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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 25, 121 and 135

[Docket No. 24995; Amdt. Nos. 25-70, 121-209, 135-34]

RIN 2120-AS77

Independent Power Source for Public Address System in Transport Category Airplanes

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: These amendments to the airworthiness standards for transport category airplanes and the operating rules for air carrier and air taxi operators of such airplanes ensure the availability of the public address (PA) system during emergency conditions by requiring an independent PA system power source. They are intended to increase airplane safety by facilitating the rapid evacuation of passengers under such conditions. These amendments are applicable to airplanes that are required to have a PA system for use in air carrier, air taxi, or commercial service and that are manufactured on or after a specified date, regardless of the date of application for type certificate. These amendments do not apply to airplanes operated by persons other than air carriers, air taxis, and commercial operators.

EFFECTIVE DATE: November 27, 1989.

FOR FURTHER INFORMATION CONTACT: Robert F. Hall, FAA, Flight Test and Systems Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 17900 Pacific Highway South, C-68966, Seattle, WA. 98168; telephone: (206) 431-2143.

SUPPLEMENTARY INFORMATION:**Background**

These amendments are based on Notice of Proposed Rulemaking (NPRM) No. 86-5 (51 FR 19140; May 27, 1986), and a correction notice published June 13, 1986 (51 FR 21563). Notice 86-5 proposed, in part, an amendment to part 25 to specify that any public address (PA) system which is required for use in air carrier or air taxi service must be powered by a source that is: (1) Independent of engine and auxiliary power unit (APU) operation, the forward motion of the airplane, and all normal means used by the flightcrew for power source disconnection; and (2) capable of powering the PA system for at least 10 minutes, including an aggregate time

duration of at least 5 minutes of announcements made by flight and cabin crewmembers. In determining this capability, all loads which may remain powered by the same source when all other power sources become inoperative would have to be considered. In addition, if the same source is required for emergency power for loads essential to safety of flight or required during emergency conditions, it would also have to be capable of powering the added PA system load for an additional time duration that is appropriate or required for those essential or emergency loads. The proposed rule provided that in all cases the PA system load would be considered as that which exists during its standby state, except for an aggregate time duration of at least 5 minutes of announcements.

Notice 86-5 also proposed to amend § 25.1411(a)(2) to clarify that the PA system microphone accessibility requirement is applicable only when a PA system is required by this chapter.

In addition, Notice 86-5 proposed an amendment to § 121.318 which would incorporate the provisions of the proposed amendment to part 25 by reference and thereby require certain airplanes used in air carrier service to comply with the new standards of part 25 if they are manufactured a year or more after the effective date of the amendment. Because § 135.149(d) incorporates the provisions of § 121.318 by reference, the proposed new standards would be applicable to certain airplanes used in air taxi service as well, if they are manufactured on or after the same date.

The proposed new § 25.1423, in which the new standards would be contained, would allow innovation in providing an acceptable power source; however, as a matter of practicality, the normal airplane battery or another battery would most likely be used.

In regard to the new § 25.1423, as proposed, the notice explained that: (1) The expression "all normal means used by the flightcrew for power source disconnection" means all switches or like devices provided for that purpose, including, but not necessarily limited to, the generator, APU, and battery switches; (2) the use of this expression does not establish any requirements pertaining to the disconnection or connection of loads, however accomplished; (3) the deactivation of circuit breakers is not considered to be a normal means used for power source disconnection; and (4) the expression "standby state" means that condition during which power for making announcements is provided to the PA

system but announcements are not being made.

The notice further explained that: (1) Power dependent on engine or APU operation would not be acceptable because the engines and APU would not be operating on the ground during many emergency conditions; (2) power dependent on the forward motion of the airplane, which might be provided by a ram air turbine, would not be acceptable because it would not be available on the ground during either normal or emergency conditions; (3) the proposal would not affect the capability of the flightcrew to disconnect the PA system by using its electrical switch or circuit breaker(s) either to clear electrical faults and protect the airplane and occupants against smoke or fires in the PA system (or its wiring) or to conserve the PA system's power source capacity for other loads powered by the same source that are essential to safety of flight or of higher priority during emergency conditions; and (4) the megaphones presently required by § 121.309(f) could not serve as an adequate means of communication. Sections 121.318(b)(1) and 135.149(d), by reference, require the means of communication to be accessible for immediate use from each of two flight crewmember stations in the pilot compartment. As further explained in the notice, such use of the megaphones by the flightcrew is not considered feasible in view of the high workload during emergency conditions, the directionality of megaphone output relative to the flightcrew's forward location and forward-facing position, and the fact that the flight compartment door is normally locked.

The notice expressly requested comments on the proposed time duration for announcements of at least 5 minutes, and on the possible need for operational procedures or flight or cabin crew training to prevent un disciplined use of the PA system during emergency conditions which could result in a hazardous, premature depletion of its power source capacity.

Discussion of Comments

One commenter states that these proposed amendments should be considered as part of a total package of proposals involving crashworthiness that the FAA has under study, which includes a proposal to require "push-to-talk" switches for PA system handset microphones and a possible draft advisory circular pertaining to PA system training and the use of megaphones. The FAA disagrees. Because those other proposals are wholly or largely unrelated to the PA

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system power source, there would be no significant cost advantage in complying with those proposed standards, should they be adopted, at the same time. Furthermore, combining these proposed amendments with other proposals currently under consideration would unduly delay the safety benefits expected to result from this proposal.

Several commenters question whether or not the proposed amendments would actually result in an increase in emergency cabin evacuation safety. One commenter states that the FAA had provided no quantitative measure of safety improvement, based on demonstrated service experience showing that fatalities or injuries had occurred specifically because a required PA system was not operable during an emergency condition, and that the qualitative justification "lacks persuasiveness." In contrast, other commenters, including the National Transportation Safety Board (NTSB), support the FAA's position that an operable PA system would provide a definite increase in safety. The FAA concurs that the available quantitative data are limited; however, none of the commenters provided convincing reasons as to why this increase in safety would not be realized.

Several commenters state that the portable megaphones required by § 121.309(f) are the primary means for directing emergency evacuations in airplanes operated in air carrier service, and that the proposed amendments are, therefore, unnecessary. The FAA does not concur that megaphones are the primary means for directing evacuations nor that, for reasons stated above in the Background Section, they could serve as adequate means of communication in the event the PA system is disabled. The FAA also notes that portable megaphones may not even be aboard some airplanes operated in air taxi service, because they are not required for those airplanes.

Several commenters express a desire for this proposal to be applied retroactively to existing airplanes. Conversely, other commenters express their concern that the adoption of the proposed amendments would lead to later proposals to apply them retroactively. While a retroactive requirement would be beyond the scope of Notice 86-5 and could not be considered at this time, it must be noted that the FAA did propose a retroactive requirement in Notice 81-1 (46 FR 5487; January 19, 1981). That proposal was later withdrawn because comments showed that it would not be cost-effective. In the absence of any recent

information to the contrary, the FAA currently has no plans to again propose a retroactive requirement.

Several commenters object to the proposed amendments, stating that their adoption would result in a mixed fleet, with some airplanes having an independent PA system power source and some not, and that this would cause confusion among flight and cabin crewmembers. They further state that such confusion could cause a hazard if crewmembers were to assume that their announcements would be heard by the passengers, in the mistaken belief that the airplane had an independent power source when, in fact, it did not. The FAA does not concur that such confusion would occur. It is noted that operation with a mixed fleet began around 1965 when a major manufacturer began providing battery power capability to the PA systems in all its large transport airplanes in production at that time, and continued providing it in all such airplanes produced later under amended or new type certificates. The FAA is not aware that any problems occurred during or after the introduction of airplanes with independent power sources for the PA systems.

Several commenters state that if a battery required for emergency power for loads essential to safety of flight or required during emergency conditions were also used as the PA system power source, then discipline must be ensured over the use of the PA system by including appropriate information in the crew operations manual and providing appropriate training to crewmembers. The FAA concurs that such information and training are necessary; however, each operator is required under §§ 121.135(a)(1), 121.417, 135.83(a)(2), and 135.331 to ensure that the crew operations manuals or checklists do include necessary information on the PA system power source, and that flight and cabin crewmembers are adequately trained in emergency procedures. Furthermore, FAA personnel ensure that all affected air carrier and air taxi operators provide all the necessary crew information and training.

In the situation where a battery required for emergency power for loads essential to safety of flight or required during emergency conditions would also be used as the PA system power source, one commenter states that the likelihood that a larger battery capacity would be needed for certain airplanes would be reduced by flight and cabin crew operational procedures and training on disciplined use of the PA system. The FAA concurs; however, the FAA estimates that the proposed amendment

would result in a relatively small increase in battery "energy" depletion of approximately 3 ampere-hours.

Therefore, the FAA considers that batteries of larger capacity would be required for few, if any, airplanes.

Several commenters state that if a battery required for emergency power for loads essential to safety of flight or required during emergency conditions were also used as the PA system power source, the PA system should not be required to remain operative after disconnecting the battery with its switch, because this design could result in partial or complete battery discharge while the airplane is parked and possibly at other times. According to the commenters, this would be a hazard in itself and would cause unnecessary and expensive battery maintenance. Two commenters state that one possible means to prevent such discharge, an additional switch connecting the PA system to the unswitched or "hot" battery bus, would increase system complexity and therefore decrease reliability, and also add to crew workload. Another commenter states that there must be a means to disconnect power from the PA system during emergency conditions such as electrically caused smoke, but that the proposed rule does not ensure it. The FAA agrees with these comments. After further consideration, the FAA has determined that the regulation should not require the PA system to have a higher priority for power than loads essential to safety of flight or other loads required during emergency conditions, and that it should not, in effect, prohibit providing the flightcrew with a ready means to disconnect the PA system concurrently with other loads after, or in anticipation of, the occurrence of electrical faults or electrically caused smoke or fires. For these reasons, § 25.1423, as adopted, specifies that a required PA system must be powerable, in flight or stopped on the ground, after the shutdown or failure of all engines and auxiliary power units, or the disconnection or failure of all power sources dependent on their continued operation. This language does not preclude loss of power to the PA system as a consequence of disconnecting the battery with its switch. The final rule will not result in unnecessary battery discharges and associated hazards, and will not increase battery maintenance costs above present levels.

One commenter states that the proposed new § 25.1423 is ambiguous as to whether it would require automatic switching. Another commenter states that any switching required to connect

the PA system to the independent power source should be automatic, so as not to increase crew workload. The notice was very specific in stating that the proposed § 25.1423 would not establish any requirements pertaining to the disconnection or connection of loads, however accomplished. Furthermore, although not stated in the notice, the proposed new § 25.1423 was not intended to establish any requirements pertaining to the connection of power sources, such as by using emergency power switches. Because these comments go beyond the scope of the notice, they cannot be considered at this time. In addition, the FAA considers that the capability to restore power to the PA system by a manual switching operation is a considerable improvement over having no means at all to restore it. Furthermore, requiring automatic switching for the PA system would be inconsistent with other emergency operations, such as loadshedding, which are not required to be automatic.

One commenter asks whether the amendments would apply only to airplanes that are newly manufactured after the specified date, or if they would also apply to earlier airplanes that are modified or remanufactured after that date to seat more than 19 passengers. Airplanes manufactured prior to the specified date and later modified to seat more than 19 passengers would not have to comply, regardless of when they are modified. It must be noted, however, that airplanes manufactured after the specified date with 19 or fewer passenger seats would have to comply if they are modified later to seat more than 19 passengers.

One commenter suggests that the language in § 135.149(d), " * * * a passenger seating configuration * * * of more than 19 * * * " be changed to read identically to that in § 121.318(a), " * * * a passenger seating capacity of more than 19 * * * " so as to base the requirements for air taxi operators, as well as for air carrier operators, on the capacity for installing seats, rather than on the actual seating configuration as required by § 135.149(d). The suggested change would have to be the subject of future rulemaking because it goes beyond the scope of Notice 86-5.

One commenter states that certain language in the proposed amendment to § 25.1411(a)(2) would differ from the corresponding language in the proposed amendment to § 121.318(b)(2). The commenter appears to suggest that the language should be identical. Actually, there are minor editorial differences which existed previously between those

sections and are not part of the proposed amendments. Nevertheless, it has been brought to the attention of the FAA that both sections are ambiguous in regard to the number of microphones required for adjacent exits. Since there has been considerable confusion as to the number of microphones intended by those sections, editorial changes have been made to each section to clarify that one microphone may serve two adjacent exits. These are nonsubstantive changes which place no additional burden on any person because they reflect the actual intent and are consistent with past FAA interpretation of the two sections.

In regard to the proposed compliance time of 1 year for newly manufactured airplanes, one commenter states that additional time might be needed in order for the Airlines Electronic Engineering Committee (AEEC) to revise PA system equipment characteristics. The FAA disagrees that compliance is dependent on such a revision because a large part of the present fleet has already been equipped with PA system installations that would comply with § 25.1423 without benefit of the revision.

Comments are divided on the proposed requirement for a time duration of at least 10 minutes of PA system operation (which includes at least 5 minutes of announcements). In this regard, one commenter suggests that 30 minutes should be required. The FAA considers that 10 minutes would be sufficient for most emergency conditions. Additional duration would, in most cases, be provided inherently because the same source that provides emergency power to instrument displays and other equipment essential to safety of flight during instrument meteorological conditions would also usually be used to power the PA system. Accepted design practice for compliance with §§ 25.1333(b) and 25.1309(b) for these instruments and equipment would usually ensure at least 30 minutes of PA system power availability, including at least 5 minutes of announcements.

In regard to the proposed requirement for a time duration of at least 5 minutes of announcements made by flight and cabin crewmembers, two commenters state that they do not consider this amount of time to be adequate. Since the two commenters did not provide compelling reasons as to why 5 minutes would not be sufficient, the FAA concurs with the other commenters who believe that 5 minutes is sufficient.

As noted above, the requirements of § 121.318 are presently incorporated by reference in § 135.149. Since the time Notice 86-5 was prepared, it has come

to the attention of the FAA that the practice of incorporating certain provisions of part 121 in part 135 by reference may cause confusion. In order to preclude any confusion in this regard, part 135 is amended to include the requirements of § 121.318 and related § 121.319 explicitly rather than by reference. This is a nonsubstantive editorial change that places no additional burden on any person.

Except as discussed above, the amendments are adopted as proposed in Notice 86-5.

Regulatory Evaluation

This document summarizes the final cost-benefit assessment of a rule requiring an independent power source for the public address (PA) system in newly manufactured transport category airplanes that are required to have such systems by existing operating rules. The objective of this rulemaking is to ensure that the PA system is available to initiate and direct emergency evacuations and provide instructions to passengers during emergency conditions.

In response to several public comments solicited by the FAA in the Notice of Proposed Rulemaking (NPRM), the FAA has revised this final rule to ensure that disconnection of the airplane battery with its switch would not preclude shutting off power to the PA system. This revision is intended to allow the PA system to be shut off as the battery is disconnected with its switch, in order to prevent the possibility of battery discharges while the airplane is parked. The revised rule also responds to concerns in several of the comments about potential additional costs, by effectively eliminating the need for additional maintenance checks and costs resulting from depleted batteries.

The FAA has updated the economic analysis of this rule from the analysis performed for the NPRM issued in May 1986, based on new information and data received since then. On the basis of the information that is currently available, the FAA concludes that this rule is cost-effective.

Costs

This amendment should have some cost impact on one of the two major U.S. manufacturers of transport category airplanes with more than 19 seats. The airplanes produced by the other manufacturer already meet the new standards. The other manufacturer will therefore not incur any additional costs.

The manufacturer not currently in compliance had indicated that the most cost-effective method of complying with

this rule would be to change the type design to locate the PA system circuit breaker at the battery bus. For the affected airplanes, the existing battery system would be sufficient to provide an independent power source for the PA system.

After consultation with industry and other sources, the FAA has determined that approximately 400 design and engineering hours would be necessary for such a redesign. The FAA has adopted the conservative assumption that all of the design and engineering costs will be incurred in the year after this rule is issued, rather than spread out over future years; design and engineering costs therefore are not discounted in this analysis. The estimate of required engineering time has been adjusted upward to 437 hours to account for leave and other absences.

An appropriate rate for valuing engineering hours is \$54.58 per hour, after overhead multipliers and fringe benefit factors have been applied to the current average hourly salary figure for aerospace engineers. Total cost for design and engineering is therefore \$23,850, incurred in the first year after issuance of this rule.

The FAA estimates that the redesign of the circuit connecting the public address system to the airplane's main battery would add at most \$500 in wiring and additional equipment to the production cost of each airplane. Additional labor required for installation is expected to be negligible.

The present value of the total cost of compliance with this regulation between 1988 and the year 2000 is expected to be \$192,744, based on a 1987 production forecast of the affected types of airplanes.

Benefits

There have been several accidents over the last two decades in which injuries or fatalities may have resulted from a malfunction or disconnection of the public address system on U.S.-operated transport category airplanes. The National Transportation Safety Board recommended in 1974, 1979, and 1981 that the FAA mandate an independent power source for the public address system in such airplanes, stressing that the availability of the PA system is vital for directing emergency evacuations and providing pre-impact instruction.

The extent to which the safety of passengers would be enhanced by compliance with this rule cannot be quantified. Nonetheless, the \$192,744 total cost of this regulation would be more than offset if as few as 16 minor injuries, each valued at \$21,000, 7

serious injuries, each valued at \$54,000, or one fatality, valued at \$1 million, were prevented between the date of enactment of this rule and the year 2000. Potential benefits, as well as costs, have been discounted over time in this determination.

It is reasonable to conclude that such a small number of injuries or fatalities could be prevented in a single accident, particularly if the circumstances involve the possibility of fire on the ground. In such emergency situations, the ability of the flight and cabin crew to brief the passengers on emergency procedures just before and once the airplane has landed could well save lives and prevent injuries, if the time required for egress from the airplane were consequently reduced.

Trade Impact Assessment and Regulatory Flexibility Analysis

This rule will have little or no impact on trade for both U.S. firms doing business in foreign countries and foreign firms doing business in the U.S. Furthermore, this rulemaking is expected to cause no significant impact on small entities, since the manufacturer of the transport category airplanes affected by this regulation is a large manufacturer according to the FAA's size threshold criterion.

Federalism Implications

The regulations adopted herein do 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. Thus, in accordance with Executive Order 12612, it is determined that such a regulation does not have sufficient federalism implications warranting the preparation of a Federalism Assessment.

Conclusion

For the reasons discussed earlier in the preamble, the FAA has determined that this is not a major regulation as defined in Executive Order 12291. In addition, the amendment will have little or no impact on trade opportunities for U.S. firms doing business overseas and foreign firms doing business in the U.S. Since the amendment concerns a matter on which there is substantial public interest, the FAA has determined that this action is significant under Department of Transportation Regulatory Policies and Procedures. In addition, the FAA certifies that under the criteria of the Regulatory Flexibility Act, this amendment will not have a significant economic impact, positive or negative, on a substantial number of

small entities. A regulatory evaluation of this action, including a Regulatory Flexibility Determination and a Trade Impact Assessment, has been placed in the regulatory docket. A copy of this evaluation may be obtained by contacting the person identified under "FOR FURTHER INFORMATION CONTACT."

List of Subjects:

14 CFR Part 25

Air transportation, Aircraft, Aviation safety, Safety.

14 CFR Part 121

Air carriers, Air transportation, Aircraft, Airplanes, Aviation safety, Common carriers, Safety, Transportation.

14 CFR Part 135

Air carriers, Air taxi, Air transportation, Aircraft, Airplanes, Aviation safety, Safety, Transportation.

Adoption of the Amendments

Accordingly, parts 25, 121 and 135 of the Federal Aviation Regulations (FAR), 14 CFR parts 25, 121, and 135, are amended as follows:

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation for part 25 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1982); and 49 CFR 1.47(a).

2. By amending § 25.1411 by revising the paragraph heading for (a) and paragraph (a)(2) to read as follows:

§ 25.1411 General.

(a) *Accessibility requirements.* * * *

(2) If a public address system is required by this chapter—

(i) For each required floor-level passenger emergency exit which has an adjacent flight attendant seat, there must be a public address system microphone which is readily accessible to the seated flight attendant, except that—

(ii) One microphone may serve more than one exit, provided the proximity of the exits allows unassisted verbal communication between seated flight attendants.

* * * * *

3. By adding a new § 25.1423 to read as follows:

§ 25.1423 Public address system.

A public address system required by this chapter must be powerable, in flight

or stopped on the ground, after the shutdown or failure of all engines and auxiliary power units, or the disconnection or failure of all power sources dependent on their continued operation, for—

(a) A time duration of at least 10 minutes, including an aggregate time duration of at least 5 minutes of announcements made by flight and cabin crewmembers, considering all other loads which may remain powered by the same source when all other power sources are inoperative; and

(b) An additional time duration in its standby state appropriate or required for any other loads that are powered by the same source and that are essential to safety of flight or required during emergency conditions.

PART 121—CERTIFICATION AND OPERATIONS: DOMESTIC, FLAG, AND SUPPLEMENTAL AIR CARRIERS AND COMMERCIAL OPERATORS OF LARGE AIRCRAFT

4. The authority citation for part 121 continues to read as follows:

Authority: 49 U.S.C. 1354(a), 1355, 1356, 1357, 1401, 1421 through 1430, 1472, 1485, and 1502; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983); and 49 CFR 1.47(a).

5. By revising § 121.318 to read as follows:

§ 121.318 Public address system.

No person may operate an airplane with a seating capacity of more than 19 passengers unless it is equipped with a public address system which—

(a) Is capable of operation independent of the crewmember interphone system required by § 121.319, except for handsets, headsets, microphones, selector switches, and signaling devices;

(b) Is approved in accordance with § 21.305 of this chapter;

(c) Is accessible for immediate use from each of two flight crewmember stations in the pilot compartment;

(d) For each required floor-level passenger emergency exit which has an adjacent flight attendant seat, has a microphone which is readily accessible to the seated flight attendant, except that one microphone may serve more than one exit, provided the proximity of the exits allows unassisted verbal communication between seated flight attendants;

(e) Is capable of operation within 10 seconds by a flight attendant at each of those stations in the passenger compartment from which its use is accessible;

(f) Is audible at all passenger seats, lavatories, and flight attendant seats and work stations; and

(g) For transport category airplanes manufactured on or after November 27, 1990, meets the requirements of § 25.1423 of this chapter.

PART 135—AIR TAXI OPERATORS AND COMMERCIAL OPERATORS

6. The authority citation for Part 135 continues to read as follows:

Authority: 49 U.S.C. 1354(a), 1355, 1356, 1357, 1401, 1421-1431, and 1502; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983); and 49 CFR 1.47(a).

7. By amending § 135.149 by removing paragraph (d) and marking it [Reserved].

§ 135.149 Equipment requirements: General.

(d) [Reserved]

8. By adding a new § 135.150 to read as follows:

§ 135.150 Public address and crewmember interphone systems.

No person may operate an aircraft having a passenger seating configuration, excluding any pilot seat, of more than 19 unless it is equipped with—

(a) A public address system which—

(1) Is capable of operation independent of the the crewmember interphone system required by paragraph (b) of this section, except for handsets, headsets, microphones, selector switches, and signaling devices;

(2) Is approved in accordance with § 21.305 of this chapter;

(3) Is accessible for immediate use from each of two flight crewmember stations in the pilot compartment;

(4) For each required floor-level passenger emergency exit which has an adjacent flight attendant seat, has a microphone which is readily accessible to the seated flight attendant, except that one microphone may serve more than one exit, provided the proximity of the exits allows unassisted verbal communication between seated flight attendants;

(5) Is capable of operation within 10 seconds by a flight attendant at each of those stations in the passenger compartment from which its use is accessible;

(6) Is audible at all passenger seats, lavatories, and flight attendant seats and work stations; and

(7) For transport category airplanes manufactured on or after [insert a date

one year after the effective date of this amendment], meets the requirements of § 25.1423 of this chapter.

(b) A crewmember interphone system which—

(1) Is capable of operation independent of the public address system required by paragraph (a) of this section, except for handsets, headsets, microphones, selector switches, and signaling devices;

(2) Is approved in accordance with § 21.305 of this chapter;

(3) Provides a means of two-way communication between the pilot compartment and—

(i) Each passenger compartment; and
(ii) Each galley located on other than the main passenger deck level;

(4) Is accessible for immediate use from each of two flight crewmember stations in the pilot compartment;

(5) Is accessible for use from at least one normal flight attendant station in each passenger compartment;

(6) Is capable of operation within 10 seconds by a flight attendant at each of those stations in each passenger compartment from which its use is accessible; and

(7) For large turbojet-powered airplanes—

(i) Is accessible for use at enough flight attendant stations so that all floor-level emergency exits (or entryways to those exits in the case of exits located within galleys) in each passenger compartment are observable from one or more of those stations so equipped;

(ii) Has an alerting system incorporating aural or visual signals for use by flight crewmembers to alert flight attendants and for use by flight attendants to alert flight crewmembers;

(iii) For the alerting system required by paragraph (b)(7)(ii) of this section, has a means for the recipient of a call to determine whether it is a normal call or an emergency call; and

(iv) When the airplane is on the ground, provides a means of two-way communication between ground personnel and either of at least two flight crewmembers in the pilot compartment. The interphone system station for use by ground personnel must be so located that personnel using the system may avoid visible detection from within the airplane.

Issued in Washington, DC, on October 20, 1989.

James B. Busey,
Administrator.

[FR Doc. 89-25329 Filed 10-26-89; 8:45 am]

BILLING CODE 4910-13-M

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DEPARTMENT OF TRANSPORTATION

14 CFR Part 29

[Docket No. 23485; Amdt. 29-28]

RIN 2120-AA84

Airworthiness Standards; Transport Category Rotorcraft Structural Fatigue Evaluation

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: The rule amends the type certification standards for transport category rotorcraft by adding flaw tolerance requirements to the requirements for fatigue evaluation of structures. The amendment also extends the requirements for fatigue evaluations from flight structures only to all critical structures, including landing gear, and requires consideration of operations having a high number of power cycles per hour. This amendment is intended to avoid or reduce catastrophic fatigue failures in transport category rotorcraft.

EFFECTIVE DATE: November 27, 1989.

FOR FURTHER INFORMATION CONTACT: Robert T. Weaver, Manager, Regulations Group (ASW-111), Aircraft Certification Service, Rotorcraft Directorate, Federal Aviation Administration, Fort Worth, Texas 76193-0111, telephone (817) 624-5111.

SUPPLEMENTARY INFORMATION:

Background

Flaw tolerance is the capability of rotorcraft structure to continue functioning without catastrophic failure after being subjected to intrinsic/discrete flaws, environmental effects, and accidental damage expected during fabrication and operation of the rotorcraft. The term "flaw tolerance" is used rather than the term "damage tolerance" which appeared in the NPRM since flaw tolerance more clearly describes the factors to be considered (such as intrinsic/discrete flaws during manufacture). This change in terms introduces no substantive change.

The addition of flaw tolerance to the fatigue evaluation of transport category rotorcraft regulations results from an assessment of the potential for preventing crashes and saving lives by the use of redundant structure and other flaw tolerant design features. The addition of the requirements to evaluate other critical structures, including landing gear, and to consider operations having a high number of power cycles per hour in the fatigue evaluation results from the ongoing Rotorcraft Regulatory Review Program. These additions are

based on two proposals submitted for consideration at the Rotorcraft Regulatory Review Conference held in New Orleans, Louisiana, in December 1979. Since landing gear requirements are being added to the evaluation in § 29.571, the section title is revised to read "Fatigue evaluation of structure."

As a result of these proposals, the FAA issued Advance Notice of Proposed Rulemaking (ANPRM) No. 83-1 on December 16, 1982 (48 FR 772; January 6, 1983), and Notice of Proposed Rulemaking (NPRM) No. 86-13 on September 12, 1986 (51 FR 33704; September 22, 1986). The comment period for Notice No. 86-13 was reopened until May 4, 1987 (52 FR 11997; April 14, 1987). Public meetings were held in Fort Worth, Texas, on February 8, 1983 (48 FR 772; January 6, 1983), and March 5, 1987 (51 FR 45343; December 18, 1986). All interested persons have been given an opportunity to participate in the making of this amendment and due consideration has been given to all matter presented.

A few changes of an editorial and clarifying nature have been made to the proposals based upon relevant comments received and upon further review by the FAA. Except for the editorial and clarifying changes discussed below, the proposals contained in Notice No. 86-13 are adopted without change.

Discussions of Comments

Although all commenters basically support the proposals to amend § 29.571 to add a requirement for flaw tolerance, several recommend editorial and clarifying changes.

One commenter recommends that in paragraph (a) the phrase "considering the effects of" be added between the words "fatigue" and "environmental." This change clarifies that paragraph (a) concerns fatigue and avoiding catastrophic failure due to fatigue and not to the environment. The FAA agrees, and this change has been made.

A commenter recommends that the phrase "and detail design points" be removed from paragraph (a)(1)(i). The commenter points out that the evaluation of detail design points is already required by the first sentence in paragraph (a), and it is unnecessary in paragraph (a)(1)(i). The FAA agrees, and the phrase has been removed.

Two commenters recommend that the words "temperature effects" be added to paragraph (a)(1)(ii) after "altitude effects." The FAA disagrees since temperature effects are already included in paragraph (a) under the general term "effects of environment."

A commenter recommends that the word "prevent" in paragraph (a)(2) be changed to "avoid" to be consistent with the wording of paragraph (a). The FAA agrees, and the change has been made.

One commenter recommends that the words "replacement times, or combination thereof" be inserted after "These inspections" in the last sentence of paragraph (a)(2) for a more complete listing of airworthiness limitations section items. The FAA agrees, and for internal consistency the change also has been made to the first sentence.

Two commenters recommend changes to paragraph (b) to clarify the use of crack initiation techniques (safe-life or flaw tolerant safe-life) in conjunction with flaw growth techniques (fail-safe or residual strength evaluation after flaw growth). Another commenter recommends a reorganization of paragraph (b) to list the three fatigue tolerance evaluation methods more explicitly. The FAA agrees with these comments, and paragraph (b) has been reorganized to list: (1) Flaw tolerant safe-life evaluation; (2) fail-safe (residual strength after flaw growth) evaluation; and (3) safe-life evaluation.

A commenter recommends that the clause "unless the applicant establishes that damage tolerance design for a particular structure is impractical" in paragraph (b)(2)(v) be changed to "unless the applicant establishes that these fatigue (flaw) tolerant methods for a particular structure cannot be achieved within the limitations of geometry, inspectability, or good design practice." The commenter emphasizes that the word "impractical" is subject to wide interpretations and more explicit limitations are necessary. The FAA agrees, and the more explicit wording is used in the reorganized paragraph (b). In addition, the heading of paragraph (b), "Fatigue tolerance evaluation (safe-life supplemented by damage tolerance)," has been changed to "Fatigue tolerance evaluation (including tolerance to flaws)" for clarity and imposes no additional burden. The use of the word "flaws" is considered more appropriate than the word "damage" in the heading of paragraph (b) since this amendment requires fatigue tolerance to intrinsic/discrete flaws resulting from manufacturing as well as damage accidentally resulting from manufacturing, maintenance, or operational activities.

One commenter recommends the addition of "wear" to the damage to be included in the fatigue tolerance evaluation of paragraph (b)(2)(i) of the proposal. The commenter also recommends that information on wear

limits be included in advisory circular material. The FAA agrees that information on wear limits is appropriate for advisory circular material but does not agree that mandating consideration of wear effects in the rule is appropriate given state-of-the-art technology. Design practice has been to prevent wear in airframe structure and to prevent or minimize it in mechanisms. This recommended change is, therefore, not adopted.

Another commenter recommends that proposed paragraph (b)(2)(i) be changed by adding the words "including the possibility of concurrent damage at multiple sites" to be more in accord with the requirements of § 25.571(b) for airplanes. This requirement as applied to airplanes basically addresses small concurrent cracks in stiffened shell construction such as in adjacent fastener holes in sheet metal joints. The critical structural elements in helicopters tend to be complex forgings or other shapes which may have fewer fastener holes. The application of multiple site damage to typical helicopter structure needs additional evaluation before it is mandated by rulemaking action. This additional evaluation should also determine the necessity for, as well as feasibility of, multiple site damage assessment and is beyond the scope of this rulemaking action. This recommended change is, therefore, not adopted.

One commenter recommends that the clause "An inspection interval and method should be established" be added to paragraph (b)(2)(iii) of the proposal. The FAA agrees, and the substance of this change has been incorporated as a requirement in new paragraph (b)(2)(ii).

Regulatory Evaluation Summary

The following is a summary of the final industry cost impact and benefit assessment of a proposed rulemaking to amend Federal Aviation Regulations (FAR) Part 29—Airworthiness Standards: Transport Category Rotorcraft. The primary objective of the proposal is to avoid or reduce catastrophic fatigue failures in transport category helicopters.

The rule adopts a new airworthiness standard to add flaw tolerance to the

fatigue evaluation of rotorcraft structures; extends fatigue evaluation from flight structure to all critical structures, including landing gear; and explicitly requires the consideration of operations having a high number of ground-air-ground or power cycles per hours.

Of special note is the use in the rule of the terminology "flaws" rather than the term "damage" used in the notice stage of rulemaking. The objective of this change is to enhance understanding by adopting a more generic term that includes intrinsic "flaws" as well as service or other damage.

The decision to add flaw tolerance requirements to the fatigue evaluation of rotorcraft structure results from an assessment of the potential for avoiding crashes and saving lives by use of redundant structure and other flaw tolerant design features and from an assessment of the current rotorcraft design "state-of-the-art." The decision to add landing gear and increased frequency of ground-air-ground and other power cycles to the fatigue evaluation is based on proposals submitted for consideration at the Rotorcraft Regulatory Review Conference held in New Orleans, Louisiana, in 1979.

The estimates of economic impacts for the amendment to § 29.571 are based on the best information currently available to the FAA. The estimates of the cost of compliance with the additional requirements of § 29.571 rely to a considerable extent on a report prepared for the FAA by Logical Technical Services Corporation entitled "Estimates of the Cost Difference Resulting from the Introduction of Damage Tolerance to Rotorcraft Structural Fatigue Requirements" (herein referred to as the LTS study). A report on the LTS study is available in the docket of this rulemaking. Information for analysis of benefit was obtained from the safety records of the NTSB and the FAA. The conclusions regarding economic consequences, however, reflect the final judgment of FAA personnel.

Comments on the proposal were submitted by domestic and foreign trade

associations representing manufacturers and operators. Although all commenters basically support the proposals to add requirements for flaw tolerance, several recommended editorial changes and clarifications. The FAA has evaluated the public comments and made final determinations regarding their impact. The FAA finds that the costs and benefits estimates for the proposals at the NPRM stage of rulemaking have not significantly changed, but they have been updated to reflect recent accident data and current prices.

At present, the FAA has not determined whether flaw tolerant components will typically experience a longer service life than safe-life components. To allow for the uncertainty inherent in predicting future flaw tolerant component service life, the potential life cycle cost increases or decreases of replacing safe-life components with flaw tolerant components for a fleet of 600 typical transport rotorcraft were analyzed for 3 different service life scenarios: Where flaw tolerant components have the same life as safe-life components, twice the lifetime of safe-life components, and an indefinite lifetime. For any service life scenario, the economic benefit of the proposal is the sum of the safety benefit (i.e., the net present value of the preventable loss, consisting of the costs of mortality, morbidity, hull damage, and investigation) and the life cycle cost impact. Table 1 illustrates the relationship between life cycle costs and various accident prevention scenarios for a fleet of 600 typical transport category rotorcraft. As shown in this table, if the flaw tolerant components can be made to have a lifetime that is twice the life of safe-life components and four accidents per year are avoided, the total net present value of the benefit resulting from the change will be approximately \$31 million. In the extreme end, if flaw tolerant components can be made with indefinite life and if ten accidents per year can be avoided by the use of these flaw tolerant parts, the present value of the net benefit is estimated to be about \$98 million.

TABLE 1.—THE RELATIONSHIP BETWEEN LIFE CYCLE COSTS AND SAFETY BENEFIT FOR A FLEET OF 600 S-76 CLASS ROTORCRAFT (1987)

Service life scenario	Present value of life cycle costs savings	Annual number of accidents avoided	Present value of expected value of preventable loss	Present value of net benefits
Same as Safe Life.....	(\$26,939,750) (26,939,750)	1 4	\$4,893,063 19,572,273	(\$22,046,687) (7,367,477)

TABLE 1.—THE RELATIONSHIP BETWEEN LIFE CYCLE COSTS AND SAFETY BENEFIT FOR A FLEET OF 600 S-76 CLASS ROTORCRAFT (1987)—Continued

Service life scenario	Present value of life cycle costs savings	Annual number of accidents avoided	Present value of expected value of preventable loss	Present value of net benefits
Twice Safe Life	(26,939,750)	10	48,930,684	21,990,934
	11,117,228	1	4,893,063	16,010,291
	11,117,228	4	19,572,273	30,689,501
	11,117,228	10	48,930,684	60,047,912
Indefinite Life	49,508,970	1	4,893,063	54,402,033
	49,508,970	4	19,572,273	69,081,243
	49,508,970	10	48,930,684	98,439,654

The FAA believes that in most cases the service life of flaw tolerant components will be at least a factor of two or three times greater than current safe-life components as a result of advances in the use of new high strength-to-weight materials and improved design data. Similarly, the number of accidents that will be avoided annually will exceed the average of four accidents per year experienced in the period between 1971 through 1986 because of the increasing size of the transport category rotorcraft fleet. On the basis of the above, the FAA calculates that the midrange of benefits associated with the introduction of flaw tolerance criteria will exceed costs by approximately \$16.0 to \$60.0 million over the 10-year period following promulgation of this regulation.

Regulatory Flexibility Determination

The FAA has determined that under the criteria of the Regulatory Flexibility Act (RFA) of 1980, this amendment will not have a significant economic impact on a substantial number of small entities. The RFA requires agencies to specifically review rules which may have a "significant economic impact on a substantial number of small entities." The FAA has developed guidance for conducting regulatory flexibility analyses and reviews, including criteria and guidelines for determining if a proposed or existing rule has a significant economic impact on a substantial number of small entities. The FAA small entity size standards criteria define a small helicopter manufacturer as an independently owned and managed firm having fewer than 75 employees. Presently, no manufacturer subject to the changes to § 29.571 has fewer than 75 employees. Accordingly, this amendment to § 29.571 will not have an economic impact on a substantial number of small entities.

International Trade Impact Analysis

The FAA believes that the certification cost which may be imposed by this amendment will not result in a competitive trade disadvantage or advantage for American manufacturers in domestic or foreign markets. This assumption is based on the fact that foreign manufacturers must comply with the certification standards of Federal Aviation Regulations, Part 29, as a condition to entry into U.S. markets. Considering the size of the U.S. market, foreign manufacturers are likely to comply with U.S. certification standards which is the largest segment of their export market. Further, foreign and American manufacturers are expected to pass the new certification costs on to consumers in their respective domestic and foreign markets.

Federalism Implications

The regulations adopted 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 final rule does not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion

In the context of these analyses, the FAA has determined that the benefits of this amendment, in providing an increased level of safety to passengers traveling in rotorcraft while at the same time recognizing and providing for the unique qualities and capabilities of rotorcraft, far outweigh the burdens. This action: (1) Involves a regulation that is not a major rule under Executive Order 12291; and (2) is a significant rule under Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). In addition, for the reasons discussed above, I

certify that under the criteria of the Regulatory Flexibility Act these amendments will not have a significant economic impact on a substantial number of small entities. Also, these amendments would have little or no impact on trade opportunities for U.S. firms doing business overseas or for foreign firms doing business in the United States. A final regulatory evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

List of Subjects 14 CFR Part 29

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

Adoption of the Amendment

Accordingly, part 29 of the Federal Aviation Regulations (14 CFR Part 29) is amended as follows:

PART 29—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT

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

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

2. By revising § 29.571 to read as follows:

§ 29.571 Fatigue evaluation of structure.

(a) *General.* An evaluation of the strength of principal elements, detail design points, and fabrication techniques must show that catastrophic failure due to fatigue, considering the effects of environment, intrinsic/discrete flaws, or accidental damage will be avoided. Parts to be evaluated include, but are not limited to, rotors, rotor drive systems between the engines and rotor hubs, controls, fuselage, fixed and movable control surfaces, engine and transmission mountings, landing gear,

and their related primary attachments. In addition, the following apply:

(1) Each evaluation required by this section must include—

(i) The identification of principal structural elements, the failure of which could result in catastrophic failure of the rotorcraft;

(ii) In-flight measurement in determining the loads or stresses for items in paragraph (a)(1)(i) of this section in all critical conditions throughout the range of limitations in § 29.309 (including altitude effects), except that maneuvering load factors need not exceed the maximum values expected in operations; and

(iii) Loading spectra as severe as those expected in operation based on loads or stresses determined under paragraph (a)(1)(ii) of this section, including external load operations, if applicable, and other high frequency power cycle operations.

(2) Based on the evaluations required by this section, inspections, replacement times, combinations thereof, or other procedures must be established as necessary to avoid catastrophic failure. These inspections, replacement times, combinations thereof, or other procedures must be included in the airworthiness limitations section of the Instructions for Continued Airworthiness required by § 29.1529 and section A29.4 of Appendix A of this part.

(b) *Fatigue tolerance evaluation (including tolerance to flaws).* The structure must be shown by analysis supported by test evidence and, if available, service experience to be of fatigue tolerant design. The fatigue tolerance evaluation must include the requirements of either paragraph (b) (1), (2), or (3) of this section, or a combination thereof, and also must include a determination of the probable locations and modes of damage caused by fatigue, considering environmental effects, intrinsic/discrete flaws, or accidental damage. Compliance with the flaw tolerance requirements of paragraph (b) (1) or (2) of this section is required unless the applicant establishes that these fatigue flaw tolerant methods for a particular structure cannot be achieved within the limitations of geometry, inspectability, or good design practice. Under these circumstances, the safe-life evaluation of paragraph (b)(3) of this section is required.

(1) *Flaw tolerant safe-life evaluation.* It must be shown that the structure, with flaws present, is able to withstand repeated loads of variable magnitude without detectable flaw growth for the following time intervals—

(i) Life of the rotorcraft; or
(ii) Within a replacement time furnished under section A29.4 of appendix A to this part.

(2) *Fail-safe (residual strength after flaw growth) evaluation.* It must be

shown that the structure remaining after a partial failure is able to withstand design limit loads without failure within an inspection period furnished under section A29.4 of appendix A to this part. Limit loads are defined in § 29.301(a).

(i) The residual strength evaluation must show that the remaining structure after flaw growth is able to withstand design limit loads without failure within its operational life.

(ii) Inspection intervals and methods must be established as necessary to ensure that failures are detected prior to residual strength conditions being reached.

(iii) If significant changes in structural stiffness or geometry, or both, follow from a structural failure or partial failure, the effect on flaw tolerance must be further investigated.

(3) *Safe-life evaluation.* It must be shown that the structure is able to withstand repeated loads of variable magnitude without detectable cracks for the following time intervals—

(i) Life of the rotorcraft; or
(ii) Within a replacement time furnished under section A29.4 of appendix A to this part.

Issued in Washington DC on October 23, 1989.

James B. Busey,
Administrator.

[FR Doc. 89-25352 Filed 10-26-89; 8:45 am]

BILLING CODE 4910-13-M