any other tank that normally supplies fuel to that engine alone contains usable fuel.

50. By revising § 29.961 to read as follows:

§ 29.961 Fuel system hot weather operation.

Each suction lift fuel system and other fuel systems conducive to vapor formation must be shown to operate satisfactorily (within certification limits) when using fuel at the most critical temperature for vapor formation under critical operating conditions including, if applicable, the engine operating conditions defined by § 29.927(b)(1) and (b)(2).

51. By amending § 29.963 by adding a new paragraph (e) to read as follows:

§ 29.963 Fuel tanks: General.

* * * * *

(e) The maximum exposed surface temperature of all components in the fuel tank must be less by a safe margin than the lowest expected autoignition temperature of the fuel or fuel vapor in the tank. Compliance with this requirement must be shown under all operating conditions and under all normal or malfunction conditions of all components inside the tank.

§ 29.967 [Amended]

52. By amending § 29.967 by removing paragraph (f).

53. By revising § 29.969 to read as follows:

§ 29.969 Fuel tank expansion space.

Each fuel tank or each group of fuel tanks with interconnected vent systems must have an expansion space of not less than 2 percent of the combined tank capacity. It must be impossible to fill the fuel tank expansion space inadvertently with the rotorcraft in the normal ground attitude.

54. By amending § 29.971 by revising paragraph (c) to read as follows:

§ 29.971 Fuel tank sump.

* * * * *

(c) Each fuel tank must allow drainage of hazardous quantities of water from each part of the tank to the sump with the rotorcraft in any ground attitude to be expected in service.

* * * * *

55. By amending § 29.975 by removing the word "and" after the semicolon in paragraph (a)(5); by removing the period at the end of paragraph (a)(6)(ii) and inserting "; and" in its place; and by adding a new paragraph (a)(7) to read as follows:

§ 29.975 Fuel tank vents and carburetor vapor vents.

(a) * * *

(7) The venting system must be designed to minimize spillage of fuel through the vents to an ignition source in the event of a rollover during landing or ground operations, unless a rollover is shown to be extremely remote.

* * * * *

56. By revising § 29.991 to read as follows:

§ 29.991 Fuel pumps.

(a) Compliance with § 29.955 must not be jeopardized by failure of—

- (1) Any one pump except pumps that are approved and installed as parts of a type certificated engine; or
- (2) Any component required for pump operation except the engine served by that pump.

(b) The following fuel pump installation requirements apply:

- (1) When necessary to maintain the proper fuel pressure—
 - (i) A connection must be provided to transmit the carburetor air intake static pressure to the proper fuel pump relief valve connection; and
 - (ii) The gauge balance lines must be independently connected to the carburetor inlet pressure to avoid incorrect fuel pressure readings.
- (2) The installation of fuel pumps having seals or diaphragms that may leak must have means for draining leaking fuel.
- (3) Each drain line must discharge where it will not create a fire hazard.

57. By amending § 29.997 by revising the introductory text and paragraph (d) to read as follows:

§ 29.997 Fuel strainer or filter.

There must be a fuel strainer or filter between the fuel tank outlet and the inlet of the first fuel system component which is susceptible to fuel contamination, including but not limited to the fuel metering device or an engine positive displacement pump, whichever is nearer the fuel tank outlet. This fuel strainer or filter must—

* * * * *

(d) Provide a means to remove from the fuel any contaminant which would jeopardize the flow of fuel through rotorcraft or engine fuel system components required for proper

rotorcraft or engine fuel system operation.

58. By amending § 29.999 by revising paragraphs (a) and (b)(2) to read as follows:

§ 29.999 Fuel system drains.

(a) There must be at least one accessible drain at the lowest point in each fuel system to completely drain the system with the rotorcraft in any ground attitude to be expected in service.

(b) * * *

(2) Have manual or automatic means to ensure positive closure in the off position; and

59. By adding a new § 29.1001 after § 29.999 and before the heading Oil System to read as follows:

§ 29.1001 Fuel jettisoning.

If a fuel jettisoning system is installed, the following apply:

(a) Fuel jettisoning must be safe during all flight regimes for which jettisoning is to be authorized.

(b) In showing compliance with paragraph (a) of this section, it must be shown that—

(1) The fuel jettisoning system and its operation are free from fire hazard;

(2) No hazard results from fuel or fuel vapors which impinge on any part of the rotorcraft during fuel jettisoning; and

(3) Controllability of the rotorcraft remains satisfactory throughout the fuel jettisoning operation.

(c) Means must be provided to automatically prevent jettisoning fuel below the level required for an all-engine climb at maximum continuous power from sea level to 5,000 feet altitude and cruise thereafter for 30 minutes at maximum range engine power.

(d) The controls for any fuel jettisoning system must be designed to allow flight personnel (minimum crew) to safely interrupt fuel jettisoning during any part of the jettisoning operation.

(e) The fuel jettisoning system must be designed to comply with the powerplant installation requirements of § 29.901(c).

(f) An auxiliary fuel jettisoning system which meets the requirements of paragraphs (a), (b), (d), and (e) of this section may be installed to jettison additional fuel provided it has separate and independent controls.

§ 29.1011 [Amended]

60. By amending § 29.1011 by revising the section heading to read "Engines: General."; by removing existing paragraph (b); by redesignating paragraphs (c) and (d) as (b) and (c), respectively; and by removing the words " * * * and rotor drive system * * * "

from paragraph (e) and redesignating it as paragraph (d).

61. By amending § 29.1019 by revising paragraph (a)(3) to read as follows:

§ 29.1019 Oil strainer or filter.

(a) * * *

(3) The oil strainer or filter, unless it is installed at an oil tank outlet, must incorporate a means to indicate contamination before it reaches the capacity established in accordance with paragraph (a)(2) of this section.

* * * * *

62. By adding a new § 29.1027 after § 29.1025 and before the heading "Cooling" to read as follows:

§ 29.1027 Transmission and gearboxes: General.

(a) The oil system for components of the rotor drive system that require continuous lubrication must be sufficiently independent of the lubrication systems of the engine(s) to ensure—

(1) Operation with any engine inoperative; and

(2) Safe autorotation.

(b) Pressure lubrication systems for transmissions and gearboxes must comply with the requirements of §§ 29.1013, paragraphs (c), (d), and (f) only, 29.1015, 29.1017, 29.1021, 29.1023, and 29.1337(d). In addition, the system must have—

(1) An oil strainer or filter through which all the lubricant flows, and must—

(i) Be designed to remove from the lubricant any contaminant which may damage transmission and drive system components or impede the flow of lubricant to a hazardous degree; and

(ii) Be equipped with a bypass constructed and installed so that—

(A) The lubricant will flow at the normal rate through the rest of the system with the strainer or filter completely blocked; and

(B) The release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flowpath;

(iii) Be equipped with a means to indicate collection of contaminants on the filter or strainer at or before opening of the bypass;

(2) For each lubricant tank or sump outlet supplying lubrication to rotor drive systems and rotor drive system components, a screen to prevent entrance into the lubrication system of any object that might obstruct the flow of lubricant from the outlet to the filter required by paragraph (b)(1) of this section. The requirements of paragraph (b)(1) of this section do not apply to

screens installed at lubricant tank or sump outlets.

(c) Splash type lubrication systems for rotor drive system gearboxes must comply with §§ 29.1021 and 29.1337(d).

63. By amending § 29.1041 by revising paragraphs (a) and (c) to read as follows:

§ 29.1041 General.

(a) The powerplant and auxiliary power unit cooling provisions must be able to maintain the temperatures of powerplant components, engine fluids, and auxiliary power unit components and fluids within the temperature limits established for these components and fluids, under ground, water, and flight operating conditions for which certification is requested, and after normal engine or auxiliary power unit shutdown, or both.

* * * * *

(c) Except for ground-use-only auxiliary power units, compliance with paragraphs (a) and (b) of this section must be shown by flight tests in which the temperatures of selected powerplant component and auxiliary power unit component, engine, and transmission fluids are obtained under the conditions prescribed in those paragraphs.

64. By amending § 29.1043 by adding a new paragraph (a)(5) to read as follows:

§ 29.1043 Cooling tests.

(a) * * *

(5) For the purposes of the cooling tests, a temperature is "stabilized" when its rate of change is less than 2 °F per minute.

* * * * *

65. By amending § 29.1045 by revising paragraph (c) to read as follows:

§ 29.1045 Climb cooling test procedures.

* * * * *

(c) Each operating engine must—

(1) For helicopters for which the use of 30-minute OEI power is requested, be at 30-minute OEI power for 30 minutes, and then at maximum continuous power (or at full throttle when above the critical altitude);

(2) For helicopters for which the use of continuous OEI power is requested, be at continuous OEI power (or at full throttle when above the critical altitude); and

(3) For other rotorcraft, be at maximum continuous power (or at full throttle when above the critical altitude).

* * * * *

66. By amending § 29.1047 by removing the words "at least" from the end of the introductory text of paragraph (a)(4) and by revising

paragraphs (a)(4)(i) and (a)(4)(ii) to read as follows:

§ 29.1047 Takeoff cooling test procedures.

(a) * * *

(4) * * *

(i) Thirty minutes, if 30-minute OEI power is used; or

(ii) At least 5 minutes after the occurrence of the highest temperature recorded, if continuous OEI power or maximum continuous power is used.

* * * * *

67. By amending § 29.1093 by revising paragraph (b)(1) to read as follows:

§ 29.1093 Induction system icing protection.

* * * * *

(b) * * *

(1) It must be shown that each turbine engine and its air inlet system can operate throughout the flight power range of the engine (including idling)—

(i) Without accumulating ice on engine or inlet system components that would adversely affect engine operation or cause a serious loss of power under the icing conditions specified in Appendix C of this Part; and

(ii) In snow, both falling and blowing, without adverse effect on engine operation, within the limitations established for the rotorcraft.

* * * * *

68. By amending § 29.1141 by revising the introductory text of paragraph (f) to read as follows:

§ 29.1141 Powerplant controls: General.

* * * * *

(f) Controls of powerplant valves required for safety must have—

* * * * *

69. By revising § 29.1143 to read as follows:

§ 29.1143 Engine controls.

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

(b) Power controls must be arranged to allow ready synchronization of all engines by—

(1) Separate control of each engine; and

(2) Simultaneous control of all engines.

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

(d) Each fluid injection control other than fuel system control must be in the corresponding power control. However, the injection system pump may have a separate control.

(e) If a power control incorporates a fuel shutoff feature, the control must have a means to prevent the inadvertent

movement of the control into the shutoff position. The means must—

(1) Have a positive lock or stop at the idle position; and

(2) Require a separate and distinct operation to place the control in the shutoff position.

70. By amending § 29.1163 by revising paragraph (d) to read as follows:

§ 29.1163 Powerplant accessories.

* * * * *

(d) Unless other means are provided, torque limiting means must be provided for accessory drives located on any component of the transmission and rotor drive system to prevent damage to these components from excessive accessory load.

71. By amending § 29.1181 by adding a new paragraph (b) to read as follows:

§ 29.1181 Designated fire zones: Regions included.

* * * * *

(b) Each designated fire zone must meet the requirements of §§ 29.1183 through 29.1203.

72. By amending § 29.1189 by revising paragraphs (e) and (f) to read as follows:

§ 29.1189 Shutoff means.

* * * * *

(e) Each shutoff valve and its control must be designed, located, and protected to function properly under any condition likely to result from fire in a designated fire zone.

(f) Except for ground-use-only auxiliary power unit installations, there must be means to prevent inadvertent operation of each shutoff and to make it possible to reopen it in flight after it has been closed.

73. By amending § 29.1193 by adding a new paragraph (f) to read as follows:

§ 29.1193 Cowling and engine compartment covering.

* * * * *

(f) A means of retention for each openable or readily removable panel, cowling, or engine or rotor drive system covering must be provided to preclude hazardous damage to rotors or critical control components in the event of—

(1) Structural or mechanical failure of the normal retention means, unless such failure is extremely improbable; or

(2) Fire in a fire zone, if such fire could adversely affect the normal means of retention.

74. By amending § 29.1305 by revising paragraphs (a)(4), (a)(17), (a)(19), (b)(2), (c)(1), and (c)(2); by adding new paragraphs (a)(20) through (a)(23); by removing the word "and" at the end of paragraph (a)(18); and by removing paragraph (c)(3) as follows:

§ 29.1305 Powerplant instruments.

* * * * *

(a) * * *

(4) A low fuel warning device for each fuel tank which feeds an engine. This device must—

(i) Provide a warning to the crew when approximately 10 minutes of usable fuel remains in the tank; and

(ii) Be independent of the normal fuel quantity indicating system.

* * * * *

(17) An indicator for the filter required by § 29.997 to indicate the occurrence of contamination of the filter to the degree established in compliance with § 29.955:

* * * * *

(19) An indicator to indicate the functioning of any selectable or controllable heater used to prevent ice clogging of fuel system components;

(20) An individual fuel pressure indicator for each engine, unless the fuel system which supplies that engine does not employ any pumps, filters, or other components subject to degradation or failure which may adversely affect fuel pressure at the engine;

(21) A means to indicate to the flightcrew the failure of any fuel pump installed to show compliance with § 29.955;

(22) Warning or caution devices to signal to the flightcrew when ferromagnetic particles are detected by the chip detector required by § 29.1337(e); and

(23) For auxiliary power units, an individual indicator, warning or caution device, or other means to advise the flightcrew that limits are being exceeded, if exceeding these limits can be hazardous, for—

(i) Gas temperature;

(ii) Oil pressure; and

(iii) Rotor speed.

(b) * * *

(2) An independent fuel pressure warning device for each engine or a master warning device for all engines with provision for isolating the individual warning device from the master warning device; and

* * * * *

(c) * * *

(1) An individual oil pressure indicator for each engine; and

(2) Fire warning indicators, when fire detection is required.

75. By amending § 29.1337 by adding a new paragraph (e) to read as follows:

§ 29.1337 Powerplant instruments.

* * * * *

(e) Rotor drive system transmissions and gearboxes utilizing ferromagnetic materials must be equipped with chip

detectors designed to indicate the presence of ferromagnetic particles resulting from damage or excessive wear within the transmission or gearbox. Each chip detector must—

- (1) Be designed to provide a signal to the indicator required by § 29.1305(a)(22); and
- (2) Be provided with a means to allow crewmembers to check, in flight, the function of each detector electrical circuit and signal.

76. By amending § 29.1521 by revising the introductory texts of paragraphs (f) and (g) and by adding a new paragraph (h) to read as follows:

§ 29.1521 Powerplant limitations.

(f) *Two and one-half minute OEI power operation.* Unless otherwise authorized, the use of 2½-minute OEI power must be limited to engine failure operation of multiengine, turbine-powered rotorcraft for not longer than 2½ minutes for any period in which that power is used. The use of 2½-minute OEI power must also be limited by—

(g) *Thirty-minute OEI power operation.* Unless otherwise authorized, the use of 30-minute OEI power must be limited to multiengine, turbine-powered rotorcraft for not longer than 30 minutes after failure of an engine. The use of 30-minute OEI power must also be limited by—

(h) *Continuous OEI power operation.* Unless otherwise authorized, the use of continuous OEI power must be limited to multiengine, turbine-powered rotorcraft for continued flight after failure of an engine. The use of continuous OEI power must also be limited by—

- (1) The maximum rotational speed, which may not be greater than—
 - (i) The maximum value determined by the rotor design; or
 - (ii) The maximum value shown during the type tests.
- (2) The maximum allowable gas temperature;
- (3) The maximum allowable torque; and
- (4) The maximum allowable oil temperature.

77. By amending § 29.1549 by removing the word "and" at the end of paragraph (c); by removing the period at the end of paragraph (d) and inserting "; and" in its place; and by adding a new paragraph (e) to read as follows:

§ 29.1549 Powerplant instruments.

(e) Each OEI limit or approved operating range must be marked to be

clearly differentiated from the markings of paragraphs (a) through (d) of this section.

78. By amending § 29.1557 by revising paragraph (c)(1)(iii) to read as follows:

§ 29.1557 Miscellaneous markings and placards.

- (c) * * *
- (1) * * *
- (iii) For turbine-engine-powered rotorcraft, the permissible fuel designations, except that if impractical, this information may be included in the rotorcraft flight manual, and the fuel filler may be marked with an appropriate reference to the flight manual; and

PART 33—AIRWORTHINESS STANDARDS: AIRCRAFT ENGINES

79. The authority citation for Part 33 is revised to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

80. By amending § 33.7 by revising paragraphs (c)(1)(v) and (c)(1)(vi); by redesignating paragraph (c)(1)(vii) as (c)(1)(viii); and by adding a new paragraph (c)(1)(vii) to read as follows:

§ 33.7 Engine ratings and operating limitations.

- (c) * * *
- (1) * * *
- (v) Rated 30-minute OEI power;
- (vi) Rated 2½-minute OEI power;
- (vii) Rated continuous OEI power; and

81. By amending § 33.87 by redesignating paragraph (e) as (f) without change; by revising paragraphs (a) (introductory text), (b) (introductory text), (b)(2), (c) (introductory text), (c)(1), (c)(2), (c)(3), (c)(4), and (c)(5); by revising paragraph (d) and redesignating it as paragraph (e); and by adding a new paragraph (d) to read as follows:

§ 33.87 Endurance test.

(a) *General.* Each engine must be subjected to an endurance test that includes a total of 150 hours of operation and, depending upon the type and contemplated use of the engine, consists of one of the series of runs specified in paragraphs (b) through (f) of this section, as applicable. For engines tested under paragraph (b), (c), (d), or (e) of this section, the prescribed 6-hour test sequence must be conducted 25 times to complete the required 150 hours of

operation. The following test requirements apply:

(b) *Engines other than certain rotorcraft engines.* For each engine except a rotorcraft engine for which a rating is desired under paragraph (c), (d), or (e) of this section, the applicant must conduct the following runs:

(2) *Rated maximum continuous and takeoff power and thrust.* Thirty minutes at—

(i) Rated maximum continuous power and thrust during fifteen of the twenty-five 6-hour endurance test cycles; and

(ii) Rated takeoff power and thrust during ten of the twenty-five 6-hour endurance test cycles.

(c) *Rotorcraft engines for which a 30-minute OEI power rating is desired.* For each rotorcraft engine for which a 30-minute OEI power rating is desired, the applicant must conduct the following series of tests:

(1) *Takeoff and idling.* One hour of alternate 5-minute periods at rated takeoff power and at idling power. The developed powers at takeoff and idling conditions and their corresponding rotor speed and gas temperature conditions must be as established by the power control in accordance with the schedule established by the manufacturer. During any one period, the rotor speed and power may be controlled manually while taking data to check performance. For engines with augmented takeoff power ratings that involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at rated takeoff power must be at the augmented power rating. In changing the power setting after each period, the power control lever must be moved in the manner prescribed in paragraph (c)(5) of this section.

(2) *Rated 30-minute OEI power.* Thirty minutes at rated 30-minute OEI power.

(3) *Rated maximum continuous power.* Two hours at rated maximum continuous power.

(4) *Incremental cruise power.* Two hours at the successive power lever positions corresponding with not less than 12 approximately equal speed and time increments between maximum continuous engine rotational speed and ground or minimum idle rotational speed. For engines operating at constant speed, power may be varied in place of speed. If there are significant peak vibrations anywhere between ground idle and maximum continuous conditions, the number of increments chosen must be changed to increase the

amount of running conducted while being subjected to the peak vibrations up to not more than 50 percent of the total time spent in incremental running.

(5) *Acceleration and deceleration runs.* Thirty minutes of accelerations and decelerations, consisting of six cycles from idling power to rated takeoff power and maintained at the takeoff power lever position for 30 seconds and at the idling power lever position for approximately 4½ minutes. In complying with this paragraph, the power control lever must be moved from one extreme position to the other in not more than 1 second, except that if different regimes of control operations are incorporated necessitating scheduling of the power control lever motion in going from one extreme position to the other, a longer period of time is acceptable, but not more than 2 seconds.

* * * * *

(d) *Rotorcraft engines for which a continuous OEI rating is desired.* For each rotorcraft engine for which a continuous OEI power rating is desired, the applicant must conduct the following series of tests:

(1) *Takeoff and idling.* One hour of alternate 5-minute periods at rated takeoff power and at idling power. The developed powers at takeoff and idling conditions and their corresponding rotor speed and gas temperature conditions must be as established by the power control in accordance with the schedule established by the manufacturer. During any one period the rotor speed and power may be controlled manually while taking data to check performance. For engines with augmented takeoff power ratings that involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at rated takeoff power must be at the augmented power rating. In changing the power setting after each period, the power control lever must be moved in the manner prescribed in paragraph (c)(5) of this section.

(2) *Rated maximum continuous and takeoff power.* Thirty minutes at—

(i) Rated maximum continuous power during fifteen of the twenty-five 6-hour endurance test cycles; and

(ii) Rated takeoff power during ten of the twenty-five 6-hour endurance test cycles.

(3) *Rated continuous OEI power.* One hour at rated continuous OEI power.

(4) *Rated maximum continuous power.* One hour at rated maximum continuous power.

(5) *Incremental cruise power.* Two hours at the successive power lever positions corresponding with not less than 12 approximately equal speed and time increments between maximum continuous engine rotational speed and ground or minimum idle rotational speed. For engines operating at constant speed, power may be varied in place of speed. If there are significant peak vibrations anywhere between ground idle and maximum continuous conditions, the number of increments chosen must be changed to increase the amount of running conducted while being subjected to the peak vibrations up to not more than 50 percent of the total time spent in incremental running.

(6) *Acceleration and deceleration runs.* Thirty minutes of accelerations and decelerations, consisting of six cycles from idling power to rated takeoff power and maintained at the takeoff power lever position for 30 seconds and at the idling power lever position for approximately 4½ minutes. In complying with this paragraph, the power control lever must be moved from one extreme position to the other in not more than 1 second, except that if different regimes of control operations are incorporated necessitating scheduling of the power control lever motion in going from one extreme position to the other, a longer period of time is acceptable, but not more than 2 seconds.

(7) *Starts.* One hundred starts, of which 25 starts must be preceded by at least a 2-hour engine shutdown. There must be at least 10 false engine starts, pausing for the applicant's specified minimum fuel drainage time, before attempting a normal start. There must be at least 10 normal restarts with not longer than 15 minutes since engine shutdown. The remaining starts may be made after completing the 150 hours of endurance testing.

(e) *Rotorcraft engines for which a 2½-minute OEI power rating is desired.* For each rotorcraft engine for which a 2½-minute OEI power rating is desired, the applicant must conduct the following series of tests:

(1) *Takeoff, 2½-minute OEI, and idling.* One hour of alternate 5-minute periods at rated takeoff power and at idling power except that, during the third and sixth takeoff power periods, only 2½ minutes need be conducted at rated takeoff power, and the remaining 2½ minutes must be conducted at rated 2½-minute OEI power. The developed powers at takeoff, 2½-minute OEI, and idling conditions and their corresponding rotor speed and gas temperature conditions must be as established by the power control in accordance with the schedule established by the manufacturer. The applicant may, during any one period, control manually the rotor speed and power while taking data to check performance. For engines with augmented takeoff power ratings that involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at rated takeoff power must be at the augmented rating. In changing the power setting after or during each period, the power control lever must be moved in the manner prescribed in paragraph (d)(6) of this section.

(2) The tests required in paragraphs (b)(2) through (b)(6), or (c)(2) through (c)(6), or (d)(2) through (d)(7) of this section, as applicable, except that in one of the 6-hour test sequences, the last 5 minutes of the 30 minutes at takeoff power test period of paragraph (b)(2) of this section, or of the 30 minutes at 30-minute OEI power test period of paragraph (c)(2) of this section, or of the 1 hour at continuous OEI power test period of paragraph (d)(3) of this section, must be run at 2½-minute OEI power.

* * * * *

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Administrator.

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