Federal Aviation Administration
Aviation Rulemaking Advisory Committee

Transport Airplane and Engine Issue Area
Engine Harmonization Working Group

Task 4 – Rotor Integrity

Task Assignment

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aviation Rulemaking Advisory Committee; Transport Airplane and Engine Subcommittee; Propulsion Harmonization Working Group

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of establishment of Propulsion Harmonization Working Group.

SUMMARY: Notice is given of the establishment of the Propulsion Harmonization Working Group of the Transport Airplane and Engine Subcommittee. This notice informs the public of the activities of the Transport Airplane and Engine Subcommittee of the Aviation Rulemaking Advisory Committee.

FOR FURTHER INFORMATION CONTACT: Mr. William J. (Joe) Sullivan, Executive Director, Transport Airplane and Engine 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 Transport Airplane and Engine Subcommittee was established at that meeting to provide advice and recommendations to the Director, Aircraft Certification Service, FAA, regarding the airworthiness standards for transport airplanes, engines and propellers in parts 25, 33, and 35 of the Federal Aviation Regulations (14 CFR parts 25, 33, and 35).

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 Transport Airplane and Engine Subcommittee those projects related to JAR/FAR 25, 33, and 35 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 transport Airplane and Engine Subcommittee, consequently, established the Propulsion Harmonization Working Group.

Specifically, the Working Group's tasks are the following: The Propulsion Harmonization Working Group is charged with making recommendations to the Transport Airplane and Engine Subcommittee concerning the FAA disposition of the following subjects recently coordinated between the JAA and the FAA:

Task 1—Bird Ingestion: Update turbine engine bird ingestion requirements, including size and number of birds and pass/fail criteria (FAR 33.77)

Task 2—Inclement Weather: Update the inclement weather requirements for rain and hail in turbine engines (FAR 33.77).

Task 3—Vibration Surveys: Determine test requirements and pass/Fail criteria for turbine engine vibration tests (FAR 33.83).

Task 4—Rotor Integrity: Determine test requirements and pass/fail criteria for turbine, compressor, fan, and turbosupercharger rotor overspeed tests (FAR 33.27).

Task 5—Turbine Rotor Overtemperature: Clarify test and pass/fail requirements for turbine engine overtemperature tests to assure consistent certification criteria (FAR 33.88).

Task 6—Windmilling: Exmaine current turbine engine windmilling requirements and specify appropriate test and analysis requirements (FAR 33.92).

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 task 1–6 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 1–6 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. Give a status report on each task at each meeting of the Subcommittee.

The Propulsion 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 Transport Airplane and Engine 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 Chairs 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 Propulsion 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, Transport Airplane and Engine Subcommittee, Aviation Rulemaking Advisory Committee.

[FR Doc. 92-30113 Filed 12-10-92; 8:45 am]

BILLING CODE 4910-13-M

Recommendation

Turbine, compressor, fan, and turbosupercharger rotors
DRAFT ADVISORY CIRCULAR

Revision: **Rev 3**

Date: **16 August, 1998**

File: **riac3.doc**

Subject: Overspeed requirements **Initiated by ANE-110** **AC No. 33.27-1**

1. PURPOSE. This advisory circular (AC) provides definitions, guidance, and acceptable methods, but not the only methods, that may be used to demonstrate compliance with the overspeed requirements of part 33, section§33.27, of the Federal Aviation Regulations. The content of this AC may be incorporated into the Aircraft Engine Type Certification Handbook at a later date.

2. RELATED SECTIONS OF THE FEDERAL AVIATION REGULATIONS.

Related Sections are 33.14, 33.75 and 33.19.

3. BACKGROUND. The subject of overspeed (rotor integrity) requirements was identified as one where differences existed between the Joint Aviation Requirements - Engines (JAR-E) and part 33 of the Federal Aviation Regulations. A study group composed of representatives of the Federal Aviation Administration (FAA), the Joint Aviation Authorities (JAA), Transport Canada and Industry worked to produce a set of improved and harmonized overspeed requirements that was subsequently incorporated into part 33 (as a revision of Section 33.27). This AC is intended to provide guidance relating to these revised requirements.

4. DEFINITIONS. For the purposes of this AC, the following definitions apply:

(a) Rotor

Individual stage of a fan, compressor or turbine assembly (some assemblies may consist of only one stage).

(b) Sample Rotor

A test article or assembly including, where appropriate, coverplates, spacers, etc. that is representative of the standard to be certified and for which the material properties and dimensions are known.

(c) Extremely Improbable

The term extremely improbable means failure conditions having an average probability of occurrence not more than 1.0E-9 per hour of engine operation.

(d) Maximum Permissible Speed

Maximum permissible rotor speed is the maximum approved speed, including transients, for the relevant rating.

5. INTENT. The safety objectives of the overspeed requirements are, (1) designing rotors with a margin to burst above certified operating conditions and above failure conditions leading to rotor overspeed, and (2) not to have a level of growth or damage which will lead to a hazardous condition..

6. GENERAL.

(a) The demonstration of compliance with the safety objectives of paragraphs 33.27(a) and (d) may be made separately or be combined, as described in this advisory material._

(b) Paragraphs 33.27(a) and (d) allow various means of compliance ("tests, analysis or a combination") in order to meet the objectives identified. It is the applicant's responsibility to propose the appropriate means of compliance, in accordance with the guidelines defined in this AC.

(c) Any analysis approach allowed under §33.27 should be defined and validated before usage.

(d) The applicant should submit to the authority the appropriate analysis to determine which of the conditions in paragraph 33.27 (b) is the most critical for each individual rotor stage with respect to the requirements of paragraph 33.27(a). A similar analysis should be submitted with respect to the requirements of paragraph 33.27(d).

Where the peak overspeed is limited by deliberate blade shedding:

(i) the conditions of paragraphs 33.27(b)(3) and (b)(4) nevertheless apply to a fully bladed rotor at that speed, and

(ii) the analysis to determine the most critical speed with respect to rotor integrity should consider this function throughout the flight envelope. Consideration should be given to the blade failure speed taking into account tolerance effects, temperature and material property variations of the blades together with the most adverse combination of the tolerance effects and material properties on the integrity of the rotor. Consequently the most critical speed with respect to rotor integrity might not be coincident with the highest achievable blade shedding speed.

(e) While considering the most adverse combination of dimensional tolerances and material

properties, as required in paragraphs 33.27 (a) and (d), the applicant should also consider the tolerances and material properties of blades, overspeed limiter, etc., adversely influencing stress levels in the rotor.

(f) Failure conditions which are of a sudden transient nature (reference paragraphs 33.27(a) & (d)) are typified by loss of load failures, i.e., characterized by high rates of acceleration and deceleration with no dwell period at the highest overspeed attained.

The applicant should also examine all possible failure conditions to determine if any case exists which would result in a dwell period at speeds close to that of the

transient short duration failure condition. If such a case exists, the applicant should determine which condition is the most critical with respect to rotor integrity.

(g) The appropriate percentage speed factor of paragraph 33.27 (b) should be applied after making the necessary speed adjustments for temperatures, material properties, tolerance effects, etc. The necessary speed adjustments for temperature and material properties will normally be established on the basis of appropriate ratios of material properties.

(h) The consequences of rotor growth sufficient to cause significant contact or displacement between engine components should be assessed to determine that the requirements of paragraph 33.27 (d)(1) can be met.

(i) When determining compliance with the requirements of paragraph 33.27 (d)(2) the applicant should consider whether or not the rotor would exhibit any condition that would be likely to prevent the safe operation of the engine for a period of time that could occur in service following any failure or combination of failures considered under paragraphs 33.27 (b)(3) or (b)(4). This period of time might be equal to that required to recognize the event and shut the engine down, or to that required for continued safe flight and landing. The length of time might also depend upon the operational instructions for an overspeed event.

(j) Where a number of rotors are of similar design, are made of materials to the same specification and are subjected to similar stress conditions, temperature levels and gradients, it is permissible for compliance with paragraph 33.27 (a) to test only the most critical rotor, with respect to burst. This would require determination of the burst speed for each rotor in order to select the most critical which is assumed to have the smaller margin to burst above the speeds specified in paragraph 33.27 (b).

The most adverse combination of temperatures and temperature gradients which is possible throughout the entire operating envelope may vary for individual rotors in an assembly.

The most critical rotor with respect to burst might not be the most critical with respect to growth. Consideration should be given to the components surrounding each rotor in order to determine the most critical rotor with respect to growth for compliance with §33.27 (d).

(k) Appropriate tests or analysis based on tests should establish the burst speed of each fan, compressor, and turbine rotor design in relation to the most critical condition prescribed in §33.27 (b) and this should be reported in the certification documentation. These burst speeds should be based on the most adverse combination of dimensional tolerances and material properties.

(l) For a multi stage rotor in which the rotors do not meet the conditions of similarity as described in paragraph (5)(j) above, the compliance of each rotor stage with §33.27 should be substantiated using representative test data.

7. ACCEPTABLE MEANS OF COMPLIANCE MAY INCLUDE.

(a) Testing a sample rotor on a rig or engine at the conditions necessary to demonstrate that a minimum strength rotor would meet the requirements of paragraphs 33.27 (a) and (d).

(b) Where the conditions of paragraphs 33.27 (b) (1) or (b)(2) are the most critical, testing a sample rotor for the required period of time in an engine at not less than 96% of the speed necessary to demonstrate that a minimum strength rotor would meet the requirements of paragraphs 33.27 (a) and (d) provided that this resultant reduced test condition is not less severe than that required to demonstrate compliance with paragraphs 33.27(b)(3) and (b)(4) and, it is shown from a validated method of burst prediction that burst would not have occurred at the conditions of paragraphs 33.27(b) (1) or (b)(2).

(c) An analytical modeling method based on representative test data may be acceptable provided that:

(i) the model has been validated by comparison with results from specimen and rotor tests and

(ii) its use is limited to rotors with material, geometry, stress, and temperature conditions encompassed by those used to construct the model and

(iii) the predictions show that the certification standard rotor is not more critical, with respect to burst and growth, than any similar rotor for which substantiation has been demonstrated both by rotor test and model prediction.

(d) Any test may be continued to rotor burst after the required time duration by increasing the speed until the rotor bursts. If the applicant chooses this method, then it should be shown that :

(i) The sample rotor was initially run at conditions not less severe than those required for compliance with paragraph 33.27 (a), and

(ii) Paragraph 33.27 (d) can be complied with using an approved analytical modeling method.

(e) The engine control devices, systems and instruments referred to in paragraph 33.27(e) is usually provided in modern engines by overspeed protection and or circuits which although they may be provided as independent devices, are

generally provided as part of the electronic engine control (EEC) system. One acceptable method for showing compliance with the requirement for "reasonable assurance" of providing functionality of the protection systems or circuits is to have them be tested by a built-in test equipment (BITE) test, or a periodic functional test.

In the case of the overspeed protection system, the BITE test should provide 100% test of the electrical/electronic part of the protection system. The mechanical or actuating part of the overspeed system can be demonstrated to be functional over a periodic inspection period.

8. FACTORS TO BE CONSIDERED WHEN DETERMINING TEST CONDITIONS.

(a) Temperature

The rotor temperatures required by paragraph 33.27 (b) are:

(i) for paragraphs 33.27 (b) (1) and (b)(2) the material temperatures and temperature gradients equal to the most adverse which could be achieved when operating in the engine at the required rating condition.

(ii) for paragraphs 33.27 (b)(3) and (b)(4) the material temperatures and temperature gradients equal to the most adverse which could be achieved

when operating in the engine at the required rating condition immediately prior to the failure(s).

These temperatures and temperature gradients should be established by temperature surveys on an engine, or derived by a validated analysis. Adjustments of test speed or blade mass or both should be applied to compensate for any deviation from the required temperatures and temperature gradients.

(b) Sample Rotor Material Properties

Material properties of the sample rotor may be determined from attached test rings/bars when the correlation of their properties has been established by a validated method using coupons obtained from forgings/castings of the type to be approved.

When attached test rings/bars are not available to determine the material properties of the sample rotor, a value for the material properties may be established by assuming that the sample rotor possesses material properties equal to known average properties of similar rotors from the same manufacturing process lot if it can be shown that the assumption is valid within acceptable confidence limits.

9. FAILURE CASES.

In order to determine the highest overspeed resulting from a loss of load to be considered under §33.27 (c), it will be necessary to consider, for possible failure locations, such factors as system inertia, available gas energy, whether the rotor is held in plane, overspeed protection devices, etc.. With respect to combinations of failures, at any rating, it is considered that if the likelihood of a combination is very low (1.0E-9 or less) the case need not be considered.

Table of References

1. FAA Advisory Circular, AC 33.2B, Aircraft Engine Type Certification Handbook

2. FAA Advisory Circular, AC 33.3, Turbine and Compressor Rotor Type Certification Substantiation Procedures

{AE1}

Mr. Ron Priddy
President, Operations
National Air Carrier Association
1100 Wilson Blvd., Suite 1700
Arlington, VA 22209

Dear Mr. Priddy:

The Federal Aviation Administration (FAA) recently completed a regulatory program review. That review focused on prioritizing rulemaking initiatives to more efficiently and effectively use limited industry and regulatory rulemaking resources. The review resulted in an internal Regulation and Certification Rulemaking Priority List that will guide our rulemaking activities, including the tasking of initiatives to the Aviation Rulemaking Advisory Committee (ARAC). Part of the review determined if some rulemaking initiatives could be addressed by other than regulatory means, and considered products of ARAC that have been or are about to be forwarded to us as recommendations.

The Regulatory Agenda will continue to be the vehicle the FAA uses to communicate its rulemaking program to the public and the U.S. government. However, the FAA also wanted to identify for ARAC those ARAC rulemaking initiatives it is considering to handle by alternative actions (see the attached list). At this time, we have not yet determined what those alternative actions may be. We also have not eliminated the possibility that some of these actions in the future could be addressed through rulemaking when resources are available.

If you have any questions, please feel free to contact Gerri Robinson at (202) 267-9678 or gerri.robinson@faa.gov.

Sincerely,

Anthony F. Fazio
Executive Director, Aviation Rulemaking Advisory Committee

Enclosure

cc:
William W. Edmunds, Air Carrier Operation Issues
Sarah MacLeod, Air Carrier/General Aviation Maintenance Issues
James L. Crook, Air Traffic Issues
William H. Schultz, Aircraft Certification Procedures Issues
Ian Redhead, Airport Certification Issues

Billy Glover, Occupant Safety Issues
John Tigue, General Aviation Certification and Operations Issues
David Hilton, Noise Certification Issues
John Swihart, Rotorcraft Issues
Roland B. Liddell, Training and Qualification Issues
Craig Bolt, Transport Airplane and Engine Issues

ARAC Projects that will be handled by Alternative Actions rather than Rulemaking

(Beta) Reverse Thrust and propeller Pitch Setting below the Flight Regime (25.1155)
Fire Protection (33.17)
Rotor Integrity--Overspeed (33.27)
Safety Analysis (33.75)
Rotor Integrity – Over-torque (33.84)
2 Minute/30 Second One Engine Inoperative (OEI) (33.XX)
Bird Strike (25.775, 25.571, 25.631)
Casting Factors (25.621)
Certification of New Propulsion Technologies on Part 23 Airplanes
Electrical and Electronic Engine Control Systems (33.28)
Fast Track Harmonization Project: Engine and APU Loads Conditions (25.361, 25.362)
Fire Protection of Engine Cowling (25.1193(e)(3))
Flight Loads Validation (25.301)
Fuel Vent System Fire Protection (Part 25 and Retrofit Rule for Part 121, 125, and 135)
Ground Gust Conditions (25.415)
Harmonization of Airworthiness Standards Flight Rules, Static Lateral-Directional Stability, and Speed Increase and Recovery Characteristics (25.107(e)(1)(iv), 25.177©, 25.253(a)(3)(4)(50)). Note: 25.107(a)(b)(d) were enveloping tasks also included in this project—They will be included in the enveloping NPRM)
Harmonization of Part 1 Definitions Fireproof and Fire Resistant (25.1)
Jet and High Performance Part 23 Airplanes
Load and Dynamics (Continuous Turbulence Loads) (25.302, 25.305, 25.341 (b), etc.)
Restart Capability (25.903(e))

Standardization of Improved Small Airplane Normal Category Stall Characteristics Requirements (23.777, 23.781, 23.1141, 23.1309, 23.1337, 25.1305)

ATTC (25.904/App I)
Cargo Compartment Fire Extinguishing or Suppression Systems (25.851(b), 25.855, 25.857)
Proof of Structure (25.307)
High Altitude Flight (25.365(d))
Fatigue and Damage Tolerance (25.571)
Material Prosperities (25.604)

respondents, and the correspondent shall pass back to its respondents interest paid on balances in the correspondent's account.

* * * * *

PART 217—PROHIBITION AGAINST PAYMENT OF INTEREST ON DEMAND DEPOSITS (REGULATION Q)—[REMOVED AND RESERVED]

■ 3. Part 217 is removed and reserved.

PART 230—TRUTH IN SAVINGS (REGULATION DD)

■ 4. The authority citation for part 230 continues to read as follows:

Authority: 12 U.S.C. 4301 *et seq.*

Supplement I to Part 230—Official Staff Interpretations

■ 5. In Supplement I to Part 230:

■ A. Under *Section 230.2—Definitions,* paragraph *(n) Interest,* is revised.

■ B. Under *Section 230.7—Payment of interest,* subsection *(a)(1) Permissible methods,* the introductory text of paragraph (5) is revised.

The revisions read as follows:

Supplement I to Part 230—Official Staff Interpretations

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Section 230.2 Definitions.

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(n) Interest

1. *Relation to bonuses.* Bonuses are not interest for purposes of this regulation.

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Section 230.7 Payment of interest.

(a)(1) Permissible methods

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5. *Maturity of time accounts.* Institutions are not required to pay interest after time accounts mature. Examples include:

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By order of the Board of Governors of the Federal Reserve System, July 12, 2011.

Jennifer J. Johnson,

Secretary of the Board.

[FR Doc. 2011–17886 Filed 7–15–11; 8:45 am]

BILLING CODE 6210–01–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 33

[Docket No. FAA–2010–0398; Amendment No. 33–31]

RIN 2120–AJ62

Airworthiness Standards; Rotor Overspeed Requirements

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This rule will amend the aircraft turbine engine rotor overspeed type certification standards. This action establishes uniform rotor overspeed design and test requirements for aircraft engines and turbochargers certificated by the FAA and the European Aviation Safety Agency (EASA). The rule also establishes uniform standards for the design and testing of engine rotor parts in the United States and in Europe, eliminating the need to comply with two differing sets of requirements.

DATES: This amendment becomes effective September 16, 2011.

FOR FURTHER INFORMATION CONTACT: For technical questions concerning this final rule, contact Tim Mouzakis, Engine and Propeller Directorate Standards Staff, ANE–111, Engine and Propeller Directorate, Federal Aviation Administration, 12 New England Executive Park, Burlington, Massachusetts 01803–5299; telephone (781) 238–7114; fax (781) 238–7199; e-mail *timoleon.mouzakis@.faa.gov.* For legal questions concerning this final rule contact Vincent Bennett, ANE–7, Office of Regional Counsel, Federal Aviation Administration, 12 New England Executive Park, Burlington, Massachusetts 01803–5299; telephone (781) 238–7044; fax (781) 238–7055; e-mail *vincent.bennett@faa.gov.*

SUPPLEMENTARY INFORMATION:

Authority for This Rulemaking

The FAA's authority to issue rules regarding aviation safety is found in Title 49 of the United States Code. Subtitle I, Section 106 describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the agency's authority.

We are issuing this rulemaking under the authority described in Subtitle VII, Part A, Subpart III, Section 44701, ''General requirements.'' Under that section, the FAA is charged with promoting safe flight of civil aircraft in air commerce by prescribing regulations for practices, methods, and procedures the Administrator finds necessary for safety in air commerce, including minimum safety standards for aircraft engines. This final rule is within the scope of that authority because it updates existing regulations for rotor overspeed for aircraft turbine engines.

Background

Part 33 of Title 14, Code of Federal Regulations, prescribes airworthiness standards for original and amended type certificates for aircraft engines. The European Aviation Safety Agency (EASA) Certification Specification—Engines (CS–E) prescribes corresponding airworthiness standards to certify aircraft engines in Europe. While part 33 and the CS–E are similar, they differ in several respects. These differences may result in added costs, delays, and time required for certification. This rule will harmonize applicable U.S. and EASA standards and clarify existing overspeed requirements for aircraft turbine engine rotor parts.

Summary of the NPRM

The FAA published a notice of proposed rulemaking (NPRM) on April 26, 2010 (75 FR 21523). The proposed changes establish a uniform certification basis for aircraft turbine engine rotor parts between the FAA and EASA. The proposal discussed requiring that rotor parts be designed with a safety margin large enough that the parts have an overspeed capability that exceeds the engine's certified operating conditions, including overspeed conditions which can occur in the event of a failure of another engine component and/or system malfunction. For failures that may result in an overspeed, the proposal limited rotor growth to that which would not lead to a hazardous condition as defined in § 33.75. The comment period for the NPRM closed on July 26, 2010.

Summary of the Final Rule

There are minor differences between the proposal and this final rule. Sections 33.27(c) and (g) were changed in response to comments and our review of the proposal. This rule harmonizes rotor overspeed requirements found in part 33 with EASA CS–E 840, Rotor Integrity.

Summary of Comments

The FAA received comments from Rolls-Royce, General Electric Aviation, Turbomeca, Pratt and Whitney, and General Aviation Manufacturers Association (GAMA). The commenters

suggested minor improvements in the following areas:

- Differences in the definition of ''extremely remote'' in § 33.27(c);
- Exclusions of shaft sections from overspeed tests;
- Material properties of test rotors; and
- Validation of analytical tools.

Discussion of the Final Rule

The final rule requires that rotor parts be designed with a safety margin large enough that the parts have an overspeed capability exceeding the engine's certified operating conditions, including overspeed conditions, which can occur in the event of a failure of another engine component and/or system malfunction. For failures that may result in an overspeed, the final rule limits rotor growth to that which would not lead to a hazardous condition as defined by § 33.75.

To harmonize FAA and EASA standards, the FAA will:

- Change the current FAA overspeed design margin from 115 to 120 percent of maximum permissible speed for all engine ratings except one engine inoperative (OEI) ratings of less than 2½ minutes;
- Change the current FAA overspeed design margin from 100 to 105 percent for operating conditions associated with multiple failures;
- Introduce similar OEI overspeed design requirements;
- Require new similar rotor pass/fail design criteria;
- Require similar overspeed margin requirements;
- Allow the use of validated structural analysis tools to demonstrate compliance;
- Require that validated structural analysis tools be calibrated to actual overspeed tests of similar rotors; and
- Allow engine test durations of less than 5 minutes for failure conditions for which a 5-minute duration is not realistic.

Like EASA's CS–E, the final rule specifies that rotors may not burst for overspeed conditions that do not involve component or system failure. For component or engine failures that result in an overspeed, the final rule specifies that rotors may not burst and limits the amount of rotor growth.

Differences in Definition of Probability of Occurrence in § 33.27(c)

Section 33.27(c) proposed that overspeeds resulting from combinations of failures must also be considered unless the applicant can show that the probability of occurrence is not greater than 10^{-9} per flight. Rolls-Royce, General Electric, Turbomeca, Pratt and Whitney, and GAMA commented that the proposed criteria in § 33.27(c) is inconsistent with § 33.75, CS–E 510, and CS–E 840. The commenters also took issue with the FAA's criteria of probability of occurrence as not greater than 10^{-9} and FAA's use of the term ''per flight.'' They suggested that the probability of occurrence should follow the more flexible criteria of not greater that ''extremely remote,'' which has been defined in the previous rulemakings as between 10^{-7} to 10^{-9}. Finally, the commenters indicated that the term ''per engine flight hour'' should be substituted for ''per flight'' to be consistent with § 33.75 and CS–E 840.

We agree with the revised criteria proposed by the commenters. The final rule will reflect that overspeeds resulting from combinations of failures must also be considered, unless the applicant can show that the probability of occurrence is not greater than extremely remote (probability range of 10^{-7} to 10^{-9} per engine flight hour).

Exclusion of Shaft Sections From Overspeed Tests

Proposed § 33.27(f) allows exclusion of certain shaft sections, but not the whole shaft system, from the requirement when determining the terminal rotor speed due to shaft failure. Rolls-Royce commented that § 33.27(c) allows exclusion on a probability basis only of overspeeds ''resulting from combinations of failures,'' whereas CS–E 840(c) allows the probability exclusion for any cause if ''it can be shown to be Extremely Remote under the provisions of CS–E 850.''

Rolls-Royce requested that the lead sentence of § 33.27(c) be changed to, ''The highest overspeed which will result from a complete loss of load on a turbine rotor, unless it can be shown to be Extremely Remote or except as provided by paragraph (f) of this section.* * *''. The change proposed by Rolls-Royce would allow exclusion of the whole shaft system from consideration of failure, which is not the intent of the rule. Our changes to overspeed requirements due to shaft failures are consistent with those in CS–E–840 and CS–E–850(b). We did not change the rule due to this comment.

Material Properties of Test Rotors

Section 33.27(a)(1) proposed that test rotors used to demonstrate compliance with this section that do not have the most adverse combination of material properties and dimensional tolerances must be tested at conditions which have been adjusted to ensure the minimum specification rotor possesses the required overspeed capability.

Rolls-Royce claimed that determining the precise ''most adverse combination'' is not practical. Rolls-Royce noted that Advisory Circular (AC) 33.27–1, paragraph 7.g indicates that the applicant should consider ''the most adverse combination of dimensional tolerances and material properties,'' which allows the use of engineering judgment and best practices in lieu of an exhaustive assessment of all possible combinations and permutations. As a result, Rolls-Royce requested that the phrase ''that do not have the most adverse combination of material properties and dimensional tolerances'' be omitted from § 33.27(a)(1).

We disagree. We find that our proposed wording of § 33.27(a)(1) is consistent with EASA's regulation CS–E 840(a) and that the suggested change would not meet the intent of the proposed paragraph. Our intent in § 33.27(a)(1) is to ensure that the minimum specifications rotor is capable of meeting the test requirements of the proposed rule. Industry has been complying with this requirement, as stated in EASA regulations, for several years. The change proposed by Rolls-Royce would, therefore, diverge from EASA's rule and could increase cost to manufacturers. We did not change the final rule due to this comment.

Validation of Analytical Tools

We proposed in § 33.27(g) that if analysis is used to meet the overspeed requirements, then the analytical tool must be calibrated to prior overspeed test results of a similar rotor. The tool must be calibrated for the same material, rotor geometry, stress level, and temperature range as the rotor being certified. Calibration includes the ability to accurately predict rotor dimensional growth and burst speed. The predictions must also show that the rotor being certified does not have lower burst and growth margins than rotors used to calibrate the tool.

Rolls-Royce commented that the requirements for validation of analytical tools eligible for use in showing compliance in lieu of testing are overly restrictive. Rolls-Royce said the language of § 33.27(g) appears to invalidate any potential for the applicant to propose analysis methods to the Administrator for acceptance per AC 33.27–1, paragraphs 7.b and 7.c. Rolls-Royce noted that it seems unlikely that an applicant will have a tool calibrated for the same conditions and the same rotor as that being certified; such a certification appears redundant. Rolls-Royce requested that § 33.27(g) be

modified to read: ''If analysis is used to meet the overspeed requirements, then the analytical tool must be calibrated to prior overspeed test results of a similar rotor.''

We agree that the language of proposed 33.27(g) appears overly restrictive. We changed the language to read the analytical tool must be ''validated'' instead of ''calibrated'' for each material. The analytical model must be validated using rotors which ''surround'' the rotor being certified in terms of ''shape, stresses and temperature.'' The final rule now reads: ''If analysis is used to meet the overspeed requirements, then the analytical tool must be validated to prior overspeed test results of a similar rotor. The tool must be validated for each material. The rotor being certified must not exceed the boundaries of the rotors being used to validate the analytical tool in terms of geometric shape, operating stress, and temperature.'' This changed wording is also consistent with EASA advisory material AMC E 840.

Definition of Terms Used in the Final Rule

The following definitions of terms used in the final rule are provided for clarity:

Maximum permissible rotor speed. The maximum approved rotor speed, including transients, for the maximum approved rating, including One-Engine-Inoperative (OEI) ratings.

Overspeed Capability. The r.p.m. (revolutions per minute) at which the part fails or bursts.

Rotor Growth. The total increase in a rotor part's radial dimensions caused by an overspeed condition. Total growth includes both the recoverable (elastic) and the permanent (plastic) change in rotor dimensions.

Rulemaking Analyses and Notices

Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. We have determined there is no new requirement for information collection associated with this final rule.

International Compatibility

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with International Civil Aviation Organization (ICAO) Standards and Recommended Practices, to the maximum extent practicable. We determined that no ICAO Standards or Recommended Practices corresponding to these proposed regulations exist.

Regulatory Evaluation, Regulatory Flexibility Determination, International Trade Impact Assessment, and Unfunded Mandates Assessment

Proposed changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 and Executive Order 13563 direct that each Federal agency 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 (Pub. L. 96–354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Pub. L. 96–39) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, this Trade Act requires agencies to consider international standards and, where appropriate, that they be the basis of U.S. standards. Fourth, the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by private sector, of $100 million or more annually (adjusted for inflation with base year of 1995). This portion of the preamble contains the FAA's analysis of the economic impacts of this final rule.

In conducting these analyses, the FAA has determined that this rule: (1) Has benefits that justify its costs; (2) is not an economically ''significant regulatory action'' as defined in section 3(f) of Executive Order 12866; (3) is not ''significant'' as defined in DOT's Regulatory Policies and Procedures; (4) will not have a significant economic impact on a substantial number of small entities; (5) will not create unnecessary obstacles to the foreign commerce of the United States; and (6) will not impose an unfunded mandate on state, local, or tribal governments, or on the private sector by exceeding the threshold identified above.

Total Estimated Benefits and Costs of This Proposed Rule

Presently, turbine aircraft engine manufacturers must satisfy both FAA part 33 and EASA CS–E regulations to certify their products in the United States and Europe. Certification to one standard will improve certification efficiency by eliminating duplicate testing and documentation. We have not attempted to quantify the cost savings that may accrue due to this improved certification efficiency beyond noting that these are expected to be minor. We have drawn that conclusion based on the consensus among potentially affected aircraft engine manufacturers.

Industry must currently certificate to the two standards that are substantively similar, but have a few slightly different testing and documentation procedures and requirements. The rule harmonizes these procedures and requirements to the higher standard and, thereby, may increase safety. In addition, by reducing the amount of duplicative testing that would need to be either witnessed or analyzed by the FAA, the FAA is better able to prioritize its resources to other, more safety critical areas. Consequently, we determined that unquantifiable future minimal benefits from the rule may also accrue. We disagreed with a comment determining the precise ''most adverse combination'' of material properties and dimensional tolerances to establish the required overspeed capability. However, as noted in our response, the commenter's suggestion would result in a rule that is not consistent with the EASA regulations and the suggestion might increase costs to manufacturers. As a result, the FAA concludes that the combination of cost savings and potential increased safety benefits will make this rule cost beneficial. Further, we therefore determined that this rule is not a ''significant regulatory action'' as defined in section 3(f) of Executive Order 12866, and is not ''significant'' as defined in DOT's Regulatory Policies and Procedures.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (Pub. L. 96–354) (RFA) establishes ''as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration.'' The RFA covers a wide-range of small entities, including small businesses, not-for-profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a rule will have a significant economic impact on a substantial number of small entities. If

the agency determines that it will, the agency must prepare a regulatory flexibility analysis as described in the RFA.

However, if an agency determines that a rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the RFA provides that the head of the agency may so certify and a regulatory flexibility analysis is not required. The certification must include a statement providing the factual basis for this determination, and the reasoning should be clear.

The net effect of this rule is to provide regulatory cost relief. Further, all but one U.S. aircraft turbine engine manufacturer exceeds the Small Business Administration small-entity criteria for aircraft engine manufacturers of 1,500 employees. U.S. transport category aircraft engine manufacturers include: General Electric (GE); CFM International (a joint company of GE and Snecma); Pratt & Whitney (P&W); Honeywell; Rolls-Royce Corporation (formerly Allison Engines); International Aero Engines (a privately-held consortium that includes P&W, Rolls-Royce, Japanese Aero Engines Corporation, and MTU Aero Engines); and Williams International. Williams International is the only one of these manufacturers that is categorized as a U.S. small business by the SBA criteria. As this final rule reduces costs and there is only one small entity manufacturing part 33 aircraft engines, therefore, as FAA Administrator, I certify this rule will not have a significant economic impact on a substantial number of small entities.

International Trade Impact Assessment

The Trade Agreements Act of 1979 (Pub. L. 96–39), as amended by the Uruguay Round Agreements Act (Pub. L. 103–465), prohibits Federal agencies from establishing standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards is not considered an unnecessary obstacle to the foreign commerce of the United States, so long as the standard has a legitimate domestic objective, such as protection of safety, and does not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards. We assessed the potential effect of this rule and determined that it uses European standards as the basis for regulation, and thus is consistent with the Trade Assessments Act.

Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of $100 million or more (in 1995 dollars) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a ''significant regulatory action.'' The FAA currently uses an inflation-adjusted value of $140.8 million in lieu of $100 million. This final rule does not contain such a mandate, therefore, the requirements of Title II of the Act do not apply.

Executive Order 13132, Federalism

The FAA has analyzed this final rule under the principles and criteria of Executive Order 13132, Federalism. We determined that this action will not have a substantial direct effect 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, and therefore does not have federalism implications.

Environmental Analysis

FAA Order 1050.1E defines FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act (NEPA) in the absence of extraordinary circumstances. We determined this rulemaking action qualifies for the categorical exclusion identified in Chapter 3, paragraph 312d, and involves no extraordinary circumstances.

Regulations That Significantly Affect Energy Supply, Distribution, or Use

The FAA has analyzed this final rule under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). We determined that it is not a ''significant energy action'' under the executive order and is not likely to have a significant adverse effect on the supply, distribution, or use of energy.

Availability of Rulemaking Documents

You can get an electronic copy using the Internet by—

1. Searching the Federal eRulemaking Portal (*http://www.regulations.gov*);

2. Visiting the FAA's Regulations and Policies web page at *http://www.faa.gov/regulations_policies/;* or

3. Accessing the Government Printing Office's web page at *http://www.gpoaccess.gov/fr/index.html.*

You can also get a copy by sending a request to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue, SW, Washington, DC 20591, or by calling (202) 267–9680. Make sure to identify the notice, amendment, or docket number of this rulemaking.

Anyone may search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act statement in the **Federal Register** published on April 11, 2000 (Volume 65, Number 70; Pages 19477–78) or you may visit *http://DocketsInfo.dot.gov.*

Small Business Regulatory Enforcement Fairness Act

The Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires the FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. If you are a small entity and you have a question regarding this document, you may contact your local FAA official, or the person listed under the **FOR FURTHER INFORMATION CONTACT** heading at the beginning of the preamble. You can find out more about SBREFA on the Internet at *http://www.faa.gov/regulations_policies/rulemaking/sbre_act/.*

List of Subjects in 14 CFR Part 33

Air transportation, Aircraft, Aviation safety, Safety.

The Amendment

In consideration of the foregoing, the Federal Aviation Administration amends Chapter I of Title 14, Code of Federal Regulations as follows:

PART 33—AIRWORTHINESS STANDARDS: AIRCRAFT ENGINES

■ 1. The authority citation for part 33 continues to read as follows:

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

■ 2. Revise § 33.27 to read as follows:

§ 33.27 Turbine, compressor, fan, and turbosupercharger rotor overspeed.

(a) For each fan, compressor, turbine, and turbosupercharger rotor, the

applicant must establish by test, analysis, or a combination of both, that each rotor will not burst when operated in the engine for 5 minutes at whichever of the conditions defined in paragraph (b) of this section is the most critical with respect to the integrity of such a rotor.

(1) Test rotors used to demonstrate compliance with this section that do not have the most adverse combination of material properties and dimensional tolerances must be tested at conditions which have been adjusted to ensure the minimum specification rotor possesses the required overspeed capability. This can be accomplished by increasing test speed, temperature, and/or loads.

(2) When an engine test is being used to demonstrate compliance with the overspeed conditions listed in paragraph (b)(3) or (b)(4) of this section and the failure of a component or system is sudden and transient, it may not be possible to operate the engine for 5 minutes after the failure. Under these circumstances, the actual overspeed duration is acceptable if the required maximum overspeed is achieved.

(b) When determining the maximum overspeed condition applicable to each rotor in order to comply with paragraphs (a) and (c) of this section, the applicant must evaluate the following rotor speeds taking into consideration the part's operating temperatures and temperature gradients throughout the engine's operating envelope:

(1) 120 percent of the maximum permissible rotor speed associated with any of the engine ratings except one-engine-inoperative (OEI) ratings of less than 2½ minutes.

(2) 115 percent of the maximum permissible rotor speed associated with any OEI ratings of less than 2½ minutes.

(3) 105 percent of the highest rotor speed that would result from either:

(i) The failure of the component or system which, in a representative installation of the engine, is the most critical with respect to overspeed when operating at any rating condition except OEI ratings of less than 2½ minutes, or

(ii) The failure of any component or system in a representative installation of the engine, in combination with any other failure of a component or system that would not normally be detected during a routine pre-flight check or during normal flight operation, that is the most critical with respect to overspeed, except as provided by paragraph (c) of this section, when operating at any rating condition except OEI ratings of less than 2½ minutes.

(4) 100 percent of the highest rotor speed that would result from the failure of the component or system which, in a representative installation of the engine, is the most critical with respect to overspeed when operating at any OEI rating of less than 2½ minutes.

(c) The highest overspeed that results from a complete loss of load on a turbine rotor, except as provided by paragraph (f) of this section, must be included in the overspeed conditions considered by paragraphs (b)(3)(i), (b)(3)(ii), and (b)(4) of this section, regardless of whether that overspeed results from a failure within the engine or external to the engine. The overspeed resulting from any other single failure must be considered when selecting the most limiting overspeed conditions applicable to each rotor. Overspeeds resulting from combinations of failures must also be considered unless the applicant can show that the probability of occurrence is not greater than extremely remote (probability range of 10^{-7} to 10^{-9} per engine flight hour).

(d) In addition, the applicant must demonstrate that each fan, compressor, turbine, and turbosupercharger rotor complies with paragraphs (d)(1) and (d)(2) of this section for the maximum overspeed achieved when subjected to the conditions specified in paragraphs (b)(3) and (b)(4) of this section. The applicant must use the approach in paragraph (a) of this section which specifies the required test conditions.

(1) Rotor Growth must not cause the engine to:

(i) Catch fire,

(ii) Release high-energy debris through the engine casing or result in a hazardous failure of the engine casing,

(iii) Generate loads greater than those ultimate loads specified in § 33.23(a), or

(iv) Lose the capability of being shut down.

(2) Following an overspeed event and after continued operation, the rotor may not exhibit conditions such as cracking or distortion which preclude continued safe operation.

(e) The design and functioning of engine control systems, instruments, and other methods not covered under § 33.28 must ensure that the engine operating limitations that affect turbine, compressor, fan, and turbosupercharger rotor structural integrity will not be exceeded in service.

(f) Failure of a shaft section may be excluded from consideration in determining the highest overspeed that would result from a complete loss of load on a turbine rotor if the applicant:

(1) Identifies the shaft as an engine life-limited-part and complies with § 33.70.

(2) Uses material and design features that are well understood and that can be analyzed by well-established and validated stress analysis techniques.

(3) Determines, based on an assessment of the environment surrounding the shaft section, that environmental influences are unlikely to cause a shaft failure. This assessment must include complexity of design, corrosion, wear, vibration, fire, contact with adjacent components or structure, overheating, and secondary effects from other failures or combination of failures.

(4) Identifies and declares, in accordance with § 33.5, any assumptions regarding the engine installation in making the assessment described above in paragraph (f)(3) of this section.

(5) Assesses, and considers as appropriate, experience with shaft sections of similar design.

(6) Does not exclude the entire shaft.

(g) If analysis is used to meet the overspeed requirements, then the analytical tool must be validated to prior overspeed test results of a similar rotor. The tool must be validated for each material. The rotor being certified must not exceed the boundaries of the rotors being used to validate the analytical tool in terms of geometric shape, operating stress, and temperature. Validation includes the ability to accurately predict rotor dimensional growth and the burst speed. The predictions must also show that the rotor being certified does not have lower burst and growth margins than rotors used to validate the tool.

Issued in Washington, DC, on June 30, 2011.

J. Randolph Babbitt,

Administrator.

[FR Doc. 2011–18002 Filed 7–15–11; 8:45 am]

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

[Docket No. FAA–2011–0257; Directorate Identifier 2010–NM–122–AD; Amendment 39–16741; AD 2011–14–06]

RIN 2120–AA64

Airworthiness Directives; Airbus Model A318, A319, A320, and A321 Series Airplanes

AGENCY: Department of Transportation (DOT), Federal Aviation Administration (FAA).

ACTION: Final rule.

SUMMARY: We are superseding an existing airworthiness directive (AD)