Federal Aviation Administration
Aviation Rulemaking Advisory Committee

Rotorcraft Issue Area
JAR/FAR 27 and 29 Harmonization Working Group

Task 1 – Category A Performance

Task Assignment

Aviation Rulemaking Advisory Committee; Rotorcraft Subcommittee; JAR/FAR 27 and 29 Harmonization Working Group

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of establishment of JAR/FAR 27 and 29 Harmonization Working Group.

SUMMARY: Notice is given of the establishment of the JAR/FAR 27 and 29 Harmonization Working Group of the Rotorcraft Subcommittee. This notice informs the public of the activities of the Rotorcraft Subcommittee of the Aviation Rulemaking Advisory Committee.

FOR FURTHER INFORMATION CONTACT: Mr. William J. (Joe) Sullivan, Executive Director, Rotorcraft Subcommittee, Aircraft Certification Service (AIR-3), 800 Independence Avenue SW., Washington, DC 20591, Telephone: (202) 267-9554; FAX: (202) 267-5364.

SUPPLEMENTARY INFORMATION: The Federal Aviation Administration (FAA) established an Aviation Rulemaking Advisory Committee (56 FR 2190, January 22, 1991) which held its first meeting on May 23, 1991 (56 FR 20492, May 3, 1991). The Rotorcraft Subcommittee was established at that meeting to provide advice and recommendations to the Director, Aircraft Certification Service, FAA, regarding the airworthiness standards for normal and transport category rotorcraft in parts 27 and 29 of the Federal Aviation Regulations (14 CFR parts 27 and 29).

The FAA announced at the Joint Aviation Authorities (JAA)—Federal Aviation Administration (FAA) Harmonization Conference in Toronto, Ontario, Canada, (June 2–5, 1992) that it would consolidate within the Aviation Rulemaking Advisory Committee structure an ongoing objective to "harmonize" the Joint Aviation Requirements (JAR) and the Federal Aviation Regulations (FAR). Coincident with that announcement, the FAA assigned to the Rotorcraft Subcommittee those projects related to JAR/FAR 27 and 29 Harmonization which were then in the process of being coordinated between the JAA and the FAA. The Harmonization process included the intention to present the results of JAA/FAA coordination to the public in the form of either a Notice of Proposed Rulemaking or an advisory circular—an objective comparable to and compatible with that assigned to the Aviation Rulemaking Advisory Committee. The Rotorcraft Subcommittee, consequently, established the JAR/FAR 27 and 29 Harmonization Working Group.

Specifically, the Working Group's tasks are the following:

The JAR/FAR 27 and 29 Harmonization Working Group is charged with making recommendations to the Rotorcraft Subcommittee concerning the FAA disposition of the following subjects recently coordinated between the JAA and the FAA:

Task 1—Performance: Category A performance of normal category rotorcraft (FAR 27.1 and Appendix C).

Task 2—Rotor Drive System: Design assessment of the rotor drive systems which are consistent with the present state of the design art (FAR 29.547, 29.917, AC 29-2A).

Task 3—Critical Parts: Identification of the critical parts for consideration under design, production and maintenance, according to a critical parts plan to be prepared by the manufacture (FAR 27.602, 29.602).

Task 4—Oil Pressure Indicator: An oil pressure indicator to be provided for pressure-lubricated gear boxes to inform the crew in time that oil pressure is abnormal (FAR 27.1305, 29.1305).

Task 5—Performance & Propulsion: Miscellaneous performance and propulsion requirements for transport category rotorcraft (FAR 29.67, 29.923, 29.1587).

Task 6—Flutter: Update the flutter substantiation methodology and documentation requirements for transport category rotorcraft (FAR 29.629).

Task 7—Lighting and Bonding: Update lighting and bonding requirements for transport category rotorcraft (FAR 29.610, 29.1309).

Task 8—Bird Strike: Determine the need for bird strike protection for transport category rotorcraft (FAR 29.631).

Task 9—Battery Endurance: Reassess battery endurance requirements relative to different modes of operation and to varying environments for transport category rotorcraft (FAR 29.1351).

Task 10—Fire Detection: Reduce probability of false fire detector warning for transport category rotorcraft (AC 29-2A; ref. FAR 29.1203).

Task 11—Vibrations: Update advisory material of Appendix A of FAR 29 to provide guidance on basic vibration data to be provided for service (continuing airworthiness) use (AC 29-2A; ref. FAR 29 Appendix A).

Task 12—Rotor Drive System and Fatigue Gear Substantiation: Identify acceptable compliance methodology for gear teeth fatigue (AC 29-2A; ref. FAR 29.571, 29.901).

Reports

A. Recommend time line(s) for completion of each task, including rationale, for Subcommittee consideration at the meeting of the subcommittee held following publication of this notice.

B. Give a detailed conceptual presentation on each task to the Subcommittee before proceeding with the work stated under items C and D, below. If tasks 1–9 require the development of more than one Notice of Proposed Rulemaking, identify what proposed amendments will be included in each notice.

C. Draft a Notice of Proposed Rulemaking for tasks 1–9 proposing new or revised requirements, a supporting economic analysis, and other required analysis, with any other collateral documents (such as Advisory Circulars) the Working Group determines to be needed.

D. Draft a change to Advisory Circular 29-2A for tasks 2 and 10–12 providing appropriate advisory material for each task.

E. Give a status report on each task at each meeting of the Subcommittee.

The JAR/FAR 27 and 29 Harmonization Working Group will be comprised of experts from those organizations having an interest in the tasks assigned. A Working Group member need not necessarily be a representative of one of the organizations of the parent Rotorcraft Subcommittee or of the full Aviation Rulemaking Advisory Committee. An individual who has expertise in the subject matter and wishes to become a member of the Working Group should write the person listed under the caption **FOR FURTHER INFORMATION CONTACT** expressing that desire, describing his or her interest in the task, and the expertise he or she would bring to the Working Group. The request will be reviewed with the Subcommittee and Working Group Chair, and the individual will be advised whether or not the request can be accommodated.

The Secretary of Transportation has determined that the information and use of the Aviation Rulemaking Advisory Committee and its subcommittees are necessary in the public interest in connection with the performance of duties of the FAA by law. Meetings of the full Committee and any subcommittees will be open to the public except as authorized by section 10(d) of the Federal Advisory Committee Act. Meetings of the JAR/FAR 27 and 29 Harmonization Working Group will not be open to the public except to the extent that individuals with an interest and expertise are selected to participate. No public announcement of Working Group meetings will be made.

Issued in Washington, DC, on December 4, 1992.

William J. Sullivan,

Executive Director, Rotorcraft Subcommittee, Aviation Rulemaking Advisory Committee.

[FR Doc. 92-30128 Filed 12-10-92; 8:45 am]

BILLING CODE 4910-13-M

Recommendation Letter

Helicopter Association International

Please direct responses to:
1101 Naugatuck Avenue
Milford,CT 06460-2317
Tel: 203-878-1943
Fax: 203-878-2544

1635 Prince Street, Alexandria, Virginia 22314-2818 Telephone: (703) 683-4646 Fax: (703) 683-4745

June 30,1994

Mr. Anthony J. Broderick
Associated Administrator for Regulation and Certification (AVR-1)
Federal Aviation Administration
800 Independence Avenue,SW
Washington,DC 20591

Dear Mr. Broderick:

The JAR/FAR 27 and 29 Harmonization Working Group of the Aviation Rulemaking Advisory Committee (ARAC) has completed the task assigned to it by the FAA, the substance of which was published in the "Federal Register" on December 11,1992. The ARAC has reviewed the results of their effort, as contained in the documents attached, and hereby recommends that they be processed so as to affect changes to Federal Aviation Regulation parts 27 and 29.

The rotorcraft community of the ARAC believe that this rulemaking package is a prime candidate for being processed in accordance with one of the procedures discussed during the JAA/FAA Harmonization meeting in Boston, namely, going directly to final rule without the use of a formal Notice of Rulemaking:

- The draft NPRM contained in this package has been undergoing negotiation by the FAA, JAA and industry for about five years and were elevated to official "Harmonization" status in 1992.
- It has experienced several iterations with the offices of the General Counsel and Rulemaking.
- It has been accepted without exception by all of the rotorcraft interests on the ARAC in public meeting and through a follow-up vote.

It must be noted, however, that Enclosure (1) has been harmonized with the understanding of the ARAC that the NPRM's listed below would have progressed to final rules by the time of this recommendation. Such rules are still not publicly available in spite of their being given full recognition by the FAA and JAA managements during the meeting in Toronto in 1992 but also, we understand, elevated into the top-ten priorities of FAA rulemaking.

NPRM 89-26 Docket No.26018	Parts 27 and 29	New Rotorcraft 30-Second/ 2-Minute One-Engine-Inoperative Power Ratings.

NPRM 89-29A Docket No.26037	Part 29	Turboshaft Engine Rotor Burst Protection.
NPRM 90-1 NPRM 90-1A Docket No.24802	Part 29	Transport Category Rotorcraft Performance.
NPRM 90-24 Docket No.26352	Parts 27 and 29	Crash Resistant Fuel System.

I have been advised that the JAA has already included the substance of the above listed NPRM's and the enclosed recommended NPRM into JAR 27 and 29 to the satisfaction of the FAA.

Respectfully yours,

T.E.Dumont
Assistant Chair for Rotorcraft Issues
FAA Aviation Rulemaking Advisory Committee

Enclosures: (1) Draft NPRM
(2) Preliminary Regulatory Evaluation
(3) Executive Summary

cc: William H. Schultz
Chris A. Christie
Eric Bries
Giffen A. Marr
Frank L. Jensen,Jr.

U.S. Department
of Transportation

**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

JUL 21 1994

Mr. T. E. Dumont
Assistant Chair, Aviation Rulemaking
Advisory Committee
1101 Naugatuck Avenue
Milford, CT 06460-2317

Dear Mr. Dumont:

Thank you for your June 30 letter forwarding the Aviation Rulemaking Advisory Committee's (ARAC) recommendation to harmonize the Federal Aviation Regulations (FAR) rotorcraft type certification requirements with the European Joint Airworthiness Requirements (JAR).

You have requested that the draft notice of proposed rulemaking be processed as a direct final rule. We will take your recommendation under consideration and notify you when a decision has been reached.

I would like to thank the aviation community for its commitment to ARAC and its expenditure of resources to develop the recommendation. We in the Federal Aviation Administration (FAA) pledge to process the document expeditiously as a high-priority action.

Again, let me thank the ARAC and, in particular, the JAR/FAR 27 and 29 Harmonization Working Group for its dedicated efforts in completing the task assigned by the FAA.

Sincerely,

Anthony J. Broderick
Associate Administrator for
Regulation and Certification

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 27 and 29

[Docket No. 28008; Amdt. 27–33, 29–40]

RIN 2120–AF65

Rotorcraft Regulatory Changes Based on European Joint Airworthiness Requirement; Correction

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule; correction.

SUMMARY: This document contains a correction to the final rule published in the Federal Register on May 10, 1996 (61 FR 21904). That final rule amended the airworthiness standards for normal and transport category rotorcraft under parts 27 and 29 of Title 14, Code of Federal Regulations (CFR) relating to performance systems, propulsion and airframes.

FOR FURTHER INFORMATION CONTACT: Carroll Wright, (817) 222–5120.

Need for Correction

In the final rule document (FR Doc. 96–11493) published in the Federal Register on May 10, 1996, (61 FR 21904), on page 21908, at the end of the first column, Item No. 14 is corrected to read as follows:

14. Section 29.1305 is amended by redesignating existing paragraphs (a)(6) through (a)(25) as paragraphs (a)(7) through (a)(26), by adding a new paragraph (a)(6), and by changing the words "paragraph (a)(13)" in the text of redesignated paragraph (a)(13) to read as "paragraph (a)(14)".

§ 29.1305 [Corrected]

(a) * * *

(6) An oil pressure indicator for each pressure-lubricated gearbox.

* * * * *

(13) A tachometer for each engine that, if combined with the applicable instrument required by paragraph (a)(14) of this section, indicates rotor r.p.m. during autorotation.

* * * * *

Issued in Washington, DC, on August 22, 1996.

Donald P. Byrne,

Assistant Chief Counsel for Regulations.

[FR Doc. 96–21653 Filed 8–26–96; 8:45 am]

BILLING CODE 4910–13–M

Recommendation

ENCLOSURE 1

[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 27 and 29

[Docket No. ; Notice No. 93-]

RIN: 2120-AC27

Rotorcraft Regulatory Changes Based on European Joint Aviation Requirements Proposals

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This notice proposes changes to the type certification requirements for both normal and transport category rotorcraft. The changes would revise airworthiness standards for performance, systems, propulsion, and airframes and would introduce safety improvements, clarify existing regulations, and standardize terminology. The changes are based on standards that have been adopted by the European Joint Aviation Authorities for Joint Aviation Requirements (JAR) 27 and 29. These proposed changes are intended to harmonize the Federal Aviation Regulations rotorcraft type certification requirements with the European JAR.

DATES: Comments must be received on or before [insert date 90 days after date of publication in the Federal Register].

ADDRESSES: Comments on this notice should be mailed in triplicate to: Federal Aviation Administration (FAA), Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. ; 800 Independence Avenue SW, Washington, DC 20591. Comments delivered must be marked Docket No. .

Comments may be examined in Room 915G weekdays between 9 a.m. and 5 p.m., except on Federal holidays.

FOR FURTHER INFORMATION CONTACT: Mr. Carroll Wright, Rotorcraft Directorate, Aircraft Certification Service, Regulations Group, ASW-111, FAA, Fort Worth, Texas 76193-0111, telephone number (817) 222-5120.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to submit written data, views, or arguments on this proposed rule. Comments relating to the environmental, energy, federalism, or economic impact that might result from adopting the proposals in this notice are also invited. Substantive comments should be accompanied by cost estimates. Comments should identify the regulatory docket number and be submitted in triplicate to the address specified under the caption "ADDRESSES." All comments received on or before the closing date for comments will be considered before taking action on this proposed rule. The proposals contained in this notice may be changed in light of the comments received. All comments received will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerned with this rulemaking will be filed in the docket. Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must include a preaddressed, stamped postcard on which the following statement is made: "Comments on Docket No. ." The postcard will be date stamped and mailed to the commenter.

Availability of NPRM's

Any person may obtain a copy of this NPRM by submitting a request to the FAA, Office of Public Affairs, Attention: Public Inquiry Center, APA-200, 800 Independence Avenue, SW, Washington, DC 20591, or by calling (202) 267-3484. Communications must identify the notice number of this NPRM.

Persons interested in being placed on a mailing list for future NPRM's should request from the above office a copy of Advisory Circular No. 11-2A, NPRM Distribution System, which describes the application procedure.

Background

At a meeting between FAA representatives and the European Airworthiness Authorities Steering Committee (AASC) in Washington, DC, in April 1983, the aviation manufacturing industry requested that the certification rules of Europe and the United States be standardized. The AASC agreed to provide the FAA with a comprehensive list of recommended changes for the regulations in part 29 of Title 14 of the Code of Federal Regulations (CFR). These changes would make part 29 acceptable to AASC members for adoption as airworthiness standards. The AASC subsequently established a Joint Aviation Requirements (JAR) 29 group to develop transport category rotorcraft airworthiness standards for the issuance of European type certificates. The JAR 29 group was tasked with providing a list of recommended changes for part 29. The FAA solicited comments on key issues. The initial responses to that solicitation were published in the Federal Register (49 FR 19309, May 7, 1984). On September 15, 1984, the AASC submitted a more comprehensive list of 92 suggested changes to part 29. An FAA review found that 34 of these proposals had either been incorporated, in whole or in part, in part 29 or were being considered in active rulemaking projects. Of the 58 proposals remaining, 25

were rejected for various reasons involving failure to meet Executive Order or Department of Transportation rulemaking requirements. The FAA provided the results of the review to the JAR 29 group including a summary of the status of the proposals being considered in active rulemaking projects.

During further review of the remaining AASC proposals not included in existing rulemaking projects, the FAA determined that several of the proposals warranted public discussion. Accordingly, the FAA held a public meeting in Fort Worth, Texas, May 1-2, 1986 (51 FR 4504, February 5, 1986). Over 50 persons attended the meeting, which remained in session until each proposal not already in rulemaking had been discussed. The FAA subsequently issued NPRM No. 89-10 (54 FR 17396; April 25, 1989), which addressed the AASC proposals and resulted in the issuance of Amendments 27-27 and 29-31 (55 FR 38964; September 21, 1990).

The AASC activities were absorbed by the Joint Aviation Authorities (JAA), and the JAA established the Helicopter Airworthiness Study Group (HASG) to formulate JAR 27 and 29 for use by the 19 JAA countries. The JAA invited the FAA and industry groups to participate in HASG meetings on March 20-21, 1990. Members of Association Europeenne des Constructeurs de Materiel Aerospatial (AECMA) represented the European manufacturers at the HASG Meetings, and AECMA invited members of the Aerospace Industries Association of America (AIA) to represent U.S. manufacturers. The HASG was chartered to formulate JAR 29, and subsequently JAR 27, to parallel as closely as possible part 29 as amended through Amendment 29-31 effective September 21, 1990, and part 27 as amended through Amendment 27-27 effective September 21, 1990. The JAR 29 includes FAA NPRM's 89-26 (54 FR 39086, September 22, 1989) which proposes a new 30 second/2 minute One Engine Inoperative power rating, 89-29

(54 FR 42716, October 17, 1989) which proposes rotorburst protection, 90-1 (55 FR 698, January 8, 1990) which proposes new performance requirements, and 90-24 (55 FR 41000, October 5, 1990) which proposes a Crash Resistant Fuel System; JAR 27 is to also include NPRM's 89-26 and 90-24.

Aviation Rulemaking Advisory Committee (ARAC) Considerations

By announcement in the Federal Register (57 FR 58846, December 11, 1992), the JAR-FAR 27 and 29 Harmonization Working Group was chartered by the ARAC. The working group included representatives from four major rotorcraft manufacturers (normal and transport) and representatives from AIA, AECMA, Helicopter Association International (HAI), JAA, and the FAA Rotorcraft Directorate. This broad participation is consistent with FAA policy to have all known interested parties involved as early as practicable in the rulemaking process.

The Harmonization Working Group was tasked with making recommendations to the ARAC concerning the FAA acceptance or rejection of JAA Notice of Proposed Amendments (NPA's) recently coordinated between the JAA and the FAA. The ARAC subsequently recommended that the FAA revise the certification standards for normal and transport category rotorcraft as now contained in JAR 27 and 29.

FAA Evaluations of ARAC and JAA Proposals

The FAA has evaluated the ARAC recommendations and proposes changes to the rotorcraft certification rules in both parts 27 and 29. These proposed changes have evolved from the FAA-JAA industry meetings of 1990-1992 and the ARAC recommendations of 1993. These proposed changes would (1) incorporate current design and testing practices into the rules by requiring additional performance data, additional powerplant and rotor brake controls, and bird-

strike protection, and (2) harmonize the certification requirements between the FAR and JAR. The proposals for part 27 include JAA's harmonized NPA's 27-basic and 27-1; and the proposals for part 29 include NPA's 29-basic and 29-1 through 29-5. All sections of the harmonized NPA's are included in these proposals except for § 27.602 of NPA 27-basic and § 29.602 of NPA 29-4. Those JAR sections include a critical parts plan that would control the design, substantiation, manufacture, maintenance, and modification of critical parts. While the JAA prescribes manufacturing and maintenance requirements in JAR 29, the FAA does not do the same in part 29. Part 21 of Title 14 addresses manufacturing requirements; part 43 of Title 14 prescribes maintenance requirements. Part 29 contains the airworthiness requirements for rotorcraft certification; part 29 addresses maintenance standards only to the extent that it mandates that the type certificate holder prepare Instructions for Continued Airworthiness, which includes the maintenance manual or section and maintenance instructions, and the Airworthiness Limitations section. Accordingly, the FAA may propose critical parts requirements in a separate rulemaking, which may also propose changes to parts 21 and 43.

General Discussion of the Proposals

These proposals would introduce safety improvements, clarify existing regulations, and standardize terminology with the JAR's by revising the airworthiness standards for rotorcraft performance, systems, propulsion, and airframes. These proposed changes are based on requirements that have been adopted by JAA for JAR 27 and 29. The part 27 proposals would require all-engines-operating (AEO) climb performance data, powerplant controls to maintain any set position, and rotor brake control standards. The proposals would also provide an option for the certification of part 27 rotorcraft to

Category A; i.e., one engine inoperative (OEI) requirements. The part 29 proposals would provide standards for electrical bonding of airframe components to protect against lightning and precipitation static discharge, a design assessment of rotors and drive train, and bird-strike protection. Additional powerplant instruments are proposed. The part 29 proposals would also clarify performance requirements for Category A, flutter and divergence applicability, and emergency electrical power supply requirements.

Discussion of Specific Proposals

Section 27.1 Applicability

Proposed new § 27.1(c) would provide an optional basis for normal category multiengine rotorcraft to be certificated to Category A requirements by meeting those design and performance requirements of part 29 as specified in a new appendix C to part 27.

Section 27.65 Climb: all engines operating.

This proposed revision of § 27.65(b)(2) would require a determination of AEO climb performance for all rotorcraft. Currently rotorcraft AEO climb performance is required only for ambient conditions where the never-exceed speed (V_{ne}) is less than the speed for the best rate of climb (V_y). Climb performance information is necessary for operational planning for rotorcraft, e.g., planning for obstacle clearance. Manufacturers have historically provided this information even though it is not required by the existing regulations. This change would incorporate that current practice as a requirement in the FAR.

Section 27.1141 Powerplant controls: general

This proposed new § 27.1141(d) would add to part 27 the requirement of FAR § 29.1141(d) that powerplant controls must maintain any set position. The

proposed requirement states that each control "must be able to maintain any set position without constant attention or tendency to creep due to control loads or vibration." "Must be able to," in this regard, would require that the rotorcraft have identifiable design features that keep the controls from moving. This requirement would improve safety by reducing pilot work load for part 27 rotorcraft. Because most rotorcraft manufacturers already comply voluntarily with this standard, this should require no significant design or manufacturing effort.

Section 27.1151 Rotor brake controls

This proposed new section would add to part 27 the requirements of FAR § 29.1151 on rotor brake controls. These proposed requirements are necessary for the safe operation of any rotorcraft equipped with a rotor brake. Requirements to prevent inadvertent application of rotor brakes in flight are necessary to prevent possible damage or fire due to rotor brake application. Current rotorcraft rotor brake installations normally incorporate these design features; no significant design or manufacturing effort should be necessary.

Appendix C to part 27

This proposed new appendix would provide a list of part 29 Category A standards that are directly related to the continued safe powered flight capability of a multiengine rotorcraft in the event of engine or other system failure. The proposed standards would be required to be met for an optional Category A approval for a part 27 rotorcraft.

Section 29.547 Main and tail rotor structures

Proposed new § 29.547(b) would require a design assessment that identifies the critical components of the main and tail rotor structures. The design assessment must also identify the means (such as scheduled inspection,

removal, and replacement of components) that minimize the likelihood of failure for each critical component.

Section 29.610 Lightning and static electricity protection

The word "structure" would be added to current § 29.610 (a) to clarify that these requirements address the rotorcraft structure and not equipment, systems, and installations that are adequately covered under the requirements of § 29.1309. The proposed addition of the word "structure" to paragraph (a) is intended to clarify that the metallic components and nonmetallic components of paragraphs (b) and (c) are structural components. Proposed new paragraph (d) would require electrical bonding of the rotorcraft components for protection against hazardous effects from lightning and discharge of static electricity. In this regard, the reference to the bonding and protection "be[ing] such as to" would require that the rotorcraft have identifiable design features that achieve the standards required in paragraphs (d)(1) through (4). Part 29 does not currently provide electrical bonding requirements, and experience has shown that inadequate bonding can result in hazardous conditions due to discharge of static electricity. The proposed new paragraph (d)(4) would require electrical bonding and protection against lightning and static electricity that would reduce the effects on the functioning of essential electrical and electronic equipment to an acceptable level (as determined by §§ 29.1309 and 29.1431).

Section 29.629 Flutter and divergence

This proposed revision of § 29.629 would add the words "and divergence" to the title and text of the section. This proposal would extend the requirements to cover aeroelastic instability other than flutter of aerodynamic surfaces. This proposal would require the use of rational

analysis, tests, or a combination of analysis and tests to demonstrate freedom from aeroelastic instability for the basic design. Most manufacturers currently do this type of analysis or test; this change would require formal documentation and approval of that analysis or test.

Section 29.631 Bird strike

This proposed new section would require bird-strike protection for transport rotorcraft. Rotorcraft, as well as airplanes, are exposed to the possibility of collision with a bird. With the potential for higher speeds by modern transport rotorcraft designs and the changes in material technology, the possibility of increased damage from bird strikes exists. In addition, the effects of bird strikes on new materials used in rotorcraft must be evaluated. The FAA has determined that a requirement for protection against catastrophic effects from impact with a 2.2 pound (1 kilogram) bird is reasonable for rotorcraft certificated in the transport category (part 29). A 2.2 pound bird represents the typical size for intended structural capability; therefore, such protection is being proposed. Proposed § 29.631 would require that the rotorcraft be designed to assure capability of continued safe flight and landing (for Category A) or safe landing (for Category B) after bird strike. In this regard, "capability" means that the design has features that assure continued safe flight and/or landing, as would be required. Proposed § 29.631 would also require that substantiation of the design be based on tests or analysis of tests carried out on sufficiently representative structures of design similar to that of the design to be approved. In this regard, "sufficiently" means that the structures at least represent the design to be approved.

Section 29.917 Design

A new § 29.917(b) is proposed for this section, and redesignation of existing paragraph (b) as (c) is proposed. This proposed new § 29.917(b) would require a design assessment that identifies critical components of the rotor drive system. The design assessment would also identify the means that minimize the likelihood of failure for each critical component (such as scheduled inspection, removal, and replacement of components). This proposed section is a companion to the rotor structure proposal of § 29.547.

Section 29.923 Rotor drive system and control mechanism tests

This proposed revision to § 29.923(b)(3)(i) would increase the testing for 2 minute OEI power from one to two runs per cycle. The JAA are concerned that a possible inconsistency exists in the current rule. Using one run per cycle, a higher and potentially more damaging power rating could be substantiated by less testing at the 2-minute OEI power than at the 2 1/2 minute OEI power. The FAA agrees and increased testing for 2 minute OEI power is proposed.

Section 29.1305 Powerplant instruments

The current rule requires an oil pressure warning device, which could be a simple light, for each pressure-lubricated gearbox. Proposed new § 29.1305(a)(6) would add a requirement for an oil pressure indicator for each pressure-lubricated gearbox. This change would provide the crew with an early warning of oil pressure problems and confirm that the oil pressure warning is valid. The proposed addition of a new § 29.1305(a)(6) would necessitate renumbering of existing paragraphs (a)(6) through (a)(23) as (a)(7) through (a)(24) and paragraphs (a)(24) and (a)(25).

Section 29.1309 Systems, equipment, and installations

Section 29.610 was referenced in § 29.1309(h) to require protection against a catastrophic systems failure due to lightning. Since § 29.1309(h) applies to lightning protection of systems and equipment, it is unnecessary to reference § 29.610, which applies to lightning protection of structures. Therefore, this proposed change would delete the reference to § 29.610 in § 29.1309(h).

Section 29.1351 General

The proposed changes to §§ 29.1351(d) and 29.1351(d)(1) would clarify that the regulation applies to the normal electrical power generating system and would editorially change the § 29.1351(d) heading. The § 29.1351(d) heading would change from, "Operation without normal electrical power" to "Operation with the normal electrical power generating system inoperative," and "generating system" would be added after electrical power in § 29.1351(d)(1).

The proposed additions to § 29.1351(d)(2) would provide requirements for the emergency electrical power system for Category A rotorcraft. Section 29.1351(d)(2) is entitled "Category A Aircraft." The proposed new § 29.1351(d)(2)(i) would require that emergency electrical power be provided to those systems necessary for continued safe flight and landing for rotorcraft certificated to Category A requirements. Consideration of the possible duration of flight time to reach a suitable landing site and make a safe landing would be required. A minimum of 30 minutes flight time is necessary for continued safe flight and landing for Category A rotorcraft. Proposed new § 29.1351(d)(2)(ii) would require that loss of both normal and emergency electrical power systems be shown to be extremely improbable. This

will ensure that no single failure (such as effects of fire or loss of junction box) will result in the disabling of both the normal and emergency electrical power systems. Finally, a new § 29.1351(d)(2)(iii) would require that the emergency electrical power system include independent, automatic features for electrical load shedding to conserve the emergency electrical power (batteries) after loss of the normal electrical power generating system. The intent is to allow the flight crew time to take corrective actions for engine fire, cockpit fire, or other in-flight emergencies common to situations resulting in loss of the normal electrical power generating system without being distracted by a need to manually switch off or shed electrical power. In this regard, "immediate" refers to those systems that, if they did not continue to operate, would necessitate the attention of the flight crew.

Section 29.1587 Performance information

Proposed new § 29.1587(a)(6) would require that the climb gradient information necessary for the pilot to determine the allowable maximum takeoff weight to clear any obstacle in the takeoff path be added to the Rotorcraft Flight Manual for Category A rotorcraft. Because the data are already available from the other requirements, the only additional requirement would be to incorporate this data into the Rotorcraft Flight Manual.

Appendix B to Part 29 Airworthiness Criteria for Helicopter Instrument Flight

The proposed addition of a section VIII(b)(6) to Appendix B would provide a reference to new § 29.1351(d)(2) to clarify that requirements for operation with the normal electrical power generating system inoperative apply to Instrument Flight Rules (IFR) certificated rotorcraft. When the emergency electrical power source provided for an IFR certificated rotorcraft is time limited; e.g., a battery, the required duration will depend on the type and

role of the rotorcraft. However, an endurance of less than 30 minutes would not be acceptable.

Regulatory Evaluation Summary

Introduction

Proposed changes to federal regulations must undergo several economic analyses. First, Executive Order 12866 directs Federal agencies to promulgate new regulations or modify existing regulations only if the potential benefits to society outweigh the potential costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Finally, the Office of Management and Budget has directed agencies to assess the effects of regulatory changes on international trade. In conducting these analyses, the FAA has determined that this proposed rule (1) would generate benefits exceeding its costs and is neither a significant regulatory action as defined in the Executive Order nor significant as defined in DOT's Policies and Procedures, (2) would not have a significant impact on a substantial number of small entities, and (3) would lessen restraints on international trade. These analyses, available in the docket, are summarized below.

Costs and Benefits

All of the proposed changes to part 27 and all but four of the proposed changes to part 29 would impose no or insignificant costs on rotorcraft manufacturers because they reflect current design practices. In recent years, manufacturers have incorporated engineering and structural improvements into rotorcraft designs that exceed the minimum regulatory requirements with the aim of increasing operating efficiencies, payload capabilities, and marketability in world markets. Most new rotorcraft designs are based on

existing designs. Many of these improvements have also improved safety. Codification of these improvements and other proposed changes would ensure that these features are incorporated in all future rotorcraft designs.

Additionally, adoption of the proposed changes would increase harmonization and commonality between U.S. and European airworthiness standards. Harmonization would eliminate differences between airworthiness requirements, thus reducing manufacturers' costs for dual certification. Based on experience in a recent certification, one rotorcraft manufacturer indicated that complying with different FAA/JAA requirements resulted in several hundred thousand dollars in excessive certification costs. Aside from the benefits of enhanced safety levels as described above, the benefits of certification cost savings would, by themselves, outweigh the relatively modest increase in certification costs that the amendments would impose.

Following is a brief summary of the four proposed changes to part 29 that would impose additional costs totalling approximately $150,000 per type certification. The safety benefits of these proposed changes are expected to easily exceed the incremental costs.

Section 29.547 - Main and tail rotor structure. While manufacturers currently perform the proposed design assessment as an integral part of the design requirements of § 29.917, there would be some incremental costs to formalize the existing information. These costs are included in the cost estimates of proposed § 29.917 summarized below. Formal identification and assessment of critical component failures would increase safety by providing more comprehensive maintenance information to operators. The benefits of averting a single catastrophic accident would exceed the relatively low incremental costs of compliance.

Section 29.631 - Bird strike. Manufacturers indicate that present rotorcraft structures can withstand impacts from a 2.2 pound bird; therefore, no incremental manufacturing costs are anticipated to implement new designs. Nonrecurring testing and analysis costs of the proposed requirement are estimated to be $100,000 per type certification. A review of National Transportation Safety Board (NTSB) data for the period 1983-1991 reveals two rotorcraft accidents caused by bird strikes. One accident resulted in one serious injury, one minor injury, and substantial damage to the rotorcraft (tail rotor separation); in the other accident the rotorcraft was destroyed but there were no injuries. There is at least an equal probability of such accidents and the resultant damage in the future, given the tendencies towards higher operating speeds and use of composite materials. The benefits of averting a single catastrophic accident would exceed the incremental costs.

Section 29.917 - Design. The incremental costs to formalize existing design information for the rotor structure (proposed § 29.547 above) and drive system are estimated to total $44,000 per type certification. Formal assessment and identification of critical components of the rotor drive system would increase safety by providing more comprehensive maintenance information to operators. The benefits of averting a single catastrophic accident caused directly or indirectly by a lack of relevant data would easily exceed the incremental costs of providing that data.

Section 29.1587 - Performance information. Because the required climb gradient data would already be available from the results of flight tests required to obtain performance information, the only additional costs would be those associated with incorporating the data into the Rotorcraft Flight Manual, estimated to total $5,500 per certification. Although NTSB accident

records do not include any accidents directly attributable to lack of performance data, there were a few accidents in which such data were ignored or misinterpreted. The availability and accuracy of such data would enhance operational safety. The benefits of averting a single catastrophic accident caused directly or indirectly by a lack of relevant performance information would easily exceed the incremental costs of providing that data.

International Trade Impact Analysis

The proposed rule would not constitute a barrier to international trade, including the export of American rotorcraft to foreign countries and the import of foreign rotorcraft into the United States. Instead, the proposed changes on rotorcraft certification procedures, harmonized with those of the JAA, would lower dual certification costs, thereby enhancing free trade.

Regulatory Flexibility Determination

The Regulatory Flexibility Act (RFA) of 1980 was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires a Regulatory Flexibility Analysis if a rule would have a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. Based on the criteria of FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, the FAA has determined that the proposed rule would not have a significant economic impact on a substantial number of small entities.

Conclusion

For the reasons discussed above, including the findings in the Regulatory Flexibility Determination and the International Trade Impact Analysis, the Office of Information and Regulatory Affairs (OIRA) in conjunction with the FAA has determined that this proposed regulation is not a

significant regulatory action under Executive Order 12866 and, therefore, was not subject to centralized regulatory review by the OIRA. In addition, the FAA certifies that this regulation will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. This proposal is considered to be nonsignificant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). An initial regulatory evaluation of the proposal, including a Regulatory Flexibility Determination and Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under "FOR FURTHER INFORMATION CONTACT."

List of Subjects

14 CFR Parts 27 and 29

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

THE PROPOSED AMENDMENTS

Accordingly, the FAA proposes to amend parts 27 and 29 of the Federal Aviation Regulations (14 CFR parts 27 and 29) as follows:

PART 27--AIRWORTHINESS STANDARDS: NORMAL CATEGORY ROTORCRAFT

1. 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, and 1430; 49 U.S.C.106(g).

2. Section 27.1 is amended by adding a new paragraph (c) to read as follows:

§ 27.1 Applicability.

* * * * *

(c) Multiengine rotorcraft may be type certificated as Category A provided the requirements of appendix C of this part are met.

3. Section 27.65 is amended by revising paragraph (b)(2) and (b)(2)(ii) to read as follows:

§ 27.65 Climb: all engines operating.

* * * * *

(b) * * *

(2) The steady rate of climb must be determined -

(ii) Within the range from sea level up to the maximum altitude for which certification is requested;

* * * * *

4. Section 27.1141 is amended by redesignating existing paragraphs (c) and (d) as paragraphs (d) and (e) and by adding a new paragraph (c) to read as follows:

§ 27.1141 Powerplant controls: general.

* * * * *

(c) Each control must be able to maintain any set position without -

(1) Constant attention; or

(2) Tendency to creep due to control loads or vibration.

* * * * *

5. Section 27.1151 is added to read as follows:

§ 27.1151 Rotor brake controls.

(a) It must be impossible to apply the rotor brake inadvertently in flight.

(b) There must be means to warn the crew if the rotor brake has not been completely released before takeoff.

6. Part 27 is amended by adding a new appendix C to read as follows:

APPENDIX C TO PART 27--CRITERIA FOR CATEGORY A

C27.1 General.

A small multiengine rotorcraft may not be type certificated for Category A operation unless it meets the design installation and performance requirements contained in this appendix in addition to the requirements of this part.

C27.2 Applicable part 29 sections.

The following sections of part 29 of this chapter must be met in addition to the requirements of this part:

29.45(a) and (b)(2) - General.
29.49(a) - Performance at minimum operating speed.
29.51 - Takeoff data: General.
29.53 - Takeoff: Category A.
29.55 - Takeoff decision point: Category A.
29.59 - Takeoff path: Category A.
29.60 - Elevated heliport takeoff path: Category A.
29.61 - Takeoff distance: Category A.
29.62 - Rejected takeoff: Category A.
29.64 - Climb: General.
29.65(a) - Climb: AEO.
29.67(a) - Climb: OEI.
29.75 - Landing: General.
29.77 - Landing decision point: Category A.
29.79 - Landing; Category A.
29.81 - Landing distance (Ground level sites): Category A.
29.85 - Balked landing: Category A.
29.87(a) - Height-velocity envelope.
29.547(a) and (b) - Main and tail rotor structure.
29.571 - Fatigue evaluation of structure. AC Material only: AC 29-2A Item 230 Paragraph 10.
29.861(a) - Fire protection of structure, controls, and other parts.
29.901(c) - Powerplant: Installation.
29.903(b)(c) and (e) - Engines.
29.908(a) - Cooling fans.
29.917(b) and (c)(1) - Rotor drive system: Design.
29.927(c)(1) - Additional tests.
29.953(a) - Fuel system independence.
29.1027(a)-Transmission and gearboxes: General.
29.1045(a)(1),(b),(c),(d), and (f) - Climb cooling test procedures.
29.1047(a) - Takeoff cooling test procedures.
29.1181(a) - Designated fire zones: Regions included.
29.1187(e) - Drainage and ventilation of fire zones.
29.1189(c) - Shutoff means.
29.1191(a)(1) - Firewalls.
29.1193(e) - Cowling and engine compartment covering.
29.1195(a) and (d) - Fire extinguishing systems (one shot).
29.1197 - Fire extinguishing agents.
29.1199 - Extinguishing agent containers.
29.1201 - Fire extinguishing system materials.
29.1305(a)(6) and (b) - Powerplant instruments.
29.1309(b)(2)(i) and (d) - Equipment, systems, and installations.
29.1323(c)(1) - Airspeed indicating system.
29.1331(b) - Instruments using a power supply.
29.1351(d)(2) - Electrical systems and equipment: General (operation without normal electrical power).
29.1587(a) - Performance information.

3. In complying with the paragraphs listed in paragraph 2 above, relevant material in AC 29-2A should be used.

PART 29--AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT

7. 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, and 1430; 49 U.S.C. 106(g).

8. Section 29.547 is amended by changing the title; revising paragraph (a); adding a new paragraph (b); deleting the word "main" in the introductory text of paragraphs (c), (d), and (e); and revising paragraph (e)(1)(ii) to read as follows:

§ 29.547 Main and tail rotor structure.

(a) A rotor is an assembly of rotating components, which includes the rotor hub, blades, blade dampers, the pitch control mechanisms, and all other parts that rotate with the assembly.

(b) Each rotor assembly must be designed as prescribed in this section and must function safely for the critical flight load and operating conditions. A design assessment must be performed, including a detailed failure analysis to identify all failures that will prevent continued safe flight or safe landing, and must identify the means to minimize the likelihood of their occurrence.

(c) The rotor structure * * *

* * * * *

(d) The rotor structure * * *

* * * * *

(e) The rotor structure * * *

(1) * * *

(ii) For the main rotor, the limit engine torque * * *

* * * * *

9. In § 29.610 the title is changed; the word "structure" is added between the words "rotorcraft" and "must" in paragraph (a); and a new paragraph (d) is added to read as follows:

§ 29.610 Lightning and static electricity protection.

(a) The rotorcraft structure must * * *

* * * * *

(d) The electrical bonding and protection against lightning and static electricity must be such as to ---

(1) Minimize the accumulation of electrostatic charge;

(2) Minimize the risk of electrical shock to crew, passengers, and service and maintenance personnel using normal precautions;

(3) Provide an electrical return path, under both normal and fault conditions, on rotorcraft having grounded electrical systems; and

(4) Reduce to an acceptable level the effects of lightning and static electricity on the functioning of essential electrical and electronic equipment.

10. Section 29.629 is revised to read as follows:

§ 29.629 Flutter and divergence

Each aerodynamic surface of the rotorcraft must be free from flutter and divergence under each appropriate speed and power condition.

11. A new § 29.631 is added to read as follows:

§ 29.631 Bird Strike.

The rotorcraft must be designed to assure capability of continued safe flight and landing (for Category A) or safe landing (for Category B) after impact with a 2.2 lb (1.0 kg) bird when the velocity of the rotorcraft (relative to the bird along the flight path of the rotorcraft) is equal to V_{NE}

or V_H (whichever is the lesser) at altitudes up to 8,000 feet. Compliance must be shown by tests or by analysis based on tests carried out on sufficiently representative structures of similar design.

12. Section 29.917 is amended by redesignating existing paragraph (b) as (c) and adding a new paragraph (b) to read as follows:

§ 29.917 Design.

* * * * *

(b) Design assessment. A design assessment must be performed to ensure that the rotor drive system functions safely over the full range of conditions for which certification is sought. The design assessment must include a detailed failure analysis to identify all failures that will prevent continued safe flight or safe landing and must identify the means to minimize the likelihood of their occurrence.

* * * * *

13. Section 29.923 is amended by revising paragraph (b)(3)(i) to read as follows:

§ 29.923 Rotor drive system and control mechanism tests.

* * * * *

(b) * * *

(3) * * *

(i) Immediately following any one 5-minute power-on run required by paragraph (b)(1) of this section, simulate a failure for each power source in turn, and apply the maximum torque and the maximum speed for use with 30-second OEI power to the remaining affected drive system power inputs for not less than 30 seconds. Each application of 30-second OEI power must be followed by two applications of the maximum torque and the maximum speed for

use with the 2 minute OEI power for not less than 2 minutes each; the second application must follow a period at stabilized continuous or 30 minute OEI power (whichever is requested by the applicant). At least one run sequence must be conducted from a simulated "flight idle" condition.

* * * * *

14. Section 29.1305 is amended by redesignating existing paragraphs (a)(6) through (a)(25) as paragraphs (a)(7) through (a)(26) and adding a new paragraph (a)(6) to read as follows:

§ 29.1305 Powerplant instruments

* * * * *

(a) * * *

(6) An oil pressure indicator for each pressure-lubricated gearbox.

* * * * *

15. Section 29.1309 is amended by revising paragraph (h) to read as follows:

§ 29.1309 Equipment, systems, and installations.

* * * * *

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

16. Section 29.1351 is amended by revising the title of paragraph (d), redesignating the introductory text of paragraph (d) as (d)(1) and adding the words "generating system" in new (d)(1), redesignating paragraphs (d)(1), (d)(2), and (d)(3) as (d)(1)(i), (d)(1)(ii), and (d)(1)(iii), and adding a new paragraph (d)(2) to read as follows:

§ 29.1351 General

* * * * *

(d) Operation with the normal electrical power generating system inoperative.

(1) * * * for a period of not less than 5 minutes, with the normal electrical power generating system (electrical power sources excluding the battery) inoperative, * * *

(2) Additional requirements for Category A Rotorcraft.

(i) Unless it can be shown that the loss of the normal electrical power generating system is extremely improbable, an emergency electrical power system, independent of the normal electrical power generating system, must be provided, with sufficient capacity to power all systems necessary for continued safe flight and landing.

(ii) Failures, including junction box, control panel, or wire bundle fires, which would result in the loss of the normal and emergency systems, must be shown to be extremely improbable.

(iii) Systems necessary for immediate safety must continue to operate following the loss of the normal electrical power generating system, without the need for flight crew action.

17. Section 29.1587 is amended by adding a new paragraph (a)(6), removing "and" from end of paragraph (a)(4), and adding "and" to end of paragraph (a)(5).

§ 29.1587 Performance Information

* * * * *

(a) * * *

(5) * * * ; and

(6) The steady gradient of climb for each weight, altitude, and temperature for which takeoff data are to be scheduled, along the takeoff path determined in the flight conditions required in § 29.67(a)(1) and (a)(2):

(i) In the flight conditions required in § 29.67(a)(1) between the end of the takeoff distance and the point at which the rotorcraft is 200 feet above the takeoff surface (or 200 feet above the lowest point of the takeoff profile for elevated heliports).

(ii) In the flight conditions required in § 29.67(a)(2) between the points at which the rotorcraft is 200 and 1000 feet above the takeoff surface (or 200 and 1000 feet above the lowest point of the takeoff profile for elevated heliports).

* * * * *

18. Part 29 Appendix B is amended by adding a new paragraph VIII (b)(6).

APPENDIX B TO PART 29--AIRWORTHINESS CRITERIA FOR HELICOPTER INSTRUMENT FLIGHT

* * * * *

VIII * * *

(b) * * *

(6) In determining compliance with the requirements of § 29.1351(d)(2), the supply of electrical power to all systems necessary for flight under IFR must be included in the evaluation.

Issued in Washington, DC, on

U.S. Department
of Transportation

**FEDERAL AVIATION
ADMINISTRATION**

Washington, D.C. 20591

PRELIMINARY REGULATORY EVALUATION, INITIAL REGULATORY FLEXIBILITY DETERMINATION, AND TRADE IMPACT ASSESSMENT

FOR

NOTICE OF PROPOSED RULEMAKING:

ROTORCRAFT REGULATORY CHANGES BASED ON EUROPEAN JOINT AIRWORTHINESS REQUIREMENTS PROPOSALS

OFFICE OF AVIATION POLICY, PLANS, AND MANAGEMENT ANALYSIS
AIRCRAFT REGULATORY ANALYSIS BRANCH, APO-320
Arnold J. Hoffman
May 1993
(revised June 1994)

TABLE OF CONTENTS

Executive Summary

This regulatory evaluation examines the impacts of several proposed changes to parts 27 and 29 of the Federal Aviation Regulations (FAR's). Part 27 prescribes airworthiness standards for type certification of normal category rotorcraft (maximum weight of 6,000 pounds) and part 29 prescribes corresponding standards for transport category rotorcraft. The changes would revise the airworthiness standards for performance, systems, propulsion, and airframes by introducing safety improvements, clarifying existing regulations, and standardizing terminology. The amendments are based on changes that are being proposed by the European Joint Airworthiness Authorities (JAA) for incorporation into Joint Aviation Requirements (JAR) parts 27 and 29, and are intended to promote harmonization between FAA and JAA regulations. Harmonization would eliminate unnecessary duplication of airworthiness requirements, thus reducing manufacturers' certification costs.

All of the proposed changes to part 27 and most of those to part 29 would impose no or negligible costs on rotorcraft manufacturers since they largely reflect current design practices. However, four of the proposed changes to part 29 would impose incremental costs totalling approximately $150,000. These changes relate to: (1) identification and failure-assessment of critical components in the main and tail rotor structure; (2) bird strike protection; (3) identification of critical components of the rotor drive system; and (4) inclusion of performance information in the Flight Manual. The safety benefits of these four provisions are expected to easily exceed the incremental costs.

The proposed rule would not have a significant economic impact on small entities. In addition, it would not constitute a barrier to international trade, including the export of American rotorcraft to foreign countries and the import of foreign rotorcraft into the United States. Instead, the proposed changes in rotorcraft certification procedures, harmonized with those of the JAA, would lessen restraints on trade.

I. Introduction

This regulatory evaluation examines the impacts of several proposed changes to parts 27 and 29 of the Federal Aviation Regulations (FAR's). Part 27 prescribes airworthiness standards for type certification of normal category rotorcraft (maximum weight of 6,000 pounds) and part 29 prescribes corresponding standards for transport category rotorcraft. The changes would revise the airworthiness standards for performance, systems, propulsion, and airframes by introducing safety improvements, clarifying existing regulations, and standardizing terminology. The amendments are based on changes that are being proposed by the European Joint Airworthiness Authorities (JAA) for incorporation into Joint Aviation Requirements (JAR) parts 27 and 29, and are intended to promote harmonization between FAA and JAA regulations.

II. Costs and Benefits

Most of the proposed changes would impose no or negligible costs on rotorcraft manufacturers since they largely reflect current design practices. In recent years, manufacturers have incorporated engineering/structural improvements into rotorcraft designs exceeding minimum FAR requirements with the aim of increasing operating efficiencies, payload capabilities, and marketability in world markets. Many of these improvements have also inherently improved safety. Codification of these improvements and other proposed changes would ensure continuation of enhanced safety levels in future rotorcraft designs.

Four of the proposed changes to part 29 would impose incremental costs totalling approximately $150,000. These changes relate to: (1) identification

and failure-assessment of critical components in the main and tail rotor structure; (2) bird strike protection; (3) identification of critical components of the rotor drive system; and (4) inclusion of performance information in the Flight Manual. The safety benefits of these four provisions are expected to easily exceed the incremental costs.

Additionally, adoption of the proposed changes would increase harmonization and commonality between American and European airworthiness standards. Harmonization would eliminate unnecessary duplication of airworthiness requirements, thus reducing manufacturers' certification costs. Based on experience in a recent certification, one rotorcraft manufacturer indicated that complying with different FAA/JAA requirements resulted in several hundred thousand dollars of excessive certification costs. Aside from the benefits of sustained safety levels as described above, the benefits of certification cost-savings would, by themselves, outweigh the relatively modest increase in certification costs that the amendments would impose.

Following is a brief description of the proposed changes and FAA's estimates of their costs and benefits.

A. Part 27

1. Section 27.1 - Applicability

This section would be amended to permit type certification of normal multiengine rotorcraft as Category A (rotorcraft with guaranteed stay-up

capability) when such rotorcraft are constructed with the engine and system isolation requirements of part 29. A new Appendix C to part 27 would require that manufacturers provide a list of part 29 Category A standards related to stay-up capability of the rotorcraft in the event of engine or system failure, which must be addressed for a Category A option approval. This amendment would be cost-beneficial by its very nature since manufacturers would elect to seek certification to more stringent standards only if they perceive it in their interests to do so.

2. Section 27.65 - Climb, all engines operating

The proposed change to this section would require determination of all engine operating climb performance for all rotorcraft. Currently, climb performance is only required for certain conditions (for details see preamble of the NPRM). Since manufacturers have provided this information even though not required by existing regulations, the change would merely codify current practices and would impose no incremental costs. The proposed change would ensure that manufacturers continue providing the data in future type certifications. Benefits would be reduced risks of accidents attributable to insufficient climb performance data.

3. Section 27.1141 - Powerplant controls, general

The proposed change to this section would add the requirement that powerplant controls be able to maintain any set position without constant attention and without the tendency to creep due to control loads or vibration. Since this

change reflects current design practice, it would impose no incremental costs. The change would ensure that powerplant controls in future rotorcraft designs include this safety feature. Benefits would be reduced risks of accidents caused by failure of the powerplant controls to maintain a set position.

4. Section 27.1151 - Rotor brake controls

This proposed new section would mandate controls which would prevent inadvertent application of the rotor brake. Since this change reflects current practice, it would impose no incremental costs. Further, it would ensure that future rotorcraft designs include this safety feature. Benefits would be reduced risks of accidents caused by inadvertent application of the rotor brake.

B. Part 29

1. Section 29.547 - Main and tail rotor structure

The proposed change to this section would require (1) identification of critical components of the major tail and rotor structure, and (2) a design assessment that specifies all critical component failures that would prevent continued safe flight or safe landing and that identifies means to minimize the likelihood of such failures occurring. Currently, manufacturers perform such an assessment, which is integral to the design requirements of

§ 29.917. There are, however, some incremental costs to formalize the existing information. These costs are included in the cost estimates of proposed § 29.917 discussed later in this evaluation.

Formal identification and failure-assessment of critical components would increase safety by providing more comprehensive maintenance information to operators. The benefits of averting a single aligned accident would exceed the relatively low incremental costs of compliance.

2. Section 29.610 - Lightning and static electricity protection

The word "structure" would be added to this section to clarify that the requirements apply to the rotorcraft structure and not to other systems that are adequately covered under the requirements of § 29.1309. Additionally, precipitation static electricity requirements would be introduced covering design aspects for electrical bonding of the rotorcraft structure. These requirements would impose no incremental costs since manufacturers currently include structural lightning protection in their designs. The proposed change would ensure that future rotorcraft designs include appropriate lightning protection. Benefits would be reduced risks of accidents caused by insufficient lightning protection.

3. Section 29.629 - Flutter and divergence

The proposed changes to this section would add the word "divergence" and extend the requirements to cover aeroelastic instability other than flutter of

aerodynamic surfaces (flutter is unwanted oscillation set up by natural forces; divergence occurs when damping capacity is exceeded, the oscillation intensifies, and the resulting stress causes the structure to fail). The use of rational analysis and/or tests to demonstrate freedom from aeroelastic instability in the basic design would be required. Manufacturers currently conduct this type of test or analysis; any additional documentation would impose negligible incremental costs. The proposed changes would ensure that manufacturers continue conducting these tests and/or analyses. Benefits would be reduced risks of accidents attributable to aeroelastic instability.

4. Section 29.631 - Bird Strike

This proposed new section would require that the rotorcraft be designed to ensure capability of continued safe flight and landing (for Category A) or safe landing (for Category B) after impact with a 2.2 pound bird. The risks of damaging bird strikes have increased with the higher speeds of modern transport rotorcraft and changes in material technology (e.g., composites). Manufacturers indicate that present rotorcraft structures can withstand impacts from a 2.2 pound bird; therefore, no incremental manufacturing costs are anticipated. Nonrecurring testing and analysis costs of the proposed requirement are estimated to be $100,000 per type certification.

A review of National Transportation Safety Board (NTSB) data for the period 1983-1991 reveals two rotorcraft accidents caused by bird strikes. One accident resulted in one serious injury, one minor injury, and substantial damage to the rotorcraft (tail rotor separation), and in the other accident

the rotorcraft was destroyed but there were no injuries. There is at least an equal probability of such accidents in the future, given the tendencies towards higher operating speeds and use of composite materials. The benefits of averting a single accident would exceed the incremental costs.

5. Section 29.917 - Design

The proposed change to this section would require a design assessment that identifies critical components of the drive system and means available to minimize the likelihood of failures. This proposal is a companion to the rotor structure proposal of § 29.547. The incremental costs to formalize the existing information for the rotor structure and drive system are estimated to total $44,000 per type certification.

Formal assessment and identification of critical components of the rotor drive system would increase safety by providing more comprehensive maintenance information to operators. The benefits of averting a single accident caused directly or indirectly by a lack of relevant data would easily exceed the incremental costs.

6. Section 29.923 - Rotor drive system endurance test

The proposed change to this section would apply to multiengine turbine-powered rotorcraft for which use of a 30 second, 2 minute one engine inoperative (OEI) power rating is requested. The new standard would increase the required testing for 2 minute OEI power from one run per cycle [as would be mandated by

a pending rulemaking] to two runs per cycle. The purpose of the change is to negate an inconsistency in the current rule [pending] in that a higher and potentially more damaging power rating would be substantiated by less testing at 2 minute OEI power than at the 2 1/2 minute OEI power. Incremental testing costs would be insignificant and offset by the benefits of reduced risk of engine or component damage caused by improper testing.

7. Section 29.1305 - Powerplant instruments

The proposed change to this section would require an oil pressure indicator for each pressure-lubricated gearbox. Currently, only an oil pressure warning device is required. The indicator would provide the crew with an early warning of oil pressure deficiencies and would provide confirmation that the oil pressure warning is not false. Good manufacturing design criteria dictate that an oil pressure indicator be included with the oil pressure warning device. Although a few older-design rotorcraft lack such indicators, rotorcraft of current designs include such devices as standard equipment. The incremental costs of providing the indicator device would be relatively low and would be easily exceeded by averting a single accident caused by a late warning of an oil-pressure problem.

8. Section 29.1309 - Systems, equipment, and installations

The proposed change to this section would delete reference to § 29.610 in subparagraph (h). Since § 29.1309 addresses systems and equipment, it is inappropriate to reference § 29.610 here, which addresses structural

requirements. The costs and benefits of this clarification would be inconsequential.

9. Section 29.1351 - General (under "Electrical Systems and Equipment")

Proposed additions to this section applicable to Category A and/or rotorcraft operating under IFR conditions would require that emergency electrical power be available to essential systems in the event of loss of the normal electrical power generating system or of all engines. No incremental costs would be incurred since this requirement formalizes current design practices which are inherent in present § 29.1309 (Systems, equipment, and installations). Specification of emergency electrical power system requirements in § 29.1351 is more appropriate and definitive, and thus would ensure that future rotorcraft designs continue to include sufficient emergency electrical power. Benefits would be reduced risks of accidents caused by power failures.

10. Section 29.1587 - Performance information

This section would be amended to require that manufacturers include climb gradient information for the pilot to determine the maximum takeoff weight possible to clear any obstacle in the takeoff path. Since the data are already available from the results of flight tests required to obtain performance information, the only additional costs would be those incurred in

incorporating the data into the Rotorcraft Flight Manual, estimated to total $5,500.

Although NTSB accident records do not include any accidents directly attributable to lack of performance data, there were a few accidents in which such data were ignored or misinterpreted. The availability and accuracy of such data is paramount to operational safety. The benefits of averting a single accident caused directly or indirectly by a lack of relevant performance information would easily exceed the incremental costs.

III. Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires a Regulatory Flexibility Analysis if a rule would have a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. Based on the criteria of implementing FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, the FAA has determined that the proposed rule would not have a significant economic impact on a substantial number of small manufacturers or operators.

IV. International Trade Impact Assessment

The proposed rule would not constitute a barrier to international trade, including the export of American rotorcraft to foreign countries and the

import of foreign rotorcraft into the United States. Instead, the proposed changes in rotorcraft certification procedures, harmonized with those of the JAA, would lessen restraints on trade.

EXECUTIVE SUMMARY

TITLE: Rotorcraft Regulatory Changes Based on European Joint Aviation Requirements Proposals

SUMMARY: This notice proposes changes to the type certification requirements for both normal and transport category rotorcraft. The changes would revise airworthiness standards for performance, systems, propulsion, and airframes and would introduce safety improvements, clarify existing regulations, and standardize terminology. The changes are based on proposals that are being incorporated by the European Joint Aviation Authorities for the Joint Aviation Requirements (JAR) 27 and 29. These proposed changes are intended to harmonize the Federal Aviation Regulations rotorcraft type certification requirements and the European JAR.

BACKGROUND: At a meeting between FAA representatives and the European Airworthiness Authorities Steering Committee (AASC) in Washington, DC, in April 1983, the aviation manufacturing industry requested that the certification rules of Europe and the United States be standardized. The AASC agreed to provide the FAA with a comprehensive list of recommended changes for the regulations in part 29 of Title 14 of the Code of Federal Regulations (CFR). These changes would make part 29 acceptable to AASC members for adoption as airworthiness standards. The AASC subsequently established a Joint Aviation Requirements (JAR) 29 group to develop transport category rotorcraft airworthiness standards for the issuance of European type certificates. The JAR 29 group was tasked with providing a list of recommended changes for part 29. The FAA solicited comments on key issues. The initial responses to that solicitation were published in the Federal Register (49 FR 19309, May 7, 1984). On September 15, 1984, the AASC submitted a more comprehensive list of proposals for part 29. The 92 proposals contained in the revised list suggested changes to part 29 as amended through Amendment 29-16, October 5, 1978. An FAA review found that 34 of these proposals had either been incorporated, in whole or in part, in part 29, as revised by Amendments 29-17 through 29-24 or were being considered in active rulemaking projects. Of the 58 proposals remaining, 25 were rejected for various reasons involving failure to meet Executive Order 12866 or Department of Transportation rulemaking requirements. The FAA provided the results of the review to the JAR 29 group including a summary of the status of the proposals being considered in active rulemaking projects.

During further review of the remaining AASC proposals not included in existing rulemaking projects, the FAA determined that several of the proposals warranted public discussion. Accordingly, the FAA held a public meeting in Fort Worth, Texas, May 1-2, 1986 (51 FR 4504, February 5, 1986). Over 50 persons attended the meeting, which remained in session until each proposal not already in rulemaking had been discussed. The FAA subsequently issued NPRM No. 89-10 (54 FR 17396; April 25, 1989), which addressed the AASC proposals and resulted in the issuance of Amendments 27-27 and 29-31 (55 FR 38964; September 21, 1990).

The AASC activities were absorbed by the Joint Aviation Authorities (JAA), and the JAA established the Helicopter Airworthiness Study Group (HASG) to formulate JAR 27 and 29 for use by the 19 JAA countries. The JAA invited

the FAA and industry groups to participate in HASG meetings on March 20-21, 1990. Members of Association Europeenne des Constructeurs de Materiel Aerospatial (AECMA) represented the European manufacturers at the HASG Meetings, and AECMA invited members of the Aerospace Industries Association of America (AIA) to represent U.S. manufacturers. The HASG was chartered to formulate JAR 29, and subsequently JAR 27, to parallel as closely as possible part 29 as amended through Amendment 29-31, September 21, 1990, and part 27 as amended through Amendment 27-27, September 21, 1990. The JAR 29 includes FAA NPRM's 89-26 (54 FR 39086, September 22, 1989) that proposes a new 30 second/ 2 minute One Engine Inoperative power rating, 89-29 (54 FR 42716, October 17, 1989) that proposes rotorburst protection, 90-1 (55 FR 698, January 8, 1990) that proposes new performance requirements, and 90-24
(55 FR 41000, October 5, 1990) that proposes a Crash Resistant Fuel System; and JAR 27 includes NPRM's 89-26 and 90-24.

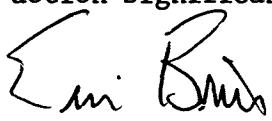
SIGNIFICANT ISSUES: Following an announcement in the Federal Register (57 FR 58846, December 11, 1992), the JAR-FAR 27 and 29 Harmonization Working Group was chartered by the Aviation Rulemaking Advisory Committee (ARAC). The Harmonization Working Group was charged with making recommendations to the ARAC concerning disposition of JAA Notice of Proposed Amendments (NPA's) recently coordinated between the JAA and the FAA. The working group and subsequently the ARAC recommended that the FAA revise the certification standards for normal and transport category rotorcraft as proposed in the NPA's. The FAA has evaluated the ARAC recommendations and proposes changes to the rotorcraft certification rules in both parts 27 and 29.

WHO WILL BE AFFECTED: Rotorcraft manufacturers and occupants of normal and transport category rotorcraft.

COSTS AND BENEFITS: Each of the proposed regulatory changes contained in this notice has been determined to have negligible or no economic impact. These proposed changes either edit, clarify, or codify current industry or certification practice and procedure.

ENERGY IMPACT: The energy impact of the notice of proposed rulemaking has been assessed in accordance with the Energy Policy and Conservation Act (EPCA), P.L. 94-163, and Interim Agency Guidelines. It has been determined that the notice of proposed rulemaking is not a major regulatory action under the provisions of the EPCA.

ENVIRONMENTAL IMPACT: The environmental impact of the notice of proposed rulemaking has been assessed in accordance with FAA Order 1050.1D, and it has been determined that the notice of proposed rulemaking is not a major Federal action significantly affecting the environment.



Eric Bries
Acting Manager, Rotorcraft Directorate,
Aircraft Certification Service

U.S. Department
of Transportation

**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

JUN 22 1995

Mr. Theodore E. Dumont
Assistant Chair for Rotorcraft Issues
Aviation Rulemaking Advisory Committee
1101 Naugatuck Avenue
Milford, CT 06460-2317

Dear Mr. Dumont:

In response to the task announced in the Federal Register on December 11, 1992 (56 FR 63545), the Aviation Rulemaking Advisory Committee (ARAC) developed a notice of proposed rulemaking (NPRM) to amend airworthiness standards for normal and transport category rotorcraft to harmonize with the Joint Aviation Requirements 27 and 29. Comments received in response to the NPRM were considered to be non-substantive; consequently, the final action will be developed internally by the Federal Aviation Administration (FAA).

Again, let me thank ARAC and, in particular, the JAR-FAR 27 and 29 Harmonization Working Group for its dedicated efforts in completing the task assigned by the FAA.

If you have any questions, please contact Mr. Mark Schilling at (817) 222-5110.

Sincerely,

Anthony J. Broderick
Associate Administrator for
Regulation and Certification

federal register

Wednesday
December 28, 1994

Part III

Department of Transportation

Federal Aviation Administration

14 CFR Parts 27 and 29
Rotorcraft Regulatory Changes Based on European Joint Airworthiness Requirements Proposals; Proposed Rule

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 27 and 29

[Docket No. 28008; Notice No. 94-36]

RIN: 2120-AC27

Rotorcraft Regulatory Changes Based on European Joint Airworthiness Requirements Proposals

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This notice proposes changes to the type certification requirements for both normal and transport category rotorcraft. The changes would revise airworthiness standards for performance, systems, propulsion, and airframes. The changes would increase the regulatory safety level, clarify existing regulations, and standardize terminology. The changes are based on standards that are being incorporated by the European Joint Aviation Authorities for the Joint Aviation Requirements (JAR) 27 and 29. These proposed changes are intended to harmonize the Federal Aviation Regulations rotorcraft type certification requirements and the European JAR.

DATES: Comments must be received on or before March 28, 1995.

ADDRESSES: Comments on this notice should be mailed in triplicate to: Federal Aviation Administration (FAA), Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. 28008; 800 Independence Avenue SW, Washington, DC 20591. Comments delivered must be marked Docket No. 28008. Comments may be examined in Room 915G weekdays between 9 a.m. and 5 p.m., except on Federal holidays.

FOR FURTHER INFORMATION CONTACT: Mr. Carroll Wright, Rotorcraft Directorate, Aircraft Certification Service, Regulations Group, ASW-111, FAA, Fort Worth, Texas 76193-0111, telephone number (817) 222-5120.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to submit written data, views, or arguments on this proposed rule. Comments relating to the environmental, energy, federalism, or economic impact that might result from adopting the proposals in this notice are also invited. Substantive comments should be accompanied by cost estimates. Comments should identify the regulatory docket number and be submitted in triplicate to the address specified under the caption **ADDRESSES**. All comments received on or before the closing date for comments will be considered before taking action on this proposed rule. The proposals contained in this notice may be changed in light of the comments received. All comments received will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerned with this rulemaking will be filed in the docket. Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must include a preaddressed, stamped postcard on which the following statement is made: "Comments on Docket No. 28008." The postcard will be date stamped and mailed to the commenter.

Availability of NPRM's

Any person may obtain a copy of this NPRM by submitting a request to the FAA, Office of Public Affairs, Attention: Public Inquiry Center, APA-200, 800 Independence Avenue, SW, Washington, DC 20591, or by calling (202) 267-3484. Communications must identify the notice number of this NPRM.

Persons interested in being placed on a mailing list for future NPRM's should request from the above office a copy of Advisory Circular No. 11-2A, NPRM Distribution System, which describes the application procedure.

Background

At a meeting between FAA representatives and the European Airworthiness Authorities Steering Committee (AASC) in Washington, DC, in April 1983, the aviation manufacturing industry requested that the certification rules of Europe and the United States be standardized. The AASC agreed to provide the FAA with a comprehensive list of recommended changes for the regulations in part 29 of Title 14 of the Code of Federal Regulations (CFR). These changes would make part 29 acceptable to AASC members for adoption as airworthiness standards. The AASC subsequently established a Joint Aviation Requirements (JAR) 29 group to develop transport category rotorcraft airworthiness standards for the issuance of European type certificates. The JAR 29 group was tasked with providing a list of recommended changes for part 29. The FAA solicited comments on key issues. The initial responses to that solicitation were published in the **Federal Register** (49 FR 19309, May 7, 1984). On September 15, 1984, the AASC submitted a more comprehensive list of 92 suggested changes to part 29. An FAA review found that 34 of these proposals had either been incorporated, in whole or in part, in part 29 or were being considered in active rulemaking projects. Of the 58 proposals remaining, 25 were rejected for various reasons involving failure to meet Executive Order or Department of Transportation rulemaking requirements. The FAA provided the results of the review to the JAR 29 group including a summary of the status of the proposals being considered in active rulemaking projects.

During further review of the remaining AASC proposals not included in existing rulemaking projects, the FAA determined that several of the proposals warranted public discussion. Accordingly, the FAA held a public meeting in Fort Worth, Texas, May 1-2, 1986 (51 FR 4504, February 5, 1986). Over 50 persons attended the meeting, which remained in session until each proposal not already in rulemaking had been discussed. The FAA subsequently issued NPRM No. 89-10 (54 FR 17396; April 25, 1989), which addressed the AASC proposals and resulted in the issuance of Amendments 27-27 and 29-31 (55 FR 38964; September 21, 1990).

The AASC activities were absorbed by the Joint Aviation Authorities (JAA), and the JAA established the Helicopter Airworthiness Study Group (HASG) to formulate JAR 27 and 29 for use by the 19 JAA countries. The JAA invited the FAA and industry groups to participate in HASG meetings on March 20-21, 1990. Members of Association Europeene des Constructeurs de Materiel Aerospatial (AECMA) represented the European manufacturers at the HASG Meetings, and AECMA invited members of the Aerospace Industries Association of America (AIA) to represent U.S. manufacturers. The HASG was chartered to formulate JAR 29, and subsequently JAR 27, to parallel as closely as possible part 29 as amended through Amendment 29-31 effective September 21, 1990, and part 27 as amended through Amendment 27-27 effective September 21, 1990. The JAR 29 includes FAA NPRM's 89-26 (54 FR 39086, September 22, 1989) which proposes a new 30 second/2 minute One Engine Inoperative power rating, 89-29 (54 FR 42716, October 17, 1989) which proposes rotorburst protection, 90-1 (55 FR 698, January 8, 1990) which proposes new performance requirements, and 90-24 (55 FR 41000, October 5, 1990) which proposes a Crash Resistant Fuel System; JAR 27 is

to also include NPRM's 89–26 and 90–24.

Aviation Rulemaking Advisory Committee (ARAC) Considerations

By announcement in the **Federal Register** (57 FR 58846, December 11, 1992), the JAR–FAR 27 and 29 Harmonization Working Group was chartered by the ARAC. The working group included representatives from four major rotorcraft manufacturers (normal and transport) and representatives from AIA, AECMA, Helicopter Association International (HAI), JAA, and the FAA Rotorcraft Directorate. This broad participation is consistent with FAA policy to have all known interested parties involved as early as practicable in the rulemaking process.

The Harmonization Working Group was tasked with making recommendations to the ARAC concerning the FAA acceptance or rejection of JAA Notice of Proposed Amendments (NPA's) recently coordinated between the JAA and the FAA. The ARAC subsequently recommended that the FAA revise the certification standards for normal and transport category rotorcraft as now contained in JAR 27 and 29.

FAA Evaluations of ARAC and JAA Proposals

The FAA has evaluated the ARAC recommendations and proposes changes to the rotorcraft certification rules in both parts 27 and 29. These proposed changes have evolved from the FAA–JAA industry meetings of 1990–1992 and the ARAC recommendations of 1993. These proposed changes would (1) incorporate current design and testing practices into the rules by requiring additional performance data, additional powerplant and rotor brake controls, and bird-strike protection, and (2) harmonize the certification requirements between Title 14 and the JAR. The proposals for part 27 include JAA's harmonized NPA's 27-basic and 27–1; and the proposals for part 29 include NPA's 29-basic and 29–1 through 29–5. All sections of the harmonized NPA's are included in these proposals except for § 27.602 of NPA 27-basic and § 29.602 of NPA 29–4. Those JAR sections include a critical parts plan that would control the design, substantiation, manufacture, maintenance, and modification of critical parts. While the JAA prescribes manufacturing and maintenance requirements in JAR 29, the FAA does not do the same in part 29. Part 21 of Title 14 addresses manufacturing requirements; part 43 of Title 14 prescribes maintenance requirements. Part 29 contains the airworthiness requirements for rotorcraft certification; part 29 addresses maintenance standards only to the extent that it mandates that the type certificate holder prepare Instructions for Continued Airworthiness, which includes the maintenance manual or section and maintenance instructions, and the Airworthiness Limitations section. Accordingly, the FAA may propose critical parts requirements in a separate rulemaking, which may also propose changes to parts 21 and 43.

General Discussion of the Proposals

These proposals would introduce safety improvements, clarify existing regulations, and standardize terminology with the JAR's by revising the airworthiness standards for rotorcraft performance, systems, propulsion, and airframes. These proposed changes are based on requirements that have been adopted by JAA for JAR 27 and 29. The part 27 proposals would require all-engines-operating (AEO) climb performance data, powerplant controls to maintain any set position, and rotor brake control standards. The proposals would also provide an option for the certification of part 27 rotorcraft to Category A; i.e., one engine inoperative (OEI) requirements. The part 29 proposals would provide standards for electrical bonding of airframe components to protect against lightning and precipitation static discharge, a design assessment of rotors and drive train, and bird-strike protection. Additional powerplant instruments are proposed. The part 29 proposals would also clarify performance requirements for Category A, flutter and divergence applicability, and emergency electrical power supply requirements.

Discussion of Specific Proposals

Section 27.1 Applicability

Proposed new § 27 1(c) would provide an optional basis for normal category multiengine rotorcraft to be certificated to Category A requirements by meeting those design and performance requirements of part 29 as specified in a new appendix C to part 27

Section 27.65 Climb: all engines operating

This proposed revision of § 27.65(b)(2) would require a determination of AEO climb performance for all rotorcraft. Currently rotorcraft AEO climb performance is required only for ambient conditions where the never-exceed speed (V_{ne}) is less than the speed for the best rate of climb (V_y). Climb performance information is necessary for operational planning for rotorcraft, e.g., planning for obstacle clearance. Manufacturers have historically provided this information even though it is not required by the existing regulations. This change would incorporate that current practice as a requirement in the FAR.

Section 27.1141 Powerplant controls: general

This proposed new § 27.1141(d) would add to part 27 the requirement of § 29.1141(d) that powerplant controls must maintain any set position. The proposed requirement states that each control "must be able to maintain any set position without constant attention or tendency to creep due to control loads or vibration." "Must be able to," in this regard, would require that the rotorcraft have identifiable design features that keep the controls from moving. This requirement would improve safety by reducing pilot work load for part 27 rotorcraft. Because most rotorcraft manufacturers already comply voluntarily with this standard, this should require no significant design or manufacturing effort.

Section 27.1151 Rotor brake controls

This proposed new section would add to part 27 the requirements of § 29.1151 on rotor brake controls. These proposed requirements are necessary for the safe operation of any rotorcraft equipped with a rotor brake. Requirements to prevent inadvertent application of rotor brakes in flight are necessary to prevent possible damage or fire due to rotor brake application. Current rotorcraft rotor brake installations normally incorporate these design features; no significant design or manufacturing effort should be necessary.

Appendix C to Part 27

This proposed new appendix would provide a list of part 29 Category A standards that are directly related to the continued safe powered flight capability of a multiengine rotorcraft in the event of engine or other system failure. The proposed standards would be required to be met for an optional Category A approval for a part 27 rotorcraft.

Section 29.547 Main and tail rotor structures

Proposed new § 29.547(b) would require a design assessment that identifies the critical components of the main and tail rotor structures. The design assessment must also identify the means (such as scheduled inspection, removal, and replacement of

components) that minimize the likelihood of failure for each critical component.

Section 29.610 Lightning and static electricity protection

The word "structure" would be added to current § 29.610(a) to clarify that these requirements address the rotorcraft structure and not equipment, systems, and installations that are adequately covered under the requirements of § 29.1309. The proposed addition of the word "structure" to paragraph (a) is intended to clarify that the metallic components and nonmetallic components of paragraphs (b) and (c) are structural components. Proposed new paragraph (d) would require electrical bonding of the rotorcraft components for protection against hazardous effects from lightning and discharge of static electricity. In this regard, the reference to the bonding and protection "be[ing] such as to" would require that the rotorcraft have identifiable design features that achieve the standards required in paragraphs (d)(1) through (4). Part 29 does not currently provide electrical bonding requirements, and experience has shown that inadequate bonding can result in hazardous conditions due to discharge of static electricity. The proposed new paragraph (d)(4) would require electrical bonding and protection against lightning and static electricity that would reduce the effects on the functioning of essential electrical and electronic equipment to an acceptable level (as determined by §§ 29.1309 and 29.1431).

Section 29.629 Flutter and divergence

This proposed revision of § 29.629 would add the words "and divergence" to the title and text of the section. This proposal would extend the requirements to cover aeroelastic instability other than flutter of aerodynamic surfaces. This proposal would require the use of rational analysis, tests, or a combination of analysis and tests to demonstrate freedom from aeroelastic instability for the basic design. Most manufacturers currently do this type of analysis or test; this change would require formal documentation and approval of that analysis or test.

Section 29.631 Bird strike

This proposed new section would require bird-strike protection for transport rotorcraft. Rotorcraft, as well as airplanes, are exposed to the possibility of collision with a bird. With the potential for higher speeds by modern transport rotorcraft designs and the changes in material technology, the possibility of increased damage from bird strikes exists. In addition, the effects of bird strikes on new materials used in rotorcraft must be evaluated. The FAA has determined that a requirement for protection against catastrophic effects from impact with a 2.2 pound (1 kilogram) bird is reasonable for rotorcraft certificated in the transport category (part 29). A 2.2 pound bird represents the typical size for intended structural capability; therefore, such protection is being proposed. Proposed § 29.631 would require that the rotorcraft be designed to assure capability of continued safe flight and landing (for Category A) or safe landing (for Category B) after bird strike. In this regard, "capability" means that the design has features that assure continued safe flight and/or landing, as would be required. Proposed § 29.631 would also require that substantiation of the design be based on tests or analysis of tests carried out on sufficiently representative structures of design similar to that of the design to be approved. In this regard, "sufficiently" means that the structures at least represent the design to be approved.

Section 29.917 Design

A new § 29.917(b) is proposed for this section, and redesignation of existing paragraph (b) as (c) is proposed. This proposed new § 29.917(b) would require a design assessment that identifies critical components of the rotor drive system. The design assessment would also identify the means that minimize the likelihood of failure for each critical component (such as scheduled inspection, removal, and replacement of components). This proposed section is a companion to the rotor structure proposal of § 29.547.

Section 29.923 Rotor drive system and control mechanism tests

This proposed revision to § 29.923(b)(3)(i) would increase the testing for 2 minute OEI power from one to two runs per cycle. The JAA are concerned that a possible inconsistency exists in the current rule. Using one run per cycle, a higher and potentially more damaging power rating could be substantiated by less testing at the 2-minute OEI power than at the 2½ minute OEI power. The FAA agrees and increased testing for 2 minute OEI power is proposed.

Section 29.1305 Powerplant instruments

The current rule requires an oil pressure warning device, which could be a simple light, for each pressure-lubricated gearbox. Proposed new § 29.1305(a)(6) would add a requirement for an oil pressure indicator for each pressure-lubricated gearbox. This change would provide the crew with an early warning of oil pressure problems and confirm that the oil pressure warning is valid. The proposed addition of a new § 29.1305(a)(6) would necessitate renumbering of existing paragraphs (a)(6) through (a)(25) as (a)(7) through (a)(26).

Section 29.1309 Systems, equipment, and installations

Section 29.610 was referenced in § 29.1309(h) to require protection against a catastrophic systems failure due to lightning. Since § 29.1309(h) applies to lightning protection of systems and equipment, it is unnecessary to reference § 29.610, which applies to lightning protection of structures, Therefore, this proposed change would delete the reference to § 29.610 in § 29.1309(h).

Section 29.1351 General

The proposed changes to §§ 29.1351(d) and 29.1351(d)(1) would clarify that the regulation applies to the normal electrical power generating system and would editorially change the § 29.1351(d) heading. The § 29.1351(d) heading would change from, "Operation without normal electrical power" to "Operation with the normal electrical power generating system inoperative," and "generating system" would be added after electrical power in § 29.1351(d)(1).

The proposed additions to § 29.1351(d)(2) would provide requirements for the emergency electrical power system for Category A rotorcraft. Section 29.1351(d)(2) is entitled "Category A Aircraft." The proposed new § 29.1351(d)(2)(i) would require that emergency electrical power be provided to those systems necessary for continued safe flight and landing for rotorcraft certificated to Category A requirements. Consideration of the possible duration of flight time to reach a suitable landing site and make a safe landing would be required. A minimum of 30 minutes flight time is necessary for continued safe flight and landing for Category A rotorcraft. Proposed new § 29.1351(d)(2)(ii) would require that loss of both normal and emergency electrical power systems be shown to be extremely improbable. This will ensure that no single failure (such as effects of fire or loss of junction box) will result in the disabling of both the normal and emergency electrical power systems. Finally, a new § 29.1351(d)(2)(iii) would require that the emergency electrical power system include independent,

automatic features for electrical load shedding to conserve the emergency electrical power (batteries) after loss of the normal electrical power generating system. The intent is to allow the flight crew time to take corrective actions for engine fire, cockpit fire, or other in-flight emergencies common to situations resulting in loss of the normal electrical power generating system without being distracted by a need to manually switch off or shed electrical power. In this regard, "immediate" refers to those systems that, if they did not continue to operate, would necessitate the attention of the flight crew.

Section 29.1587 Performance information

Proposed new § 29.1587(a)(6) would require that the climb gradient information necessary for the pilot to determine the allowable maximum takeoff weight to clear any obstacle in the takeoff path be added to the Rotorcraft Flight Manual for Category A rotorcraft. Because the data are already available from the other requirements, the only additional requirement would be to incorporate this data into the Rotorcraft Flight Manual.

Appendix B to Part 29 Airworthiness Criteria for Helicopter Instrument Flight

The proposed addition of a section VIII(b)(6) to Appendix B would provide a reference to new § 29.1351(d)(2) to clarify that requirements for operation with the normal electrical power generating system inoperative apply to Instrument Flight Rules (IFR) certificated rotorcraft. When the emergency electrical power source provided for an IFR certificated rotorcraft is time limited; e.g., a battery, the required duration will depend on the type and role of the rotorcraft. However, an endurance of less than 30 minutes would not be acceptable.

Regulatory Evaluation Summary

Introduction

Proposed changes to federal regulations must undergo several economic analyses. First, Executive Order 12866 directs Federal agencies to promulgate new regulations or modify existing regulations only if the potential benefits to society outweigh the potential costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Finally, the Office of Management and Budget has directed agencies to assess the effects of regulatory changes on international trade. In conducting these analyses, the FAA has determined that this proposed rule (1) would generate benefits exceeding its costs and is neither a significant regulatory action as defined in the Executive Order nor significant as defined in DOT's Policies and Procedures, (2) would not have a significant impact on a substantial number of small entities, and (3) would lessen restraints on international trade. These analyses, available in the docket, are summarized below.

Costs and Benefits

All of the proposed changes to part 27 and all but four of the proposed changes to part 29 would impose no or significant costs on rotorcraft manufacturers because they reflect current design practices. In recent years, manufacturers have incorporated engineering and structural improvements into rotorcraft designs that exceed the minimum regulatory requirements with the aim of increasing operating efficiencies, payload capabilities, and marketability in world markets. Most new rotorcraft designs are based on existing designs. Many of these improvements have also improved safety. Codification of these improvements and other proposed changes would ensure that these features are incorporated in all future rotorcraft designs.

Additionally, adoption of the proposed changes would increase harmonization and commonality between U.S. and European airworthiness standards. Harmonization would eliminate differences between airworthiness requirements, thus reducing manufacturers' cost for dual certification. Based on experience in a recent certification, one rotorcraft manufacturer indicated that complying with different FAA/JAA requirements resulted in several hundred thousand dollars in excessive certification costs. Aside from the benefits of enhanced safety levels as described above, the benefits of certification cost savings would, by themselves, outweigh the relatively modest increase in certification costs that the amendments would impose.

Following is a brief summary of the four proposed changes to part 29 that would impose additional costs totalling approximately $150,000 per type certification. The safety benefits of these proposed changes are expected to easily exceed the incremental costs.

Section 29.547—Main and tail rotor structure. While manufactures currently perform the proposed design assessment as an integral part of the design requirements of § 29.917, there would be some incremental costs to formalize the existing information. These costs are included in the cost estimates of proposed § 29 917 summarized below. Formal identification and assessment of critical component failures would increase safety by providing more comprehensive maintenance information to operators. The benefits of averting a single catastrophic accident would exceed the relatively low incremental costs of compliance.

Section 29.631—Bird strike. Manufacturers indicate that present rotorcraft structures can withstand impacts from a 2.2 pound bird; therefore, no incremental manufacturing costs are anticipated to implement new designs. Nonrecurring testing and analysis costs of the proposed requirement are estimated to be $100,000 per type certification. A review of National Transportation Safety Board (NTSB) data for the period 1983–1991 reveals two rotorcraft accidents caused by bird strikes. One accident resulted in one serious injury, one minor injury, and substantial damage to the rotorcraft (tail rotor separation); in the other accident the rotorcraft was destroyed but there were no injuries. There is at least an equal probability of such accidents and the resultant damage in the future, given the tendencies toward higher operating speeds and use of composite materials. The benefits of averting a single catastrophic accident would exceed the incremental costs.

Section 29.917—Design. The incremental costs to formalize existing design information for the rotor structure (proposed § 29.547 above) and drive system are estimated to total $44,000 per type certification. Formal assessment and identification of critical components of the rotor drive system would increase safety by providing more comprehensive maintenance information to operators. The benefits of averting a single catastrophic accident caused directly or indirectly by a lack of relevant data would easily exceed the incremental costs of providing that data.

Section 29.1587—Performance information. Because the required climb gradient data would already be available from the results of flight tests required to obtain performance information, the only additional costs would be those associated with incorporating the data into the Rotorcraft Flight Manual, estimated to total $5,500 per certification. Although NTSB accident records do not include any accidents directly attributable to lack of performance data, there were a few accidents in which such data were ignored or misinterpreted. The availability and accuracy of such data would enhance operational safety The

benefits of averting a single catastrophic accident caused directly or indirectly by a lack of relevant performance information would easily exceed the incremental costs of providing that data.

International Trade Impact Analysis

The proposed rule would not constitute a barrier to international trade, including the export of American rotorcraft to foreign countries and the import of foreign rotorcraft into the United States. Instead, the proposed changes on rotorcraft certification procedures, harmonized with those of the JAA, would lower dual certification costs, thereby enhancing free trade.

Regulatory Flexibility Determination

The Regulatory Flexibility Act (RFA) of 1980 was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires a Regulatory Flexibility Analysis if a rule would have a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. Based on the criteria of FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, the FAA has determined that the proposed rule would not have a significant economic impact on a substantial number of small entities.

Conclusion

For the reasons discussed above, including the findings in the Regulatory Flexibility Determination and the International Trade Impact Analysis, the Office of Information and Regulatory Affairs (OIRA) in conjunction with the FAA has determined that this proposed regulation is not a significant regulatory action under Executive Order 12866 and, therefore, was not subject to centralized regulatory review by the OIRA. In addition, the FAA certifies that this regulation will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. This proposal is considered to be nonsignificant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). An initial regulatory evaluation of the proposal, including a Regulatory Flexibility Determination and Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under FOR FURTHER INFORMATION CONTACT

List of Subjects in 14 CFR Parts 27 and 29

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

The Proposed Amendments

Accordingly, the FAA proposes to amend parts 27 and 29 of the Federal Aviation Regulations (14 CFR parts 27 and 29) as follows:

PART 27—AIRWORTHINESS STANDARDS: NORMAL CATEGORY ROTORCRAFT

1. 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, and 1430; 49 U.S.C. 106(g).

2. Section 27.1 is amended by adding a new paragraph (c) to read as follows:

§ 27.1 Applicability.

* * * * *

(c) Multiengine rotorcraft may be type certificated as Category A provided the requirements of appendix C of this part are met.

3. Section 27.65 is amended by revising paragraphs (b)(2) and (b)(2)(ii) to read as follows:

§ 27.65 Climb: all engines operating.

* * * * *

(b) * * *

(2) The steady rate of climb must be determined—

* * * * *

(ii) Within the range from sea level up to the maximum altitude for which certification is requested;

* * * * *

4. Section 27.1141 is amended by redesignating existing paragraphs (c) and (d) as paragraphs (d) and (e) and by adding a new paragraph (c) to read as follows:

§ 27.1141 Powerplant controls: general.

* * * * *

(c) Each control must be able to maintain any set position without—

(1) Constant attention; or

(2) Tendency to creep due to control loads or vibration.

* * * * *

5. Section 27.1151 is added to read as follows:

§ 27.1151 Rotor brake controls.

(a) It must be impossible to apply the rotor brake inadvertently in flight.

(b) There must be means to warn the crew if the rotor brake has not been completely released before takeoff.

6. Part 27 is amended by adding a new appendix C to read as follows:

Appendix C to Part 27—Criteria for Category A

C27.1 General.

A small multiengine rotocraft may not be type certificated for Category A operation unless it meets the design installation and performance requirements contained in this appendix in addition to the requirements of this part.

C27.2 Applicable part 29 sections.

The following sections of part 29 of this chapter must be met in addition to the requirements of this part:

29.45(a) and (b)(2)—General.
29.49(a)—Performance at minimum operating speed.
29.51—Takeoff data: General.
29.53—Takeoff: Category A.
29.55—Takeoff decision point: Category A.
29.59—Takeoff path: Category A.
29.60—Elevated heliport takeoff path: Category A.
29.61—Takeoff distance: Category A.
29.62—Rejected takeoff: Category A.
29.64—Climb: General.
29.65(a)—Climb: AEO.
29.67(a)—Climb: OEI.
29.75—Landing: General.
29.77—Landing decision point: Category A.
29.79—Landing: Category A.
29.81—Landing distance (Ground level sites): Category A.
29.85—Balked landing: Category A.
29.87(a)—Height-velocity envelope.
29.547(a) and (b)—Main and tail rotor structure.
29.571—Fatigue evaluation of structure. AC Material only: AC29-2A Item 230 Paragraph 10.
29.861(a)—Fire protection of structure, controls, and other parts.
29.901(c)—Powerplant: Installation.
29.903(b)(c) and (e)—Engines.
29.908(a)—Cooling fans.
29.917(b) and (c)(1)—Rotor drive system: Design.
29.927(c)(1)—Additional tests.
29.953(a)—Fuel system independence.
29.1027(a)—Transmission and gearboxes: General.
29.1045(a)(1), (b), (c), (d), and (f)—Climb cooling test procedures.
29.1047(a)—Takeoff cooling test procedures.
29.1181(a)—Designated fire zones: Regions included.
29.1187(e)—Drainage and ventilation of fire zones.
29.1189(c)—Shutoff means.
29.1191(a)(1)—Firewalls.
29.1193(e)—Cowling and engine compartment covering.
29.1195(a) and (d)—Fire extinguishing systems (one shot).
29.1197—Fire extinguishing agents.
29.1199—Extinguishing agent containers.
29.1201—Fire extinguishing system materials.
29.1305(a)(6) and (b)—Powerplant instruments.
29.1309(b)(2)(i) and (d)—Equipment, systems, and installations.
29.1323(c)(1)—Airspeed indicating system.
29.1331(b)—Instruments using a power supply.

29.1351(d)(2)—Electrical systems and equipment: General (operation without normal electrical power).
29.1587(a)—Performance information.

3. In complying with the paragraphs listed in paragraph 2 above, relevant material in AC 29–2A should be used.

PART 29—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT

7. 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, and 1430; 49 U.S.C. 106(g).

8. Section 29.547 is amended by revising the heading; revising paragraph (a); adding a new paragraph (b); removing the word "main" in the introductory text of paragraphs (c), (d), and (e); and revising paragraph (e)(1)(ii) to read as follows:

§ 29.547 Main and tail rotor structure.

(a) A rotor is an assembly of rotating components, which includes the rotor hub, blades, blade dampers, the pitch control mechanisms, and all other parts that rotate with the assembly.

(b) Each rotor assembly must be designed as prescribed in this section and must function safely for the critical flight load and operating conditions. A design assessment must be performed, including a detailed failure analysis to identify all failures that will prevent continued safe flight or safe landing, and must identify the means to minimize the likelihood of their occurrence.

* * * * *

(e) * * *

(1) * * *

(ii) For the main rotor, the limit engine torque specified in § 29.361.

* * * * *

9. In § 29.610 the heading is revised; the word "structure" is added between the words "rotorcraft" and "must" in paragraph (a); and a new paragraph (d) is added to read as follows:

§ 29.610 Lightning and static electricity protection.

* * * * *

(d) The electrical bonding and protection against lightning and static electricity must be such as to—

(1) Minimize the accumulation of electrostatic charge;

(2) Minimize the risk of electrical shock to crew, passengers, and service and maintenance personnel using normal precautions;

(3) Provide an electrical return path, under both normal and fault conditions, on rotorcraft having grounded electrical systems; and

(4) Reduce to an acceptable level the effects of lightning and static electricity on the functioning of essential electrical and electronic equipment.

10. Section 29.629 is revised to read as follows:

§ 29.629 Flutter and divergence.

Each aerodynamic surface of the rotorcraft must be free from flutter and divergence under each appropriate speed and power condition.

11. A new § 29.631 is added to read as follows:

§ 29.631 Bird strike.

The rotorcraft must be designed to assure capability of continued safe flight and landing (for Category A) or safe landing (for Category B) after impact with a 2.2 lb (1.0 kg) bird when the velocity of the rotorcraft (relative to the bird along the flight path of the rotorcraft) is equal to V_{NE} or V_H (whichever is the lesser) at altitudes up to 8,000 feet. Compliance must be shown by tests or by analysis based on tests carried out on sufficiently representative structures of similar design.

12. Section 29.917 is amended by redesignating existing paragraph (b) as (c) and adding a new paragraph (b) to read as follows:

§ 29.917 Design.

* * * * *

(b) *Design assessment.* A design assessment must be performed to ensure that the rotor drive system functions safely over the full range of conditions for which certification is sought. The design assessment must include a detailed failure analysis to identify all failures that will prevent continued safe flight or safe landing and must identify the means to minimize the likelihood of their occurrence.

* * * * *

13. Section 29.923 is amended by revising paragraph (b)(3)(i) to read as follows:

§ 29.923 Rotor drive system and control mechanism tests.

* * * * *

(b) * * *

(3) * * *

(i) Immediately following any one 5-minute power-on run required by paragraph (b)(1) of this section, simulate a failure for each power source in turn, and apply the maximum torque and the maximum speed for use with 30-second OEI power to the remaining affected drive system power inputs for not less than 30 seconds. Each application of 30-second OEI power must be followed by two applications of the maximum torque and the maximum speed for use with the 2 minute OEI power for not less than 2 minutes each; the second application must follow a period at stabilized continuous or 30 minute OEI power (whichever is requested by the applicant). At least one run sequence must be conducted from a simulated "flight idle" condition.

* * * * *

14. Section 29.1305 is amended by redesignating existing paragraphs (a)(6) through (a)(25) as paragraphs (a)(7) through (a)(26) and adding a new paragraph (a)(6) to read as follows:

§ 29.1305 Powerplant instruments.

* * * * *

(a) * * *

(6) An oil pressure indicator for each pressure-lubricated gearbox;

* * * * *

15. Section 29.1309 is amended by revising paragraph (h) to read as follows:

§ 29.1309 Equipment, systems, and installations.

* * * * *

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

16. Section 29.1351 is amended by revising the heading of paragraph (d), redesignating the introductory text of paragraph (d) as (d)(1) and adding the words "generating system" after the words "normal electrical power" in new (d)(1), redesignating paragraphs (d)(1), (d)(2), and (d)(3) as (d)(1)(i), (d)(1)(ii), and (d)(1)(iii), and adding a new paragraph (d)(2) to read as follows:

§ 29.1351 General.

* * * * *

(d) *Operation with the normal electrical power generating system inoperative.* * * *

* * * * *

(2) *Additional requirements for Category A Rotorcraft.*

(i) Unless it can be shown that the loss of the normal electrical power generating system is extremely improbable, an emergency electrical power system, independent of the normal electrical power generating system, must be provided, with sufficient capacity to power all systems necessary for continued safe flight and landing.

(ii) Failures, including junction box, control panel, or wire bundle fires, which would result in the loss of the normal and emergency systems, must be shown to be extremely improbable.

(iii) Systems necessary for immediate safety must continue to operate

following the loss of the normal electrical power generating system, without the need for flight crew action.

17. Section 29.1587 is amended by adding a new paragraph (a)(6), removing "and" from end of paragraph (a)(4), and adding "and" to end of paragraph (a)(5).

§ 29.1587 Performance information.

* * * * *

(a) * * *

(6) The steady gradient of climb for each weight, altitude, and temperature for which takeoff data are to be scheduled, along the takeoff path determined in the flight conditions required in § 29.67 (a)(1) and (a)(2):

(i) In the flight conditions required in § 29.67(a)(1) between the end of the takeoff distance and the point at which the rotorcraft is 200 feet above the takeoff surface (or 200 feet above the lowest point of the takeoff profile for elevated heliports).

(ii) In the flight conditions required in § 29.67(a)(2) between the points at which the rotorcraft is 200 and 1000 feet above the takeoff surface (or 200 and 1000 feet above the lowest point of the takeoff profile for elevated heliports).

* * * * *

18. Part 29 Appendix B is amended by adding a new paragraph VIII(b)(6).

Appendix B to Part 29—Airworthiness Criteria for Helicopter Instrument Flight

* * * * *

VIII. * * *

(b) * * *

(6) In determining compliance with the requirements of § 29.1351(d)(2), the supply of electrical power to all systems necessary for flight under IFR must be included in the evaluation.

Issued in Washington, DC, on December 12, 1994.

Thomas E. McSweeny,

Director, Aircraft Certification Service.

[FR Doc. 94-31311 Filed 12-27-94; 8:45 am]

BILLING CODE 4910-13-M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 27 and 29

[Docket No. 28008; Amendment No. 27–33, 29–39]

RIN 2120–AF65

Rotorcraft Regulatory Changes Based on European Joint Aviation Requirements

AGENCY: Federal Aviation Administration, DOT.

ACTION: Final rule.

SUMMARY: The Federal Aviation Administration (FAA) is amending the airworthiness standards for normal and transport category rotorcraft. The changes revise airworthiness standards for performance, systems, propulsion, and airframes. The changes increase the regulatory safety level, clarify existing regulations, and standardize terminology. The changes are based on standards incorporated by the European Joint Aviation Authorities (JAA) for Joint Aviation Requirements (JAR) 27 and 29. These changes are intended to harmonize the U.S. rotorcraft airworthiness standards with the European JAR.

EFFECTIVE DATE: August 8, 1996.

FOR FURTHER INFORMATION CONTACT: Carroll Wright, Regulations Group Rotorcraft Directorate, Aircraft Certification Service, Federal Aviation Administration, Fort Worth, Texas 76193–0111, telephone (817) 222–5120.

SUPPLEMENTARY INFORMATION:

Background

These amendments are based on Notice of Proposed Rulemaking (NPRM) No. 94–36 published in the **Federal Register** on December 28, 1994 (59 FR 67068). That notice proposed to amend the airworthiness standards for both normal and transport category rotorcraft based on recommendations from the Aviation Rulemaking Advisory Committee (ARAC). By announcement in the **Federal Register** (57 FR 58846, December 11, 1992), the "JAR/FAR 27 and 29 Harmonization Working Group" was chartered by the ARAC. The working group included representatives from four major rotorcraft manufacturers (normal and transport) and representatives from Aerospace Industries Association of America, Inc. (AIA), Association Europeene des Constructeurs de Material Aerospatial (AECMA), Helicopter Association International (HAI), JAA, and the FAA Rotorcraft Directorate. This broad participation is consistent with FAA policy to involve all known interested parties as early as practicable in the rulemaking process.

The Harmonization Working Group was tasked with making recommendations to the ARAC regarding JAA Notices of Proposed Amendment (NPA's). The ARAC subsequently recommended that the FAA revise the airworthiness standards for normal and transport category rotorcraft to those currently in the JAR 27 and 29.

The FAA evaluated the ARAC recommendations and proposed changes to the rotorcraft airworthiness standards in 14 CFR parts 27 and 29 (parts 27 and 29). These proposed changes evolved from the FAA, JAA, and industry meetings of 1990–1992 and the ARAC recommendations of 1993. The changes proposed to (1) incorporate current design and testing practices into the rules by requiring additional performance data, (2) incorporate additional powerplant and rotor brake controls requirements, (3) incorporate bird-strike protection requirements, and (4) harmonize the certification requirements between parts 27 and 29 and the JAR. The proposals for part 27 included JAA's harmonized NPA's 27-Basic and 27–1, and the proposals for part 29 included NPA's 29-Basic and 29–1 through 29–5. This rule contains the harmonized rule language of those sections of the NPA's except for § 27.602 of NPA 27-Basic and § 29.602 of NPA 29–4.

In proposed rule, NPRM 94–36, there were several instances in which a few descriptive words were proposed to either be removed from or added to regulatory text. These word changes were adequately described in the amendatory language to NPRM 94–36 when that proposal was published in the **Federal Register.** However, at least one commenter misunderstood the amendatory language. Therefore, to avoid possible misunderstanding about the final rule language, the paragraphs with the minor rule language changes are reproduced in their entirety in this final rule. Also, the numbering of other regulations referenced in §§ 29.1587(a)(4) and (a)(5) has been changed, and a new § 29.1587(a)(6) has been added. The current § 29.1587(a)(6), which is being redesignated in this rule as § 29.1587(a)(7), was added by the Transport Category Rotorcraft Performance Rule published elsewhere in this issue of the **Federal Register.**

In this final rule, under the heading "Appendix C to Part 27—Criteria for Category A," the NPRM 94–36 cites to Advisory Circular (AC) material have been removed since AC material is advisory only. A note has been added that informs the reader that there is appropriate guidance material available. Further, the requirement to meet § 29.571 standards for certification as a part 27 Category A rotorcraft has been removed from the Appendix C listing. The FAA has determined that the current § 27.571 contains sufficient certification standards to maintain an adequate level of safety for part 27 Category A rotorcraft, and an additional requirement of testing to § 29.571 standards is unnecessary.

Discussion of Comments

Interested persons have been afforded an opportunity to participate in the making of these amendments. Due consideration has been given to the comments received. Comments were received from the JAA, HAI, Transport Canada, and the United Kingdom Civil Aviation Authority (UKCAA).

The JAA agrees with the proposed rule and the effort to harmonize certification regulations of the U.S. and the European communities. To fulfill harmonization objectives, the JAA prepared an NPA identical to the NPRM and will publish the JAR final rule at the same time as this time as this final rule for parts 27 and 29.

HAI comments that the proposals faithfully reflect the recommendation made to the FAA by the ARAC on rotorcraft regulatory changes. HAI further comments that the NPRM reflects prudent rulemaking to increase safety, economic viability, and harmonization within realistic requirements and urges the adoption of the proposal.

Transport Canada comments that the NPRM was not the same as the ARAC recommendations in that there were changes in the nonregulatory sections (preamble) and in the proposed text of the rule. The commenter states that these changes cause concern because the discrepancies may lead to different interpretations. The commenter notes that the meaning of § 29.547 was changed because the word "main" had been removed in the ARAC recommendations but was not removed in the NPRM. This commenter also states that the requirements of §§ 29.547 and 29.917 are redundant because § 29.571 also requires the identification of the principal structural elements (PSE) that includes rotors and rotor drive systems with the establishment of the inspections and replacement times for those PSE's. Additionally, the commenter says that § 29.610 should state that it addresses only "direct effects" of lightning and electricity and

that indirect effects are covered elsewhere in §§ 29.954, 29.863, 29.1309, etc. This commenter also states that § 29.1309 should retain the reference to § 29.610. This commenter also suggests adding a new requirement and paragraph to Appendix B to part 29 that would require an additional, self-powered third attitude indicator.

The FAA agrees with Transport Canada that editorial changes between the ARAC recommendations and the NPRM are a concern because the differences may lead to different interpretations. To obviate this concern, editorial changes have been made in the final rule language to make it consistent with the ARAC recommended language. Also, the FAA agrees with Transport Canada that the word "main" had been removed from the introductory paragraph of § 29.547(c), (d), and (e) in the ARAC recommended language but, as previously discussed, had not been shown as removed in the NPRM rule language. However, the word "main" is being removed from this final rule.

The FAA does not agree with this commenter that §§ 29.547, 29.571, and 29.917 are redundant in requiring identification of principal structural elements (PSE's), which include rotors and rotor drive systems, and the establishment of the inspections, replacement times of those PSE's. Section 29.547(b) requires a design assessment for main and tail rotor structure components (rotor hub, blades, pitch control mechanisms, etc); § 29.571 requires fatigue evaluation of structural components; and § 29.917 requires a design assessment of the rotor drive system (drive shafts, transmission, gearboxes, etc). Therefore, these are non redundant requirements. The language is adopted as proposed.

The FAA agrees with the intent of this commenter's suggestion that § 29.610 should clearly indicate that it addresses only "direct effects" of lightning and electricity. However, this was achieved in the NPRM by adding the word "structure" between the words "rotorcraft" and "must" in § 29.610(a) to clarify that this paragraph applied to rotorcraft structure and not to systems and equipment. Accordingly, the language is adopted as proposed.

The FAA does not agree with this commenter that § 29.1309 should retain the reference to § 29.610. The NPRM added the word "structure" to § 29.610 to clarify that the paragraph applied to rotorcraft structure and not to systems and equipment. Since § 29.1309(h) applies to lightning protection of systems and equipment, it is inappropriate to reference § 29.610, which applies to lightning protection of structures. The commenter's proposal to retain the reference to § 29.610 is not adopted.

The FAA disagrees with this commenter's suggestion that a new requirement and paragraph be added to part 29, Appendix B, to require an additional, self-powered third attitude indicator. Part 29, Appendix B, paragraph VIII(a)(2) currently requires a standby attitude indicator that is independent of the aircraft electrical generating system. Additionally, part 29, Appendix B, paragraph VIII(b)(5)(iii) states, "The equipment, systems, and installations must be designed so that one display of the information essential to the safety of flight that is provided by the instruments will remain available to a pilot, without additional crew-member action, after any single failure or combination of failures that is not shown to be extremely improbable * * *." Currently, the only practical design to meet the extremely improbable (10^{-9}) requirement of part 29, Appendix B, for the display of information essential to flight safety after a single failure or combination of failures is the design that uses a third attitude indicator powered by a source other than the aircraft electrical generating system. However, the FAA does not wish to limit future alternative designs that may meet the extremely improbable standard without a third attitude indicator. The suggestion of the commenter to add a requirement for a self-powered third attitude indicator is not adopted.

The UKCAA comments that Proposal No. 13 in NPRM 94–36 proposed to amend § 29.923(b)(3)(i), to require two applications of 2-minute power following each application of 30-second power, instead of the one application of 2-minute power previously proposed. The UKCAA fully supports the proposed changes in NPRM 94–36. However, the UKCAA further comments that since publication of NPRM 94–36, the FAA published Amendment 29–34 (59 FR 47764, September 16, 1994) that states in part, "When conducted on a bench test, the test sequence must be conducted following stabilization at take-off power." The commenter states that the reason for adding this sentence, as stated in the preamble to Amendment 29–34, remains valid, and this sentence should therefore be included in the final rule developed from NPRM 94–36.

The FAA concurs with the UKCAA that the reason for adding the sentence, "When conducted on a bench test, the test sequence must be conducted following stabilization at take-off power" remains valid and the sentence should be retained in § 29.923(b)(3)(i). The sentence was adopted in Amendment 29–34 due to a commenter's statement that if the 5-minute takeoff power run to qualify the drive system is conducted as part of the endurance run, and the 30-second/2-minute OEI requirements are conducted on a bench test, then the takeoff power 5-minute run will be conducted twice on the same set of gears. The FAA did not intend to duplicate the takeoff power 5-minute run if the OEI requirements are conducted on a bench test, and the sentence was adopted for clarification. Since the omission of the sentence in NPRM 94–36 was inadvertent, since the reasons for including the sentence remain valid, and since the sentence is relieving in nature and does not place any additional burden on manufacturers, it is unnecessary to solicit prior public comment. Therefore, the sentence is restored as requested by the commenter.

After considering all of the comments, the FAA has determined that air safety and the pubic interest support adoption of the amendments with the changes noted.

Regulatory Evaluation Summary

Proposed changes to federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic effect of regulatory changes on small entities. Third, the Office of Management and Budget directs agencies to assess the effect of regulatory changes on international trade. In conducting these analyses, the FAA has determined that this rule: (1) would generate benefits that justify its costs and is not "a significant regulatory action" as defined in the Executive Order; (2) is nonsignificant as defined in DOT's Regulatory Policies and Procedures; (3) would not have a significant impact on substantial number of small entities; and (4) will lessen restraints on international trade. These analyses, available in the docket, are summarized below.

Cost-Benefit Analysis

All of the changes to part 27 and all but four of the changes to part 29 will impose no or insignificant costs on rotorcraft manufacturers since they largely reflect current design practices. In recent years, manufacturers have incorporated engineering and structural improvements into rotorcraft designs

that exceed minimum regulatory requirements with the aim of increasing operating efficiencies, payload capabilities, and marketability in world markets. Many of these improvements have also inherently improved safety codification of these improvement and other changes will ensure continuation of enhanced safety levels in future rotorcraft designs.

The changes will also increase harmonization and commonality between U.S. and European airworthiness standards. Harmonization will eliminate the need to comply with different FAA and JAA airworthiness requirements, thus reducing manufacturers' certification costs. Based on experience in a recent certification, one rotorcraft manufacturer indicated that complying with different FAA and JAA requirements resulted in several hundred thousand dollars of excessive certification costs (as related to all part 27 and 29 requirements). The duplicate certification costs avoided by the harmonized rule alone could outweigh the relatively modest increase in certification costs imposed by the few new requirements. Following is a summary of the four changes to part 29 that will impose additional costs totaling approximately $160,000 per type certification. The safety benefits of these changes are expected to easily exceed the incremental costs.

Section 29.547—Main and tail rotor structure. While manufacturers currently perform the design assessment as an integral part of the design requirements of § 29.917, there will be some incremental costs to formalize the existing information. These costs are included in the cost estimates of § 29.917 summarized below. Formal identification and assessment of critical component failures will increase safety by providing more comprehensive maintenance information to operators. The benefits of averting a single accident will exceed the relatively low incremental costs of compliance.

Section 29.631—Bird strike. Manufacturers indicate that present rotorcraft structures can withstand impacts with 2.2 pound birds; therefore, no incremental manufacturing costs are anticipated. Nonrecurring testing and analysis costs of the requirement are estimated to be $107,000 per type certification. A review of National Transportation Safety Board (NTSB) data for the period 1983–1991 reveals two rotorcraft accidents caused by bird strikes. One accident resulted in one serious injury, one minor injury, and substantial damage to the rotorcraft (tail rotor separation); in the other accident, the rotorcraft was destroyed but there were no injuries. There is at least an equal probability of such accidents in the future, given the tendencies toward higher operating speeds. The benefits of averting a single accident will exceed the incremental costs of the amendment.

Section 29.917—Design. The incremental costs to formalize existing design information for the rotor structure (§ 29.547 above) and drive system are estimated to total $47,000 per type certification. Formal identification and assessment of critical component failures of the rotor drive system will increase safety by providing more comprehensive maintenance information to operators. The benefits of averting a single accident caused directly or indirectly by a lack of relevant data would easily exceed the incremental costs.

Section 29.1587—Performance information. Since the required climb gradient data are already available from the results of flight tests required to obtain performance information, the only additional costs will be those associated with incorporating the data into the Flight Manual, estimated to total $6,000 per type certification. The availability and accuracy of performance data are paramount to operational safety. The benefits of averting a single accident caused directly or indirectly by a lack of relevant performance information will easily exceed the incremental costs.

Regulatory Flexibility determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by Federal Regulations. The RFA requires a Regulatory Flexibility Analysis if a proposed rule would have "a significant economic impact on a substantial number of small entities." Based on the criteria of FAA Order 2100.14A, the FAA has determined that the rule will not have a significant impact on a substantial number of small entities.

The rule will affect manufacturers of future type-certificated normal (part 27) and transport category (part 29) rotorcraft. For manufacturers, Order 2100.14A defines a small entity as one with 75 or fewer employees and a significant economic impact as annualized costs of $19,000 or more. The FAA has determined that the rule will not have a significant economic impact on a substantial number of small manufacturers since (1) no part 29 and only two part 27 rotorcraft manufacturers have 75 or fewer employees, and (2) the annualized certification costs of the rule are less than $19,000.

International Trade Impact Assessment

The rule will not constitute a barrier to international trade, including the export of American rotorcraft to other countries and the import of rotorcraft into the United States. Instead, the changes will harmonize with certification procedures of the JAA and thereby enhance free trade.

Conclusion

For the reasons discussed above, including the findings in the Regulatory Flexibility Determination and the International Trade Impact Analysis, the FAA has determined that this regulation is not a significant regulatory action under Executive Order 12866. In addition, the FAA certifies that this regulation will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. This regulation is considered nonsignificant under DOT Order 2100.5. A final regulatory evaluation of the regulation, including a final Regulatory Flexibility Determination and International Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under **FOR FURTHER INFORMATION CONTACT.**

List of Subjects in 14 CFR Parts 27 and 29

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

The Amendments

In consideration of the foregoing, the Federal Aviation Administration amends parts 27 and 29 of Title 14, Code of Federal Regulations (14 CFR parts 27 and 29) as follows:

PART 27—AIRWORTHINESS STANDARDS: NORMAL CATEGORY ROTORCRAFT

1. The authority citation for part 27 continues to read as follows:

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

2. Section 27.1 is amended by adding a new paragraph (c) to read as follows:

§ 27.1 Applicability.

* * * * *

(c) Multiengine rotorcraft may be type certificated as Category A provided the requirements referenced in appendix C of this part are met.

3. Section 27.65 is amended by revising paragraphs (b)(2) introductory text and (b)(2)(ii) to read as follows:

§ 27.65 Climb: all engines operating.

* * * * *

(b) * * *

(2) The steady rate of climb must be determined—

* * * * *

(ii) Within the range from sea level up to the maximum altitude for which certification is requested;

* * * * *

4. Section 27.1141 is amended by redesignating existing paragraphs (c) and (d) as paragraphs (d) and (e) and by adding a new paragraph (c) to read as follows:

§ 27.1141 Powerplant controls: general.

* * * * *

(c) Each control must be able to maintain any set position without—

(1) Constant attention; or

(2) Tendency to creep due to control loads or vibration.

* * * * *

5. New § 27.1151 is added to read as follows:

§ 27.1151 Rotor brake controls.

(a) It must be impossible to apply the rotor brake inadvertently in flight.

(b) There must be means to warn the crew if the rotor brake has not been completely released before takeoff.

6. Part 27 is amended by adding a new appendix C to read as follows:

Appendix C to Part 27—Criteria for Category A

C27.1 General.

A small multiengine rotorcraft may not be type certificated for Category A operation unless it meets the design installation and performance requirements contained in this appendix in addition to the requirements of this part.

C27.2 Applicable part 29 sections. The following sections of part 29 of this chapter must be met in addition to the requirements of this part:

29.45(a) and (b)(2)—General.
29.49(a)—Performance at minimum operating speed.
29.51—Takeoff data: General.
29.53—Takeoff: Category A.
29.55—Takeoff decision point: Category A.
29.59—Takeoff Path: Category A.
29.60—Elevated heliport takeoff path: Category A.
29.61—Takeoff distance: Category A.
29.62—Rejected takeoff: Category A.
29.64—Climb: General.
29.65(a)—Climb: AEO.
29.67(a)—Climb: OEI.
29.75—Landing: General.
29.77—Landing decision point: Category A.
29.79—Landing: Category A.
29.81—Landing distance (Ground level sites): Category A.
29.85—Balked landing: Category A.
29.87(a)—Height-velocity envelope.
29.547(a) and (b)—Main and tail rotor structure.
29.861(a)—Fire protection of structure, controls, and other parts.
29.901(c)—Powerplant: Installation.
29.903(b) (c) and (e)—Engines.
29.908(a)—Cooling fans.
29.917(b) and (c)(1)—Rotor drive system: Design.
29.927(c)(1)—Additional tests.
29.953(a)—Fuel system independence.
29.1027(a)—Transmission and gearboxes: General.
29.1045(a)(1), (b), (c), (d), and (f)—Climb cooling test procedures.
29.1047(a)—Takeoff cooling test procedures.
29.1181(a)—Designated fire zones: Regions included.
29.1187(e)—Drainage and ventilation of fire zones.
29.1189(c)—Shutoff means.
29.1191(a)(1)—Firewalls.
29.1193(e)—Cowling and engine compartment covering.
29.1195(a) and (d)—Fire extinguishing systems (one shot).
29.1197—Fire extinguishing agents.
29.1199—Extinguishing agent containers.
29.1201—Fire extinguishing system materials.
29.1305(a) (6) and (b)—Powerplant instruments.
29.1309(b)(2) (i) and (d)—Equipment, systems, and installations.
29.1323(c)(1)—Airspeed indicating system.
29.1331(b)—Instruments using a power supply.
29.1351(d)(2)—Electrical systems and equipment: General (operation without normal electrical power).
29.1587(a)—Performance information.

Note: In complying with the paragraphs listed in paragraph C27.2 above, relevant material in the AC "Certification of Transport Category Rotorcraft" should be used.

PART 29—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT

7. The authority citation for part 29 continues to read as follows:

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

8. Section 29.547 is amended by revising the heading; by revising paragraph (a); by revising the introductory text in paragraphs (c), (d), and (e); by revising paragraph (e)(1)(ii); and by adding paragraph (b) to read as follows:

§ 29.547 Main and tail rotor structure.

(a) A rotor is an assembly of rotating components, which includes the rotor hub, blades, blade dampers, the pitch control mechanisms, and all other parts that rotate with the assembly.

(b) Each rotor assembly must be designed as prescribed in this section and must function safely for the critical flight load and operating conditions. A design assessment must be performed, including a detailed failure analysis to identify all failures that will prevent continued safe flight or safe landing, and must identify the means to minimize the likelihood of their occurrence.

(c) The rotor structure must be designed to withstand the following loads prescribed in §§ 29.337 through 29.341 and 29.351:

* * * * *

(d) The rotor structure must be designed to withstand loads simulating—

* * * * *

(e) The rotor structure must be designed to withstand the limit torque at any rotational speed, including zero. In addition:

(1) * * *

* * * * *

(ii) For the main rotor, the limit engine torque specified in § 29.361.

* * * * *

9. Section 29.610 is amended by revising the heading; by revising paragraph (a); and by adding a new paragraph (d) to read as follows:

§ 29.610 Lightning and static electricity protection.

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

* * * * *

(d) The electric bonding and protection against lightning and static electricity must—

(1) Minimize the accumulation of electrostatic charge;

(2) Minimize the risk of electric shock to crew, passengers, and service and maintenance personnel using normal precautions;

(3) Provide an electrical return path, under both normal and static electricity on the functioning of essential electrical and electronic equipment.

(4) Reduce to an acceptable level the effects of lightning and static electricity on the functioning of essential electronic equipment.

10. Section 29.629 is revised to read as follows:

§ 29.629 Flutter and divergence.

Each aerodynamic surface of the rotorcraft must be free from flutter and divergence under each appropriate speed and power condition.

11. Section 29.631 is added before the undesignated center heading, "Rotors" to read as follows:

§ 29.631 Bird strike.

The rotorcraft must be designated to ensure capability of continued safe flight and landing (for Category A) or safe landing (for Category B) after impact with a 2.2-lb (1.0 kg) bird when

the velocity of the rotorcraft (relative to the bird along the flight path of the rotorcraft) is equal to V_{NE} or V_H (whichever is the lesser) at altitudes up to 8,000 feet. Compliance must be shown by tests or by analysis based on tests carried out on sufficiently representative structures of similar design.

12. Section 29.917 is amended by redesignating existing paragraph (b) as (c) and by adding a new paragraph (b) to read as follows:

§ 29.917 Design.

* * * * *

(b) Design assessment. A design assessment must be performed to ensure that the rotor drive system functions safely over the full range of conditions for which certification is sought. The design assessment must include a detailed failure analysis to identify all failures that will prevent continued safe flight or safe landing and must identify the means to minimize the likelihood of their occurrence.

* * * * *

13. Section 29.923 is amended by revising paragraph (b)(3)(i) to read as follows:

§ 29.923 Rotor drive system and control mechanism tests.

* * * * *

(b) * * *

(3) * * *

(i) Immediately following any one 5-minute power-on run required by paragraph (b)(1) of this section, simulate a failure for each power source in turn, and apply the maximum torque and the maximum speed for use with 30-second OEI power to the remaining affected drive system power inputs for not less than 30 seconds. Each application of 30-second OEI power must be followed by two applications of the maximum torque and the maximum speed for use with the 2 minute OEI power for not less than 2 minutes each; the second application must follow a period at stabilized continuous or 30 minute OEI power (whichever is requested by the applicant). At least one run sequence must be conducted from a simulated "flight idle" condition. When conducted on a bench test, the test sequence must be conducted following stabilization at take-off power.

* * * * *

14. Section 29.1305 is amended by redesignating existing paragraphs (a)(6) through (a)(25) as paragraphs (a)(7) through (a)(26) and by adding a new paragraph (a)(6) to read as follows:

§ 29.1305 Powerplant instruments

* * * * *

(a) * * *

(6) An oil pressure indicator for each pressure-lubricated gearbox.

* * * * *

15. Section 29.1309 is amended by revising paragraph (h) to read as follows:

§ 29.1309 Equipment, systems, and installations

* * * * *

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

16. Section 29.1351(d) is revised to read as follows:

§ 29.1351 General

* * * * *

(d) Operation with the normal electrical power generating system inoperative.

(1) It must be shown by analysis, tests, or both, that the rotorcraft can be operated safely in VFR conditions for a period of not less than 5 minutes, with the normal electrical power generating system (electrical power sources excluding the battery) inoperative, with critical type fuel (from the standpoint of flameout and restart capability), and with the rotorcraft initially at the maximum certificated altitude. Parts of the electrical system may remain on if—

(i) A single malfunction, including a wire bundle or junction box fire, cannot result in loss of the part turned off and the part turned on;

(ii) The parts turned on are electrically and mechanically isolated from the parts turned off; and

(iii) The electrical wire and cable insulation, and other materials, of the parts turned on are self-extinguishing when tested in accordance with § 25.1359(d) in effect on September 1, 1977.

(2) Additional requirements for Category A Rotorcraft.

(i) Unless it can be shown that the loss of the normal electrical power generating system is extremely improbable, an emergency electrical power system, independent of the normal electrical power generating system, must be provided, with sufficient capacity to power all systems necessary for continued safe flight and landing.

(ii) Failures, including junction box, control panel, or wire bundle fires, which would result in the loss of the normal and emergency systems, must be shown to be extremely improbable.

(iii) Systems necessary for immediate safety must continue to operate following the loss of the normal electrical power generating system, without the need for flight crew action.

17. Section 29.1587 is amended by redesignating (a)(6) as (a)(7), by removing "and" from the end of paragraph (a)(5), and by adding a new paragraph (a)(6) to read as follows:

§ 29.1587 Performance information.

* * * * *

(a) * * *

(6) The steady gradient of climb for each weight, altitude, and temperature for which takeoff data are to be scheduled, along the takeoff path determined in the flight conditions required in § 29.67(a)(1) and (a)(2):

(i) In the flight conditions required in § 29.67(a)(1) between the end of the takeoff distance and the point at which the rotorcraft is 200 feet above the takeoff surface (or 200 feet above the lowest point of the takeoff profile for elevated heliports);

(ii) In the flight conditions required in § 29.67(a)(2) between the points at which the rotorcraft is 200 and 1000 feet above the takeoff surface (or 200 and 1000 feet above the lowest point of the takeoff profile for elevated heliports); and

* * * * *

18. Part 29 Appendix B is amended by adding a new paragraph VIII(b)(6) to read as follows:

Appendix B to Part 29—Airworthiness Criteria for Helicopter Instrument Flight

* * * * *

VIII * * *

(b) * * *

(6) In determining compliance with the requirements of § 29.1351(d)(2), the supply of electrical power to all systems necessary for flight under IFR must be included in the evaluation.

Issued in Washington, DC, on May 2, 1996.

David R. Hinson,

Administrator.

[FR Doc. 96–11493 Filed 5–9–96; 8:45 am]

BILLING CODE 4910–13–M

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject:	CERTIFICATION OF TRANSPORT CATEGORY ROTORCRAFT	Date:	7/30/97	AC No:	29-2B
		Initiated by:	ASW-110	Change:	

1. PURPOSE:

a. This is a total revision of AC 29-2A dated 9/16/87, with changes 1, 2, and 3, dated 4/24/89, 9/24/91, and 6/1/95 respectively, incorporated. In addition, new material plus changes to existing paragraphs have been incorporated. This consolidated version is now renumbered as AC 29-2B and replaces AC 29-2A in its entirety. This revises existing material in 25 paragraphs and adds new material for 33 paragraphs.

b. b. This AC does not change regulatory requirements and does not authorize changes in, or deviations from regulatory requirements. This AC establishes an acceptable means, but not the only means of compliance. Since the guidance material presented in this AC is not regulatory, terms having a mandatory definition, such as "shall" and "must," etc., as used in this AC, apply either to the reiteration of a regulation itself, or to an applicant who chooses to follow a prescribed method of compliance without deviation.

c. This advisory circular provides information on methods of compliance with 14 CFR Part 29, which contains the Airworthiness Standards for Transport Category Rotorcraft. It includes methods of compliance in the areas of basic design, ground tests, and flight tests.

2. CANCELLATION. AC 29-2A, Certification of Transport Category Rotorcraft, September 16, 1987, is canceled in its entirety.

3. BACKGROUND. Based largely on precedents set during rotorcraft certification programs spanning the past 39 years, this AC consolidates guidance contained in earlier correspondence among FAA headquarters, foreign authorities, the rotorcraft industry, and certificating regions.

4. PRINCIPAL CHANGES:

a. Paragraphs 31A, 32, 45, 47, 55, 57, 64, 69, 71, 72, 140A, 245, 337, 596, 618, 619, 621, 633, 641, 652, 653, 726, 765, 775, and 777 are revised to incorporate technical guidance.

b. New paragraphs 42A, 55B, 56, 57A, 58A, 59, 60A, 66A, 67A, 70A, 71A, 72A, 140B, 152A, 205A, 218B, 252A, 254, 329B, 359A, 397B, 398C, 421A, 423C, 447, 454B, 456A, 459A, 460B, 563B, 619B, 619C, 724B, and 765A are added to Chapter 2.

c. New paragraph 781A is added to Chapter 3.

d. Paragraph 447, § 29.951, General, is renumbered to Paragraph 446. Paragraph 447 now addresses § 29.952, Fuel Systems Crash Resistance.

e. The following appendices have been added:

Appendix 2 One-Engine-Inoperative (OEI) Power Assurance

Appendix 3 Rotorburst

f. Use of the term "FAA/AUTHORITY" replaces "FAA" as appropriate. "FAA/AUTHORITY" as used in this document means FAA or another airworthiness authority that has adopted this AC as a means of compliance with the appropriate regulation referenced.

5. DEVIATIONS. As rotorcraft designs vary from conventional configurations, it may become necessary to deviate from the methods and procedures outlined in this AC. These procedures are only one acceptable means of compliance with Part 29. Any alternate means proposed by an applicant will be given due consideration. Applicants are encouraged to use their technical ingenuity and resourcefulness to develop more efficient and less costly methods of achieving the objectives of Part 29. Regulatory personnel and designees should respond to such efforts by the use of engineering judgment in fostering any such efforts as long as the letter and spirit of Part 29 and the Federal Aviation Act are respected. It is recommended that unusual or unique projects be coordinated a sufficient time in advance with the Rotorcraft Standards Staff, ASW-110, or the appropriate airworthiness authority, to ensure timely and uniform consideration.

6. APPLICABILITY. This material is not to be construed as having any legally binding status and must be treated as advisory only. However, to ensure standardization in the certification process, these procedures should be considered during all rotorcraft type certification and supplemental type certification activities.

7. PARAGRAPHS KEYED TO FAR PART 29. Each paragraph has the applicable amendment to Part 29 shown in the title. All of the original guidance material has been retained as appropriate, even as changes are made to the regulations. This is accomplished through the use of "A," "B," etc., paragraphs which follow the original numbered paragraphs. These subsequent paragraphs provide updated guidance information or changes to policy that parallel a specific rule change. The guidance material in the original paragraph (for earlier amendments) still applies and is modified as explained in each of the later paragraphs for later amendments. The applicable amendment number will only appear in the title line for the "A," "B," etc., paragraphs. The guidance material in the initial paragraph is intended to apply to all amendments except as modified by the later paragraphs. Each ensuing "A," "B," etc., paragraph will be identified with an amendment level to indicate the rule change that precipitated the policy change.

8. RELATED PUBLICATIONS. FAA Certification personnel and designees should be familiar with Order 8110.4, Type Certification, and Order 8100.5, Aircraft Certification Directorate Procedures.

Eric Bries
Acting Manager, Rotorcraft Directorate
Aircraft Certification Service

APPENDIX 3
ADVISORY MATERIAL FOR COMPLIANCE WITH ROTORBURST RULE

1. PURPOSE. This advisory material sets forth a method of compliance with the requirements of §§ 29.901, 29.903(b)(1), and 29.903(d)(1) of the Federal Aviation Regulations (FAR) pertaining to design precautions taken to minimize the hazards to rotorcraft in the event of uncontained engine rotor (compressor and turbine) failure. It is for guidance and to provide a method of compliance that has been found acceptable. As with all AC material, it is not mandatory and does not constitute a regulation.

2. RELATED FAR/JAR SECTIONS. Sections 29.901(c) and 29.903(d)(1) of the FAR/JAR.

3. BACKGROUND. Although turbine engine manufacturers are making efforts to reduce the probability of uncontained rotor failures, service experience shows that such failures continue to occur. Failures have resulted in high velocity fragment penetration of fuel tanks, adjacent structures, fuselage, system components and other engines of the rotorcraft. Since it is unlikely that uncontained rotor failures can be completely eliminated, rotorcraft design precautions should be taken to minimize the hazard from such events. These design precautions should recognize rotorcraft design features that may differ significantly from that of an airplane, particularly regarding an engine location and its proximity to another engine or to other systems and components.

a. Uncontained gas turbine engine rotor failure statistics for rotorcraft are presented in the Society of Automotive Engineers (SAE) Report No.'s AIR 4003 (period 1976-83) and AIR 4770 (period 1984-89).

b. The statistics in the SAE studies indicate the existence of some failure modes not readily apparent or predictable by failure analysis methods. Because of the variety of uncontained rotor failures, it is difficult to analyze all possible failure modes and to provide protection to all areas. However, design considerations outlined in this AC provide guidelines for achieving the desired objective of minimizing the hazard to rotorcraft from uncontained rotor failures. These guidelines, therefore, assume a rotor failure will occur and that analysis of the effects or evaluation of this failure is necessary. These guidelines are based on service experience and tests but are not necessarily the only means available to the designer.

4. DEFINITIONS.

a. Minimize. Means to reduce to the least possible amount by means that can be shown to be both technically feasible and economically justifiable.

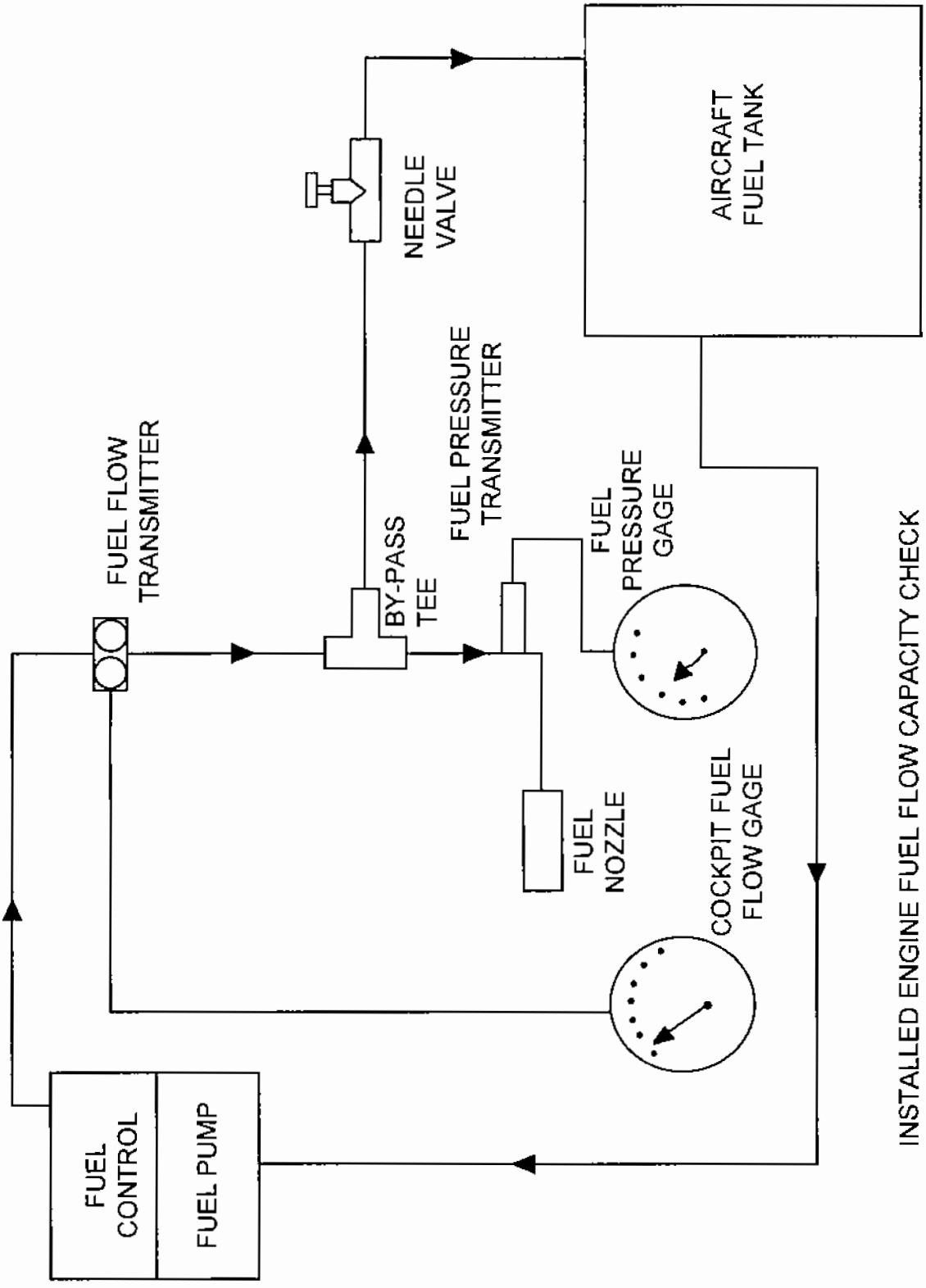


FIGURE APX2-1

b. Separation. Positioning of redundant critical structure, systems, or system components within the impact area such that the distance between the components minimizes the potential impact hazard. Redundant critical components should be separated within the spread angles of a rotor by a distance at least equal to either a ½ unbladed disk (hub, impeller) sector, or a 1/3 bladed disk (hub, impeller) sector with 1/3 blade height, with each rotating about its center of gravity (CG), whichever is greater (See Figure APX3-6).

c. Isolation. A means to limit system damage so as to maintain partial or full system function after the system has been damaged by fragments. Limiting the loss of hydraulic fluid by the use of check valves to retain the capability to operate flight controls is an example of "isolation." System damage is confined allowing the retention of critical system functions.

d. Rotor. Rotor means the rotating components of the engine and APU that analysis, test results, and/or experience has shown can be released during uncontained failure with sufficient energy to hazard the rotorcraft.

The engine or APU manufacturer should define those components that constitute the rotor for each engine and APU type design. Typical rotors have included, as a minimum, disks, hubs, drums, seals, impellers, and spacers.

e. Uncontained Engine or APU Failure (or Rotorburst). For the purposes of rotorcraft evaluations in accordance with this AC, uncontained failure of a turbine engine is any failure which results in the escape of rotor fragments from the engine or APU that could create a hazard to the rotorcraft. Rotor failures of concern are those in which released fragments have sufficient energy to create a hazard to the rotorcraft. Uncontained failures of APU's which are "ground operable only" are not considered hazardous to the rotorcraft.

f. Critical Component (System). A critical component is any component or system whose failure or malfunction would contribute to or cause a failure condition that would prevent the continued safe flight and landing of the rotorcraft. These components (systems) should be considered on an individual basis and in relation to other components (systems) that could be degraded or rendered inoperative by the same fragment or by other fragments during any uncontained failure event.

g. Fragment Spread Angle. The fragment spread angle is the angle measured, fore and aft, from the center of the plane of rotation of the disk (hub, impeller) or other rotor component initiating at the engine or APU shaft centerline or axis of rotation (See Figure APX3-1). The width of the fragment should be considered in defining the path of the fragment envelope's maximum dimension.

h. Ignition Source. Any component that could precipitate a fire or explosion. This includes existing ignition sources and potential ignition sources due to damage or fault

from an uncontained rotor failure. Potential ignition sources include hot fragments, damage or faults that produce sparking, arcing, or overheating above the auto-ignition temperature of the fuel. Existing ignition sources include items such as unprotected engine or APU surfaces with temperature greater than the auto-ignition temperature of the fuel or any other flammable fluid.

5. SAFETY ASSESSMENT.

a. Procedure. Assess the potential hazard to the rotorcraft using the following procedure:

(1) Minimizing Rotorburst Hazard. The rotorburst hazard should be reduced to the lowest level that can be shown to be both technically feasible and economically justifiable. The extent of minimization that is possible will vary from new or amended certification projects and from design to design. Thus the effort to minimize must be determined uniquely for each certification project. Design precautions and techniques such as location, separation, isolation, redundancy, shielding, containment and/or other appropriate considerations should be employed, documented, agreed to by the certifying authority, and placed in the type data file. A discussion of these methods and techniques follows.

(2) Geometric Layout and Safety Analysis. The applicant should prepare a preliminary geometric layout and safety analysis for a minimum rotorburst hazard configuration determination early in the design process and present the results to the certification authority no later than when the initial design is complete. Early contact and coordination with the certifying authority will minimize the need for design modification later in the certification process. The hazard analysis should follow the guidelines indicated in Paragraph 397c(2) in this Advisory Circular and (5)(f) of this appendix. Geometric layouts and analysis should be used to evaluate and identify engine rotorburst hazards to critical systems, powerplants, and structural components from uncontained rotor fragments, and to determine any actions which may be necessary to further minimize the hazard. Calculated geometric risk quantities may be used in accordance with Paragraph (d) following, to define the rotorcraft configuration with the minimum physical rotorburst hazard.

b. Engine and APU Failure Model. The safety analysis should be made using the following engine and APU failure model, unless for the particular engine/APU type concerned, relevant service experience, design data, test results or other evidence justify the use of a different model. In particular, a suitable failure model may be provided by the engine/APU manufacturer. This may show that one or more of the considerations below do not need to be addressed.

(1) Single One-Third Disc Fragment. It should be assumed that the one-third disc fragment has the maximum dimension corresponding to one-third of the disc with one-third blade height and a fragment spread angle of ±3°. Where energy

considerations are relevant, the mass should be assumed to be one-third of the bladed disc mass and its energy--the translational energy (i.e., neglecting rotational energy) of the sector (See Figure APX3-2).

(2) Intermediate Fragments. It should be assumed that the intermediate fragment has a maximum dimension corresponding to one third or the disc radius with one-third blade height and a fragment spread angle of ±5°. Where energy considerations are relevant, the mass should be assumed to be 1/30th of the bladed disc mass and its energy--the translational energy (neglecting rotational energy) of the piece traveling at rim speed (See Figure APX3-3).

(3) Alternative Engine Failure Model. For the purpose of the analysis, as an alternative to the engine failure model of sections (1) and (2) above, the use of a single one-third piece of disc having a fragment spread angle of ±5° would be acceptable, provided that the objectives of the analysis are satisfied.

(4) Small Fragments. It should be assumed that small fragments have a maximum dimension corresponding to the tip half of the blade airfoil and a fragment spread angle of ±15°. Where energy considerations are relevant, the mass should be assumed to be corresponding to the above fragment dimensions and the energy is the translational energy (neglecting rotational energy) of the fragment traveling at the speed of its CG location. The effects of multiple small fragments should be considered during this assessment.

(5) Critical Engine Speed. Where energy considerations are relevant, the uncontained rotor event should be assumed to occur at the engine shaft speed for the maximum rating appropriate to the flight phase (exclusive of OEI ratings), unless the most probable mode of failure would be expected to result in the engine rotor reaching a red line speed or a design burst speed. For APU's, use the maximum rating appropriate to the flight phase or the speed resulting from a failure of any one of the normal engine control systems.

(6) APU Failure Model. Service experience has shown that some APU rotor failures produced fragments having significant energy to have been expelled through the APU tailpipe. For the analysis, the applicable APU service history and test results should be considered in addition to the failure model as discussed in Paragraph 5(b) above for certification of APU installations near critical items. In addition, the APU installer needs to address the rotorcraft hazard associated with APU debris exiting the tailpipe. Applicable service history or test results provided by the APU manufacturer may be used to define the tailpipe debris size, mass, and energy. The uncontained APU rotor failure model is dependent upon the design/analysis, test results and service experience.

(A) For APU's in which rotor integrity and blade containment have been demonstrated in accordance with TSO-C77a/JAR APU, i.e., without specific

containment testing, paragraphs 5(b)(1), 5(b)(2), and 5(b)(4) or Paragraph 5(b)(3) and 5(b)(4) apply. If shielding of critical airframe components is proposed, the energy level that should be considered is that of the tri-hub failure released at the critical speed as defined in Paragraph 5(b)(5). The shield and airframe mounting point(s) should be shown to be effective at containing both primary and secondary debris at angles specified by the failure model.

(B) For APU rotor stages qualified as contained in accordance with the TSO, an objective review of the APU location should be made to ensure the hazard is minimized in the event of an uncontained APU rotor failure. Historical data shows that in-service uncontained failures have occurred on APU rotor stages qualified as contained per the TSO. These failure modes have included bi-hub and overspeed failure resulting in some fragments missing the containment ring. In order to address these hazards, the installer should use the small fragment failure model, or substantiated in-service data supplied by the APU manufacturer. Analytical substantiation for the shielding system if proposed is acceptable for showing compliance.

c. Engine/APU Rotorburst Data. The engine or APU manufacturer should provide the required engine data to accomplish the evaluation and analysis necessary to minimize the rotorburst hazard such as:

(1) Engine failure model (range of fragment sizes, spread angles and energy).

(2) Engine rotorburst probability assessment.

(3) List of components constituting the rotors.

d. Fragment Impact Risks. FAA/AUTHORITY research and development studies have shown that, for rotorcraft conventional configurations (one main rotor and one tail rotor), the main and tail rotorblades have minimal risks from a rotorburst, and thus, they require no special protection. However, unique main and tail rotor blade configurations should be carefully reviewed. Certain zones of the tail rotor drive shaft and other critical parts which may be necessary for continued safe flight and landing may not have natural, minimal risk from uncontained rotor fragments.

e. Engine Service History/Design. For the purpose of a gross assessment of the vulnerability of the rotorcraft to an uncontained rotorburst, it must be taken that an uncontained engine rotor failure (burst) will occur. However, in determining the overall risk to the rotorcraft, engine service history and engine design features should be included in showing compliance with § 29.903 to minimize the hazard from uncontained rotor failures. This is extremely important since the engine design and/or the service history may provide valuable information in assessing the potential for a rotorburst occurring and this should be considered in the overall safety analysis.

Information contained in the recent SAE studies (see Paragraph (3)(a) should be considered in this evaluation.

f. Certification Data File. A report, including all geometric layouts, that details all the aspects of minimizing the engine rotorburst hazards to the rotorcraft should be prepared by the applicant and submitted to the certification authority. Items which should be included in this report are the identification of all hazardous failures that could result from engine rotor failure strikes and their consequences (i.e., an FMEA or equivalent analysis) and the design precautions and features taken to minimize the identified hazards that could result from rotor failure fragment strikes. Thus an analysis that lists all the critical components; quantifies and ranks their associated rotorburst hazard; and clearly shows the minimization of that quantified, ranked hazard to the "maximum practicable extent" should be generated and agreed upon during certification. Critical components should all be identified and their rotorburst hazard quantified, ranked, and minimized where necessary. Design features in which the design precautions of this guidance material are not accomplished should be identified along with the alternate means used to minimize the hazard. To adequately address minimizing the hazards, all rotorcraft design disciplines should be involved in the applicant's compliance efforts and report preparation.

6. DESIGN CONSIDERATIONS. Practical design precautions should be used to minimize the damage that can be caused by uncontained engine and APU rotor debris. The following design considerations are recommended:

a. Consider the location of the engine and APU rotors relative to critical components, or areas of the rotorcraft such as:

(1) Opposite Engine - Protection of the opposite engine from damage from 1/3 disc rotor fragments may not be feasible. Protection of the opposite engine from other fragments may be provided by locating critical components, such as engine accessories essential for proper engine operation (e.g. high pressure fuel lines, engine controls and wiring, etc.), in areas where inherent shielding is provided by the fuselage, engine, or other structure.

(2) Engine Controls - Controls for the remaining engine(s) that pass through the uncontained engine failure zone should be separated/protected to the maximum extent practicable.

(3) Primary Structure of the Fuselage.

(4) Flight Crew - The flight crew is considered a critical component.

(5) Fuel system components, piping and tanks, including fuel tank access panels (NOTE: Spilled fuel into the engine or APU compartments, on engine cases or on other critical components or areas could create a fire hazard.)

(6) Critical control systems, such as primary and secondary flight controls, electrical power cables, systems and wiring, hydraulic systems, engines control systems, flammable fluid shut-off valves, and the associated actuation wiring or cables.

(7) Engine and APU fire extinguisher systems including electrical wiring and fire extinguishing agent plumbing to engine and APU compartments.

(8) Instrumentation necessary for continued safe flight and landing.

(9) Transmission and rotor drive shafts.

b. Location of Critical Systems and Components. The following design practices have been used to minimize hazards to critical components:

(1) Locate, if possible, critical components or systems outside the likely debris impact areas.

(2) Duplicate and separate critical components or systems if located in debris impact areas or provide suitable protection.

(3) Protection of critical systems and components can be provided by using airframe structure where shown to be suitable.

(4) Locate fluid shutoffs so that flammable fluids can be isolated in the event of damage to the system. Design and locate the shut-off actuation means in protected areas or outside debris impact areas.

(5) Minimize the flammable fluid spillage which could contact an ignition source.

(6) For airframe structural elements, provide redundant designs or crack stoppers to limit the subsequent tearing which could be caused by uncontained rotor fragments.

(7) Consider the likely damage caused by multiple fragments.

(8) Fuel tanks should not be located in impact areas. However, if necessitated by the basic configuration requirements of the rotorcraft type to locate fuel tanks in impact areas, then the engine rotorburst hazard should be minimized by use of design features such as minimization of hazardous fuel spillage (that could contact an ignition source by drainage or migration); by drainage of leaked fuel quickly and safely into the airstream; by proper ventilation of potential spillage areas; by use of shielding; by use of explosion suppression devices (i.e., explosion resistant foam or inert gases); and by minimization of potential fuel ignition sources or by other methods to reduce the hazard.

(9) The rotor integrity or containment capability demonstrated during APU evaluation to TSO-C77a, or JAR-APU should be considered for installation certification.

(10) The flight data recorder, cockpit voice recorder, and emergency locator transmitter, if required, should be located outside the impact zone when practical.

(11) Items such as human factors, pilot reaction time, and correct critical system status indication in the pilot compartment after an uncontained engine failure has occurred should be considered in design to permit continued safe flight and landing.

c. Rotorcraft Modifications. Modifications made to rotorcraft certified to this rule should be assessed with the considerations of this AC. These modifications include but are not limited to re-engining installations (including conversion from reciprocating to turbine powered), APU installations, fuselage stretch, and auxiliary fuel tank installations. Auxiliary fuel tank(s) should be located as much as practical so as to minimize the risk that this tank(s) will be hit by rotor failure fragments. The need to remain within the approved CG limits of the aircraft will of necessity limit the degree to which the risk may be minimized.

7. PROTECTIVE MEASURES. The following list is provided for consideration as some measures which may be used to minimize effects of a rotorburst:

a. Powerplant Containment.

(1) Engine Rotor Fragment Containment. It should be clearly understood that containment of rotor fragments is not a requirement. However, it is one of many options which may be used to minimize the hazards of an engine rotorburst. Containment structures (either around the engine, or APU, or on the rotorcraft) that have been demonstrated to provide containment should be accepted as minimizing the hazard defined by the rotor failure model for that particular rotor component. Contained rotor in-service failures may be used to augment any design or test data. Containment material stretch and geometric deformation should be considered in conjunction with fragment energies and trajectories in defining the hazards to adjacent critical components such as structures, system components, fluid lines, and control systems. Data obtained during containment system testing along with analytical data and service experience should be used for this evaluation.

(2) APU Containment. Rotor integrity or containment capability demonstrated during APU TSO evaluation should be considered for installation certification. If rotor containment option was shown by analysis or rig test an objective review of the APU location should be made to ensure the hazard is minimized in the event of an uncontained APU rotor failure.

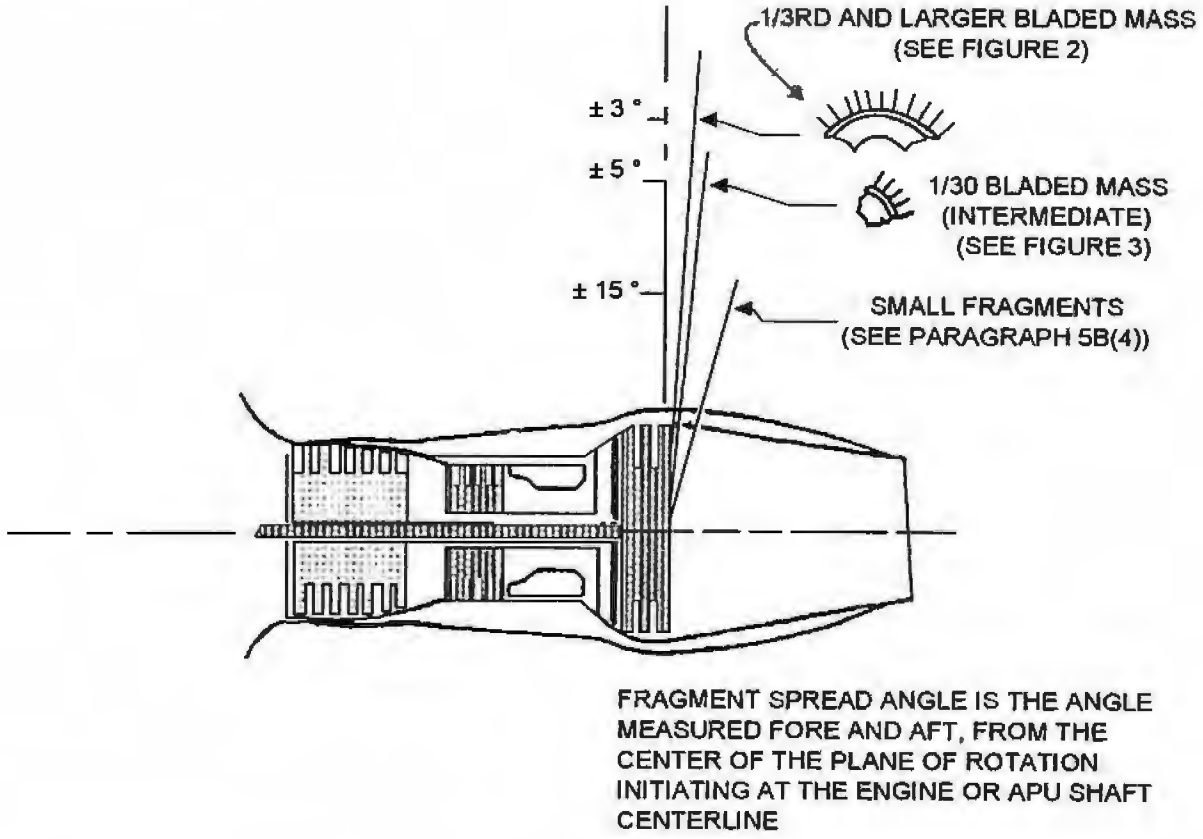
b. Shields and Deflectors. When shields, deflection devices, or intervening rotorcraft structure are used to protect critical systems or components, the adequacy of the protection should be shown by testing or analysis supported by test data, using the impact area, fragment mass, and fragment energies based on the definitions stated herein. Analytical methods used to compute protective armor or shielding thicknesses and energy absorption requirements should reflect established methods, acceptable to the certifying authority, that are supported by adequate test evidence. Protective armor, shielding, or deflectors that stop, slow down, or redirect uncontained fragments redistribute absorbed energy into the airframe. The resulting loads are significant for large fragments and should be considered as basic load cases for structural analysis purposes (reference § 29.301). These structural loads should be defined and approved as ultimate loads acting alone. The protective devices and their supporting airframe structures should be able to absorb or deflect the fragment energies defined herein and still continue safe flight and landing. If hazardous, the deflected fragment trajectories and residual energies should also be considered.

c. Isolation or Redundancy.

(1) Other Engines - Although other engines may be considered critical, engine isolation from rotorburst on multi-engine rotorcraft is not mandatory. Other methods of minimizing the risk to the engine(s) may be acceptable.

(2) Other Critical Components - Isolation or redundancy of other critical components, the failure of which would not allow continued safe flight and landing should be evaluated relative to the risk of occurrence and where the risk is deemed unacceptable isolation or shielding or other means of reducing the risk should be incorporated.

d. Composite Materials. If containment devices, shields, or deflectors are chosen by the applicant to be wholly or partially made from composites; they should comply with the structural requirements of AC 20-107A, "Composite Aircraft Structure," and Paragraph 788 of this AC, "Substantiation of Composite Rotorcraft Structure," (which includes glass transition temperature considerations). Glass transition temperature considerations are critical for proper certification of composite or composite hybrid structures used in temperature zones that reach or exceed 200° to 250°F (93° to 121°C) for significant time periods. Hot fragment containment is typically accommodated in such protective devices by use of metal-composite hybrid designs that use the metal component's properties to absorb the fragment heat load after the entire hybrid structure has absorbed the fragment's impact load. These devices should comply with §§ 29.609 and 29.1529 to ensure continued airworthiness.

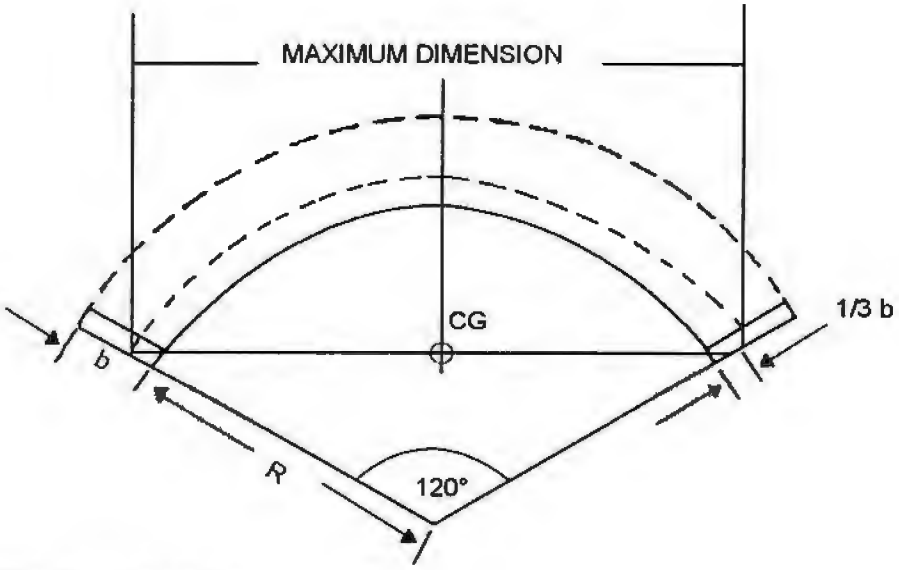


NOTE: 1) THE POSSIBILITY OF TURBINE MOVEMENT SHOULD BE CONSIDERED.

2) ALL ROTORS ARE CONSIDERED TO BE FULLY BLADED FOR CALCULATING MASS.

3) FAILURE OF EACH ROTOR STAGE SHOULD BE CONSIDERED.

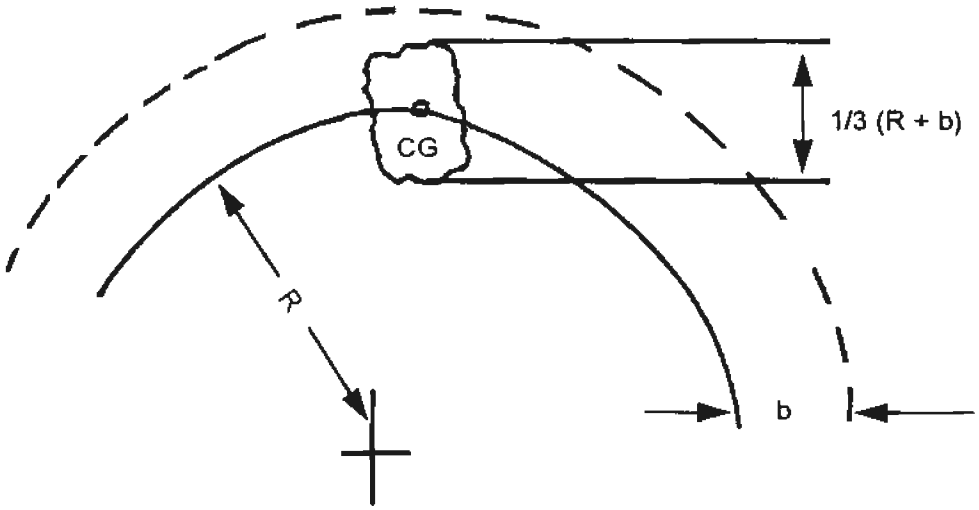
FIGURE APX3-1. ESTIMATED PATH OF FRAGMENTS



Where R = disc radius
b = blade length

The CG is taken to lie on the maximum dimension as shown.

FIGURE APX3-2. SINGLE ONE-THIRD DISC FRAGMENT



Where R = disc radius
b = blade length

Maximum dimension = 1/3 (R + b)

Mass assumed to be 1/ 30 th of bladed disc

CG is taken to lie on the disc rim

FIGURE APX3-3. INTERMEDIATE AND SMALL PIECES OF DEBRIS

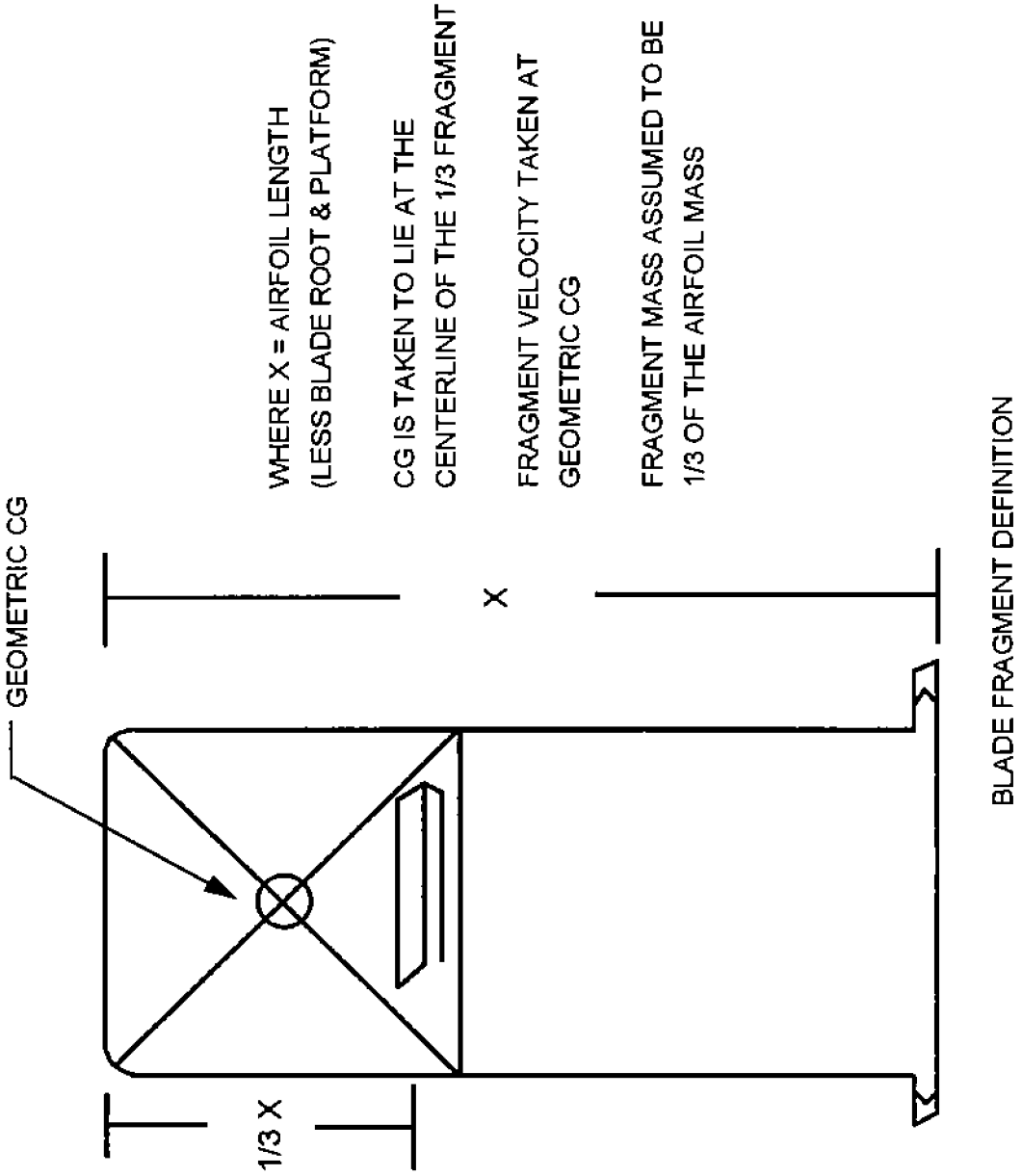


FIGURE APX3-4

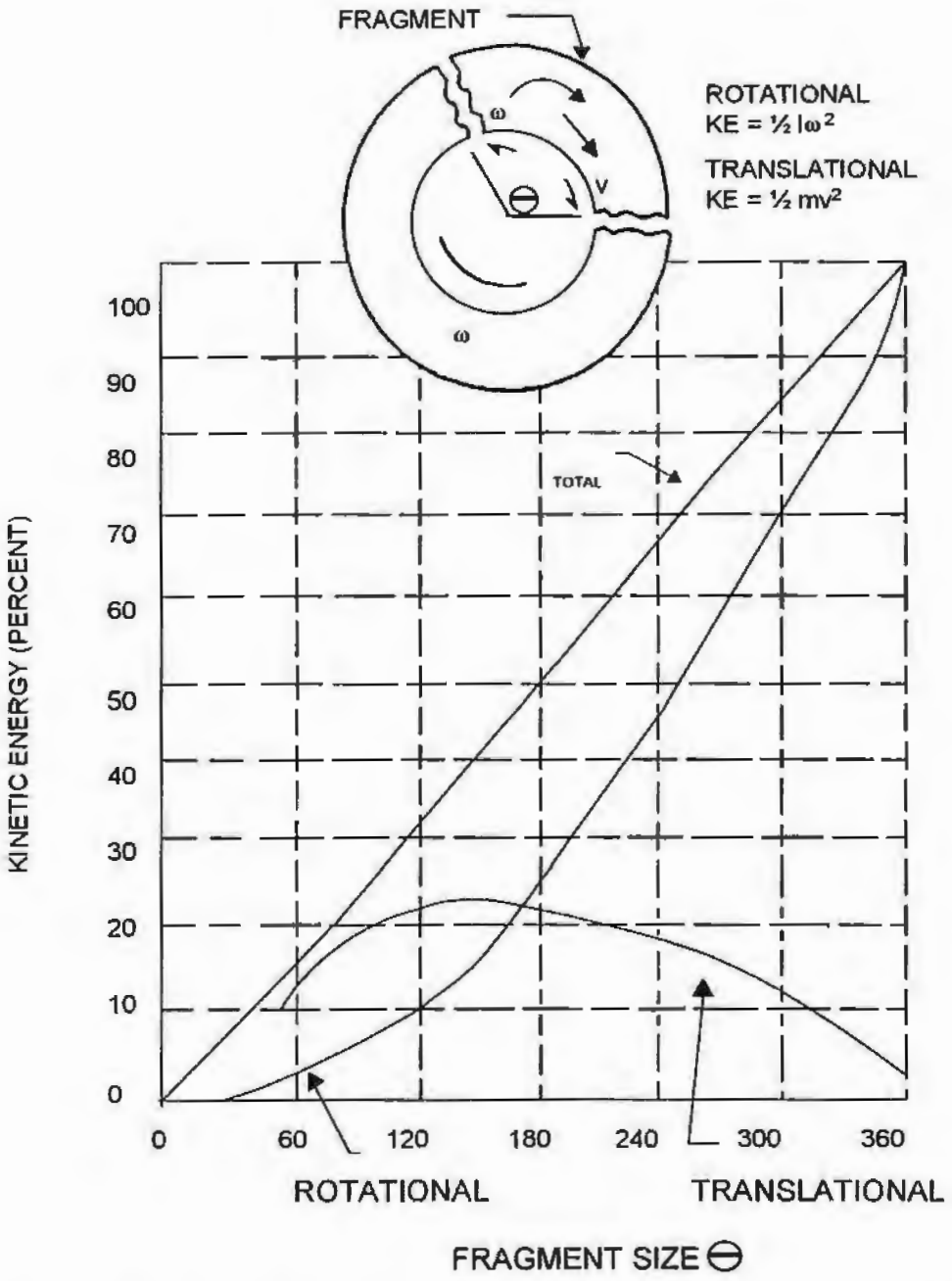
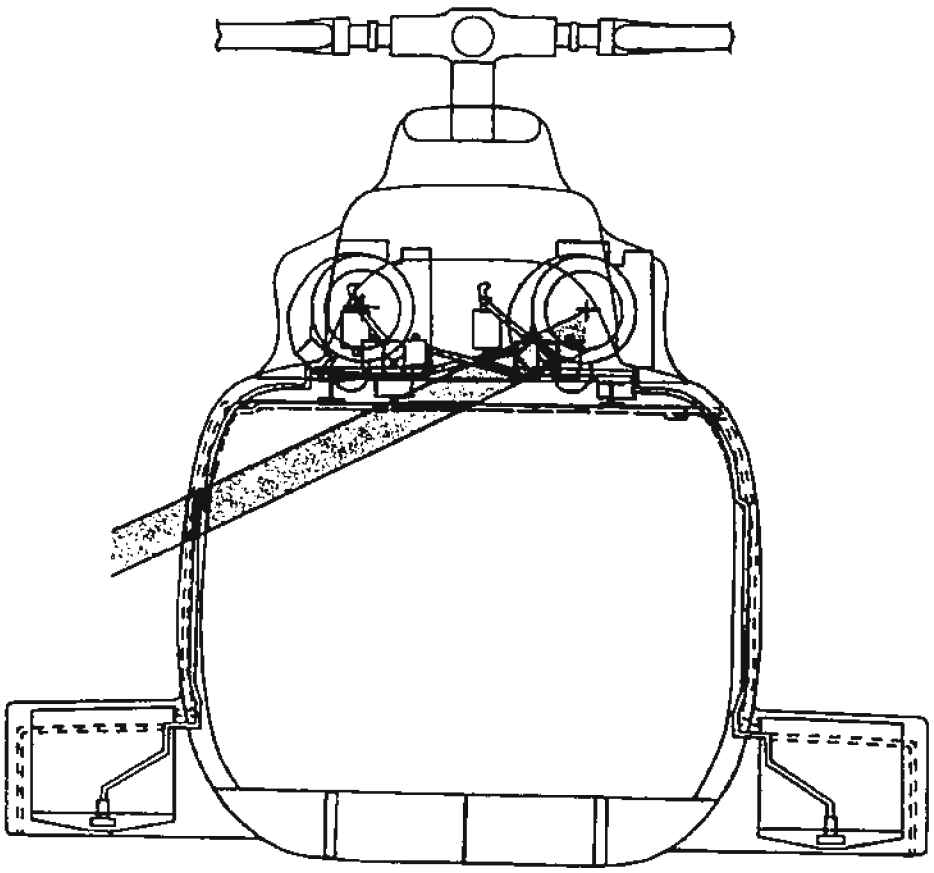


FIGURE APX3-5. DISTRIBUTION OF TRANSLATIONAL AND ROTATIONAL KINETIC ENERGY OF ROTOR-COMPONENT FRAGMENTS AS A FUNCTION OF FRAGMENT SIZE ⊖



CG of Fragment Becomes
Center of Rotation of Fragment

For Separation Distance Calculations:
1/3 Rotor with
1/3 Blade Height

FIGURE APX3-6. CROSS SECTION THROUGH AIRCRAFT AT PLANE OF ROTATION OF THE ENGINE DISK FRAGMENT