DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 29

[Docket No. 26037; Amendment No. 29–36]

RIN 2120–AB91

Airworthiness Standards: Rotorcraft Engine Rotor Burst Protection

AGENCY: Federal Aviation Administration, DOT.

ACTION: Final rule.

SUMMARY: This final rule amends the airworthiness regulations to require that manufacturers of new design transport category rotorcraft minimize the adverse effects of a turbine engine rotor failure. Turbine engine rotor failures have occurred resulting in the release of high energy engine rotor fragments or other engine component fragments. These fragments have damaged critical rotorcraft structures, systems, controls, and adjacent engines, as well as caused serious or fatal injuries to passengers and crewmembers. This action is intended to minimize these hazards.

EFFECTIVE DATE: January 31, 1996.

FOR FURTHER INFORMATION CONTACT: Mr. Ron Dalton, Federal Aviation Administration (FAA), Rotorcraft Directorate, Rotorcraft Standards Staff, Fort Worth, TX 76193–0110, telephone (817) 222–5127.

SUPPLEMENTARY INFORMATION:

Background

A Notice of Proposed Rulemaking (NPRM) No. 89–29 was published in the Federal Register on October 17, 1989 (54 FR 42716), and the comment period was reopened by NPRM No. 89–29A, published in the Federal Register on January 14, 1993 (58 FR 4566). These NPRMs proposed to amend 14 CFR part 29 (part 29) to require designs that would minimize the hazards associated with the failures of turbine engine (engine) rotors in newly designed transport category rotorcraft. Since there has not been an adverse service history for normal category rotorcraft, similar changes to 14 CFR part 27 were not proposed. If an adverse service history for normal category rotorcraft should develop, similar changes to 14 CFR part 27 would be considered.

National Transportation Safety Board (NTSB) Recommendation

This amendment responds to NTSB Safety Recommendation A–84–60 dated June 14, 1984. The NTSB recommends that the FAA review engine compartment design of all U.S. type certificated ''multiengined helicopters with regard to the probability that an uncontained engine failure will result in catastrophic damage to the drive train, electrical, and/or fuel and hydraulic system components.'' This rule responds directly to the recommendation.

Provisions of NPRM Nos. 89–29 and 89–29A

NPRM No. 89–29 proposed changes to 14 CFR 29.901 and 29.903 (§§ 29.901 and 29.903) to increase the safety margin by requiring designs that minimize the hazards to transport category rotorcraft in the event of an engine rotor failure. The required designs may include items such as separation or duplication of critical components, engine location to reduce risk, or placement of critical components in benign locations. Containment provisions for one or more stages of the engine were not specifically proposed by that proposal; however, as stated in Notice No. 89–29A, containment provisions could be one of several effective means of compliance.

NPRM No. 89–29A reopened the comment period and invited comments only on the issues of engine rotor containment and the use of advanced composite material. NPRM No. 89–29A also provided further clarification of the intent of the NPRM. Specifically, the FAA clarified that when evaluating an applicant's proposed method of compliance, the FAA would consider the available technology and the costs required to minimize the hazards from an engine rotor failure. The FAA also noted that engine rotor containment features have not been specifically required in airplane designs that comply with 14 CFR 23.903 and 25.903 (§§ 23.903 and 25.903). Likewise, containment features would not be specifically required in rotorcraft to minimize the hazards of an engine rotor failure. The guidance contained in Advisory Circular (AC) 20–128, ''Design Considerations for Minimizing Hazards Caused by Uncontained Turbine Engine and Auxiliary Power Unit Rotor and Fan Blade Failures,'' is applicable to the requirements of § 29.903 in the same way it now applies to §§ 23.903 and 25.903 for airplanes. Furthermore, the guidance in AC–29–2A, ''Certification of Transport Category Rotorcraft,'' supplements that in AC 20–128.

Comments to NPRM Nos. 89–29 and 89–29A

Three commenters fully supported the proposals of NPRM No. 89–29. Three other commenters, including the Aerospace Industries Association (AIA), requested that the NPRM be withdrawn because they believed it strongly implied that the intent of the proposed rule was to require the designer to eliminate the hazards associated with the failure of an engine rotor through the use of containment devices made of advanced composite material. As discussed above, it was not the intent of NPRM No. 89–29 to require containment or the use of advanced composite materials; containment devices made of composite materials could be one means of compliance. Since this was unclear to the three commenters, several meetings with representatives of AIA were held. Subsequently, the FAA issued NPRM No. 89–29A, which reopened the comment period with a further explanation of the proposed amendments.

Two comments were received in response to NPRM No. 89–29A. Neither commenter addressed the issues of engine rotor containment or the use of advanced composite material. As stated earlier in this document, request for comments on these issues was the reason for reopening the comment period for NPRM No. 89–29A.

One commenter simply restated an opinion submitted in response to NPRM No. 89–29 that minimizing hazards resulting from engine rotor failures in helicopters is impractical. The other commenter disagreed with the proposed wording of § 29.903. The commenter observed that the wording, ''Design procedures must be taken to minimize the hazards to the rotorcraft in the event of an engine rotor failure * * *,'' has been applied to fixed wing aircraft for some time with little or no success. The FAA disagrees that minimizing the hazards of engine rotor failure is impractical or that compliance with similar requirements for airplanes has not been successful. Based on a review of rotorcraft service history and engineering studies, the FAA concludes that the need for this amendment has been adequately demonstrated and shown to be practical for rotorcraft.

The proposed change to § 29.903 was inadvertently stated as revising paragraph (f). The correct cite should have been to paragraph § 29.903(d). This error is corrected in this final rule. The FAA adopts the changes to §§ 29.901 and 29.903 as proposed, except for the noted paragraph correction.

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 benefit of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic effect of regulatory changes on small entities. Third, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these analyses, the FAA has determined that this rule: (1) Will generate benefits that justify its costs and is not a ''significant regulatory action'' as defined in the Executive Order; (2) is not significant as defined in DOT's Regulatory Policies and Procedures; (3) will not have a significant impact on a substantial number of small entities; and (4) will not constitute a barrier to international trade. These analyses, available in the docket, are summarized below.

Costs

On the basis of estimates from FAA and industry, incremental development and certification costs are estimated to be $33,600 per type certification project. Incremental manufacturing costs are estimated to be $560 for each single-engine rotorcraft and $1,120 for each twin-engine rotorcraft.

In addition to increasing the acquisition costs of newly certificated rotorcraft, the rule could result in weight penalties. FAA and industry analyses suggest that this weight penalty could be as much as 6 pounds per engine. Each additional pound of weight increases fuel consumption for an average part 29 rotorcraft by approximately 0.0597 gallons per flight hour. Assuming 527 flight hours per year for an average part 29 rotocraft, compliance with the rule will increase annual fuel consumption by about 31.46 gallons per pound of additional weight. Using a forecast jet fuel price of $1.78 per gallon, annual fuel costs could rise by about $56 per additional pound, or about $366 per single engine transport rotorcraft, or $672 per twin-engine transport rotorcraft, respectively, per year.

Assuming a production run of 15 years during which 10 aircraft are produced per year and assuming that each rotorcraft has an operating life of 15 years, the average costs of compliance are $5,824 for a single-engine rotorcraft and $11,425 for a twin-engine rotorcraft. Applying a discount rate of 7 percent, the average costs of compliance for single-engine and twin-engine rotorcraft are $2,271 and $4,326, respectively, at present value.

Benefits of Prevented Rotorcraft Damage and Loss

The assessment of the hazards of uncontained turboshaft engine rotor bursts is based on data from the FAA, the Society of Automotive Engineers (SAE), and the National Transportation Safety Board (NTSB). For the period 1984 through 1989, in a sample representing 35.4 million flight hours and 44.3 million hours of engine operation, the FAA/SAE Committee on Uncontained Turbine Engine Rotor Events identified 68 engine rotor separation events, which resulted in the escape of rotor fragments through the engine casing or the inlet structure. Thirty-eight of those 68 events culminated in damage to rotorcraft structure or systems (other than the engine itself) or injuries to occupants. Of these, 17 events involved the release of turbine disk or spacer fragments which directly resulted in substantial damage to or loss of the aircraft. In the remaining 21 cases, damage and/or injuries were not directly attributed to the uncontained failure, but were ascribed to other causes. These 21 cases are excluded from the benefit calculations.

Assuming 527 annual airborne hours for an average part 29 rotorcraft, FAA estimates the annual average probabilities that a transport rotorcraft will be substantially damaged or destroyed as a direct result of an uncontained turbine rotor burst are 0.00012 and 0.00066 for single- and twin-engine rotorcraft respectively.

The benefits of prevented rotorcraft damage and loss are the avoided replacement and repair costs that would otherwise be incurred in the absence of compliance with this rule. In this analysis, average new unit costs of single- and twin-engine part 29 rotorcraft are estimated to be $3.200 million and $4.275 million respectively. Replacement cost is assumed to equal one-half the original new list price, and restoration cost is estimated to be 13 percent of replacement cost. The expected annual per-aircraft benefit of prevented rotorcraft damage and loss is the weighted sum of replacement and restoration costs where the weights are determined by the respective probabilities of aircraft damage or loss. The FAA/SAE data included 2 single-engine rotorcraft destroyed, and 4 single-engine rotorcraft damaged, in 26.6 million flight hours; it also included 4 twin-engine rotorcraft destroyed, and 7 twin-engine rotorcraft damaged, in 8.8 million flight hours. The FAA concludes that the annual average benefits of prevented rotorcraft damage are about $80 for single-engine rotorcraft and $628 for twin-engine rotorcraft.

Under the same production run, operating life, and discount rate assumptions used to derive average costs, the FAA estimates the expected benefits of prevented aircraft damage/loss are $1,197 per single-engine rotorcraft and $9,413 per twin-engine rotorcraft, or $412 and $3,243 at present value, respectively.

Benefits of Prevented Injuries and Fatalities

Using data from the FAA and the NTSB, the FAA identified five fatalities and eight injuries resulting from the uncontained events documented by the FAA/SAE Committee. Two of the fatalities occurred as the result of a failed autorotation landing involving a single-engine category B rotorcraft. In this case, the rotor burst did not directly cause the failed landing and, therefore, the fatalities were excluded from this analysis. The remaining three fatalities and three of the injuries occurred in twin-engine rotorcraft. Five of the injuries occurred in single-engine rotorcraft. Based on the available casualty history, the FAA concludes that in 8.8 million twin-engine part 29 rotorcraft flight hours, the rule could prevent 3 fatalities, 1 serious injury, and 2 minor injuries. The FAA also concludes that in 26.6 million single-engine part 29 rotorcraft flight hours, the rule could prevent 2 serious injuries and 3 minor injuries.

Assuming 527 annual flight hours for a typical part 29 rotorcraft, and based on costs of $2.5 million, $640,000 and $5,000 per each fatality, serious injury, and minor injury, respectively, the average annual benefits derived from avoiding fatalities and injuries are about $488 per twin-engine transport rotorcraft and $26 per single-engine rotorcraft.

Using the production run, operating life, discount rate, and other assumptions listed above, the FAA estimates that the benefits of avoided injuries and fatalities are $385 per single-engine rotorcraft, and $7,321 per twin-engine rotorcraft, or $133 and $2,523 at present value, respectively.

Cost-Benefit Summary

With respect to twin-engine rotorcraft, the benefits of avoided aircraft damage and avoided fatalities and injuries are expected to exceed the estimated development, certification, manufacturing and operating costs of the rule by a margin of roughly 1.3 to 1 ($5,766 to $4,326 in present value terms).

The benefits for single-engine rotorcraft, however, are less clear. Because part 29 rotorcraft type-certificate applications for single engine rotorcraft are unlikely, FAA's economic analysis of single-engine types concludes that the rule will be cost-beneficial only if design and manufacturing costs are modest. It should be noted that the analysis of the benefits of prevented injuries and fatalities, summarized above, does not assume that a fatality from operation of a single-engine part 29 rotorcraft would be prevented; therefore, the prevention of one fatality that would have occurred but for compliance with this rule, would make benefits clearly exceed costs.

International Trade Impact Statement

The rule will have little or no effect on trade for either U.S. firms marketing rotorcraft in foreign markets or foreign firms marketing rotorcraft in the U.S. Each applicant for a new type certificate for a transport category rotorcraft, whether the applicant be U.S. or foreign, will be required to show compliance with this rule. The rule harmonizes with proposed European Joint Aviation Requirements.

Regulatory Flexibility Determination

The Regulatory Flexibility Act (RFA) of 1980 was enacted by Congress to ensure that small entities are not unnecessarily or disproportionately burdened by Government regulations. The RFA requires a Regulatory Flexibility Analysis if a rule is expected to have a ''significant economic impact on a substantial number of small entities.''

Based on the standards and thresholds specified in implementing FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, the FAA has determined that the rule will not have a significant impact on a substantial number of small entities, because there are no ''small entity'' rotorcraft manufacturers, as defined in the order.

Federalism Implications

The regulations herein will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this regulation will not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion

For the reasons discussed above, and based on 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 RFA. This regulation is not considered to be significant under DOT Order Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). 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 Part 29

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

The Amendment

Accordingly, the FAA amends part 29 of the Federal Aviation Regulations (14 CFR part 29) as follows:

PART 29—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT

1. The authority citation for part 29 is revised to read as follows:

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

2. Section 29.901 is amended by revising paragraph (c) to read as follows:

§ 29.901 Installation.

* * * * *

(c) For each powerplant and auxiliary power unit installation, it must be established that no single failure or malfunction or probable combination of failures will jeopardize the safe operation of the rotorcraft except that the failure of structural elements need not be considered if the probability of any such failure is extremely remote.

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3. Section 29.903 is amended by revising paragraph (d) to read as follows:

§ 29.903 Engines.

* * * * *

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

(1) Design precautions must be taken to minimize the hazards to the rotorcraft in the event of an engine rotor failure; and

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

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Issued in Washington, DC, on October 6, 1995.

David R. Hinson,

Administrator.

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