Federal Aviation Administration
Aviation Rulemaking Advisory Committee

Rotorcraft Issue Area
Critical Parts Working Group

Task 2 – Review Critical Parts

Task Assignment

[Federal Register: July 30, 2001 (Volume 66, Number 146)]

[Notices]

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aviation Rulemaking Advisory Committee; Rotorcraft Issues--New Task

AGENCY: Federal Aviation Administration (**FAA**), DOT.

ACTION: Notice of new task assignment for the Aviation Rulemaking Advisory Committee (ARAC).

SUMMARY: The **FAA** assigned the Aviation Rulemaking Advisory Committee a new task to review the definition of ``Critical Part'' and determine whether the current regulation provides a clear definition of critical parts and whether the regulations establish an adequate critical parts list. This notice is to inform the public of this ARAC activity.

FOR FURTHER INFORMATION CONTACT: Larry M. Kelly, Federal Aviation Administration, Southwest Region Headquarters, 2601 Meacham Blvd., Fort Worth, Texas, 76137, larry.kelly@faa.gov.

SUPPLEMENTARY INFORMATION:

Background

The **FAA** established the Aviation Rulemaking Advisory Committee to provide advice and recommendations to the **FAA** Administrator on the **FAA**'s rulemaking activities with respect to aviation-related issues. This includes obtaining advice and recommendations on the **FAA**'s commitments to harmonize Title 14 of the Code of Federal Regulations (14 CFR) with its partners in Europe and Canada.

The Task

Review the definition of ``Critical Part'' and the critical parts requirements of Secs. 27.602 and 29.602 together with JAR 27.602, 29.602, and associated amendments 27-38 and 29-45.

Determine whether the current regulations and proposed regulations provide a clear definition of critical parts and whether the regulations establish an adequate critical parts list. Specifically, include clarification in the advisory material of the word ``and'' in the rules.

Consider the safety benefits of establishing a different definition of Critical Parts for Category A rotorcraft. If a different

definition for critical parts for Category A rotorcraft is to be considered for recommended rulemaking, an assessment of some existing Critical Parts Lists must consider the scope of change to those lists to determine the safety/economic impact of any expansion of the Critical Parts requirements.

Provide a preliminary technical recommendation within 6 months after the first working group meeting.

If a review of the safety/economic issues justifies the need for a rule change, prepare a draft Notice of Proposed Rulemaking (NPRM) and provide associated advisory material.

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The NPRM should include the preamble and the rule language along with any supporting legal analysis.

Schedule: ARAC must complete this task no later than 18 months after the **FAA** publishes the task in the Federal Register.

ARAC Acceptance of Task

ARAC accepted the task and assigned the task to the Critical Parts Harmonization Working Group, Rotorcraft Issues. The working group serves as staff to ARAC and assists in the analysis of assigned tasks. ARAC must review and approve the working group's recommendations. if ARAC accepts the working group's recommendations, it will forward them to the **FAA**. Recommendations that are received from ARAC will be submitted to the agency's Rulemaking Management Council to address the availability of resources and prioritization.

Working Group Activity

The Critical Parts Harmonization Working Group is expected to comply with the procedures adopted by ARAC. As part of the procedures, the working group is expected to:

1. Recommend a work plan for completion of the task, including the rationale supporting such a plan for consideration at the next meeting of the ARAC on rotorcraft issues held following publication of this notice.

2. Give a detailed conceptual presentation of the proposed recommendations prior to proceeding with the work stated in item 3 below.

3. Draft the appropriate documents and required analyses and/or any other related materials or documents.

4. Provide a status report at each meeting of the ARAC held to consider rotorcraft issues.

Participation in the Working Group

The Crital Parts Harmonization Working Group is composed of technical experts having an interest in the assigned task. A working group member need to be a representative or a member of the full committee.

An individual who has expertise in the subject matter and wishes to become a member of the working group should write to the person listed under the caption FOR FURTHER INFORMATION CONTACT expressing that desire, describing his or her interest in the task, and stating the expertise he or she would bring to the working group. All requests to

participate must be received no later than August 13, 2001. The requests will be reviewed by the assistant chair, the assistant executive director, and the working group co-chairs. Individuals will be advised whether or not their request can be accommodated.

Individuals chosen for membership on the working group will be expected to represent their aviation community segment and actively participate in the working group (e.g., attend all meetings, provide written comments when requested to do so, etc.). They also will be expected to devote the resources necessary to support the working group in meeting any assigned deadlines. Members are expected to keep their management chain and those they may represent advised of working group activities and decisions to ensure that the proposed technical solutions do not conflict with their sponsoring organization's position when the subject being negotiated is presented to ARAC for approval.

Once the working group has begun deliberations, members will not be added or substituted without the approval of the assistant chair, the assistant executive director, and the working group co-chairs.

The Secretary of Transportation determined that the formation and use of the ARAC is necessary and in the public interest in connection with the performance of duties imposed on the **FAA** by law.

Meetings of the ARAC will be open to the public. Meetings of the Critical Parts 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. The **FAA** will make no public announcement of working group meetings.

Issued in Washington, DC, on July 24, 2001.

Anthony F. Fazio,

Executive Director, Aviation Rulemaking Advisory Committee.

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Recommendation Letter

February 11, 2003

John D. Swihart, Jr.
7313 Janetta Dr.
Fort Worth, TX 76180

Mr. Nicholas A. Sabatini
Associate Administrator for Regulation and Certification
Federal Aviation Administration, AVR-1
800 Independence Ave., SW
Washington, D.C. 20591

Dear Mr. Sabatini:

The Aviation Rulemaking Advisory Committee (ARAC) Working Group activity associated with the Critical Parts Task has been completed. The results of their efforts were submitted to the ARAC for review and approval. The ARAC examined those results at a public meeting on February 11, 2003 in Dallas, Texas and approved them.

Accordingly, the ARAC hereby submits without change, the proposed Advisory Circular package developed by the Working Group with a recommendation that it be processed by the Rotorcraft Directorate for publication.

Very Truly Yours,

John. D. Swihart, Jr.
ARAC Assistant Chair for Rotorcraft Issues

cc:

Mr. Glenn Rizner, ARAC Chairperson
Mr. Tony Fazio, ARAC Executive Director
Mr. Mark R. Schilling, ARAC Assistant Executive Director w/ material
Mr. Tom Sandberg, Working Group Chairperson
Mr. Joe Corrao, Helicopter Association International
Ms. Caren Centorelli, FAA, ARM-203
Ms. Mary Ann Phillips, FAA, ASW-110

Recommendation

AC 27.602 § 27.602 CRITICAL PARTS.

a. Explanation.

(1) Critical parts requirements apply to structural components, rotor drive systems, rotors, and mechanical control systems.

(2) The objective of identifying critical parts is to ensure that critical parts are controlled during design, manufacture, and throughout their service life so that the risk of failure in service is minimized by ensuring that the critical parts maintain the critical characteristics on which certification is based.

(3) Definitions with respect to § 27.602:

(i) The use of the word "could" in paragraph 27.602(a) of the rule means that this failure assessment should consider the effect of flight regime (i.e., forward flight, hover, etc.). The operational environment need not be considered.

(ii) With respect to this rule, the term "catastrophic" means the inability to conduct an autorotation to a safe landing, without exceptional piloting skills, assuming a suitable landing surface is available.

(iii) The use of the word "and" in paragraph 27.602(a) of the rule means the part must have both a catastrophic failure mode together with one or more critical characteristics.

(iv) With respect to this rule, the term "part" means one piece, or two or more pieces permanently joined together.

(v) With respect to this rule, the term "critical characteristic" means any dimension, tolerance, finish, material, or any manufacturing or inspection process, or other feature which cannot tolerate variation from type design requirements and, if nonconforming, would cause failure of the critical part.

(4) Many rotorcraft manufacturers already have procedures in place within their companies for handling "critical parts." These plans may be required by their dealings with other customers, frequently military (e.g., US DoD, UK MoD, Italian MoD). Although these plans may have slightly different definitions of "critical parts" which have sometimes been called "Flight Safety Parts," "Critical Parts," "Vital Parts," or "Identifiable Parts," they have in the past been accepted as meeting the intent of this requirement and providing the expected level of safety. It is acceptable for these plans to use alternative names and terminology provided they meet the intent of this requirement.

b. Procedures. The rotorcraft manufacturer should establish a Critical Parts Plan, which identifies and controls the critical characteristics. The policies and procedures which constitute that plan should be such as to ensure that--

(1) All critical parts of the rotorcraft are identified by means of an appropriate failure assessment and a Critical Parts List is established.

(2) Documentation draws the attention of the personnel involved in the design, manufacture, maintenance, inspection, and overhaul of a critical part to the special nature of the part and details the relevant special instructions. For example all drawings, work sheets, inspection documents, etc., could be prominently annotated with the words "Critical Part" or equivalent and the Instructions for Continued Airworthiness and Overhaul Manuals (if applicable) should clearly identify critical parts and include the needed maintenance and overhaul instructions. The documentation should:

(i) Contain comprehensive instructions for the maintenance, inspection and overhaul of critical parts and emphasize the importance of these special procedures;

(ii) Indicate to operators and overhaulers that unauthorized repairs or modifications to critical parts may have hazardous consequences;

(iii) Emphasize the need for careful handling and protection against damage or corrosion during maintenance, overhaul, storage, and transportation and accurate recording and control of service life (if applicable);

(iv) Require notification of the manufacturer of any unusual wear or deterioration of critical parts and the return of affected parts for investigation when appropriate;

(3) Procedures should be established for identifying and controlling critical characteristics.

(4) To the extent needed for control of critical characteristics, procedures and processes for manufacturing critical parts (including test articles) are defined (for example material source, forging procedures, machining operations and sequence, inspection techniques, and acceptance and rejection criteria). Procedures for changing these manufacturing procedures should also be established.

(5) Any changes to the manufacturing procedures, to the design of a critical part, to the approved operating environment, or to the design loading spectrum are evaluated to establish the effects, if any, on the fatigue evaluation of the part.

(6) Materials review procedures for critical parts (i.e., procedures for determining the disposition of parts having manufacturing errors or material flaws) are in accordance with paragraphs (4) and (5) above.

(7) Critical parts are identified as required, and relevant records relating to the identification are maintained such that it is possible to establish the manufacturing history of the individual parts or batches of parts.

(8) The critical characteristics of critical parts produced in whole or in part by suppliers are maintained.

AC 29.547A. § 29.547 (Amendment 29-40) MAIN ROTOR AND TAIL ROTOR STRUCTURE.

a. Explanation. Amendment 29-40 revised § 29.547 to add requirements to perform a design assessment. Section 29.547 (a) and (b) set forth a definition of a rotor and its associated components and requires a design assessment to be performed. The intent of these paragraphs is to identify the critical components and/or clarify their design integrity to show that the basic airworthiness requirements which are applicable to the rotors will be met.

A design assessment of the rotors should be carried out in order to substantiate that they are of a safe design and that compensating provisions are made available to prevent failures classified as hazardous and catastrophic in the sense specified in paragraph b below. In carrying out the design assessment, the results of the certification ground and flight testing (including any failures or degradation) should be taken into consideration. Previous service experience with similar designs should also be taken into account (see also § 29.601(a)).

b. Definitions. For the purposes of this assessment, failure conditions may be classified according to the severity of their effects as follows:

(1) Minor. Failure conditions which would not significantly reduce rotorcraft safety, and which involve crew actions that are well within the crew capabilities. Minor failure conditions may include, for example, a slight reduction in safety margins or functional capabilities, a slight increase in crew workload, such as routine flight plan changes, or some inconvenience to occupants.

(2) Major. Failure conditions which would reduce the capability of the rotorcraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be, for example, a significant reduction in safety margins or functional capabilities, a significant increase in crew work load or in conditions impairing crew efficiency, or discomfort to occupants, possibly including injuries.

(3) Hazardous. Failure conditions which would reduce the capability of the rotorcraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be --

(i) A large reduction in safety margins or functional capabilities.

(ii) Physical distress or higher workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely.

(iii) Serious or fatal injury to a relatively small number of the occupants.

(iv) Loss of ability to continue safe flight to a suitable landing site.

(4) Catastrophic. Failure conditions which would prevent a safe landing.

(5) Minimize. Reduce to the least possible amount by means that can be shown to be both technically feasible and economically justifiable.

(6) Health Monitoring. Equipment, techniques, and/or procedures by which selected incipient failure or degradation can be determined.

c. Procedures.

(1) Failure Analysis. The first stage of the design assessment should be the failure analysis, by which all the hazardous and catastrophic failure modes are identified. The failure analysis may consist of a structured, inductive bottom-up analysis, which is used to evaluate the effects of failures on the system and on the aircraft for each possible item or component failure. When properly formatted, it will aid in identifying latent failures and the possible causes of each failure mode. The failure analysis should take into consideration all reasonably conceivable failure modes in accordance with the following:

(i) Each item/component function(s).

(ii) Item/component failure modes and their causes.

(iii) The most critical operational phase/mode associated with the failure mode.

(iv) The effects of the failure mode on the item/component under analysis, the secondary effects on the rotors and on the rotor drive system, on other systems, and on the rotorcraft. Combined effects of failures should be analyzed where a primary failure is likely to result in a secondary failure.

(v) The safety device or health monitoring means by which occurring or incipient failure modes are detected, or their effects mitigated. The analysis should consider the safety system failure.

(vi) The compensating provision(s) made available to circumvent or mitigate the effects of the failure mode (see also paragraph c(2) below)

(vii) The failure condition severity classification according to the definitions given in paragraph b above.

When deemed necessary for particular system failures of interest, the above analysis may be supplemented by a structured, deductive top-down analysis,

which is used to determine which failure modes contribute to the system failure of interest.

Dormant failure modes should be analyzed in conjunction with at least one other failure mode for the specific component or an interfacing component. This latter failure mode should be selected to represent a failure combination with potential worst case consequences.

When significant doubt exists as to the effects of a failure, these effects may be required to be verified by tests.

(2) Evaluation of Hazardous and Catastrophic Failures: The second stage of the design assessment is to summarize the hazardous and catastrophic failures and appropriately substantiate the compensating provisions which are made available to minimize the likelihood of their occurrence. Those failure conditions that are more severe should have a lower likelihood of occurrence associated with them than those that are less severe. The applicant should obtain early concurrence of the cognizant certificating authority with the compensating provisions for each hazardous or catastrophic failure.

Compensating provisions may be selected from one or more of those listed below, but not necessarily limited to this list.

(i) Design features; i.e., safety factors, part derating criteria, redundancies, etc.

(ii) A high level of integrity: All parts with catastrophic failure modes and critical characteristics are to be identified as Critical Parts and be subject to a Critical Parts Plan (see AC 29.602). Where a high level of integrity is used as a compensating provision, parts with a hazardous failure mode which would prevent continued safe flight may be included in a Critical Parts Plan or subjected to other enhancements to the normal control procedures for parts.

(iii) Fatigue tolerance evaluation.

(iv) Flight limitations.

(v) Emergency procedures.

(vi) An inspection or check that would detect the failure mode or evidence of conditions that could cause the failure mode.

(vii) A preventive maintenance action to minimize the likelihood of occurrence of the failure mode including replacement actions and verification of serviceability of items which may be subject to a dormant failure mode.

(viii) Special assembly procedures or functional tests for the avoidance of assembly errors which could be safety critical.

(ix) Safety devices or health monitoring means beyond those identified in (vi) and (vii) above.

AC 29.602 § 29.602 CRITICAL PARTS.

a. Explanation.

(1) Critical parts requirements apply to structural components, rotor drive systems, rotors, and mechanical control systems.

(2) The objective of identifying critical parts is to ensure that critical parts are controlled during design, manufacture, and throughout their service life so that the risk of failure in service is minimized by ensuring that the critical parts maintain the critical characteristics on which certification is based.

(3) Definitions with respect to § 29.602:

(i) The use of the word "could" in paragraph 29.602(a) of the rule means that this failure assessment should consider the effect of flight regime (i.e., forward flight, hover, etc.). The operational environment need not be considered.

(ii) With respect to this rule, the term "catastrophic" means the inability to conduct an autorotation to a safe landing, without exceptional piloting skills, assuming a suitable landing surface is available.

(iii) The use of the word "and" in paragraph 29.602(a) of the rule means the part must have both a catastrophic failure mode together with one or more critical characteristics.

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(v) With respect to this rule, the term "critical characteristic" means any dimension, tolerance, finish, material, or any manufacturing or inspection process, or other feature which cannot tolerate variation from type design requirements and, if nonconforming, would cause failure of the critical part.

(4) Many rotorcraft manufacturers already have procedures in place within their companies for handling "critical parts." These plans may be required by their dealings with other customers, frequently military (e.g., US DoD, UK MoD, Italian MoD). Although these plans may have slightly different definitions of "critical parts" which have sometimes been called "Flight Safety Parts," "Critical Parts," "Vital Parts," or "Identifiable Parts," they have in the past been accepted as meeting the intent of this requirement and providing the expected level of safety. It is acceptable for these plans to use alternative names and terminology provided they meet the intent of this requirement.

b. Procedures. The rotorcraft manufacturer should establish a Critical Parts Plan that identifies and controls the critical characteristics. The policies and procedures which constitute that plan should be such as to ensure that--

(1) All critical parts of the rotorcraft are identified by means of an appropriate failure assessment and a Critical Parts List is established.

(2) Documentation draws the attention of the personnel involved in the design, manufacture, maintenance, inspection, and overhaul of a critical part to the special nature of the part and details the relevant special instructions. For example all drawings, work sheets, inspection documents, etc., could be prominently annotated with the words "Critical Part" or equivalent and the Instructions for Continued Airworthiness and Overhaul Manuals (if applicable) should clearly identify critical parts and include the needed maintenance and overhaul instructions. The documentation should:

(i) Contain comprehensive instructions for the maintenance, inspection and overhaul of critical parts and emphasize the importance of these special procedures;

(ii) Indicate to operators and overhaulers that unauthorized repairs or modifications to critical parts may have hazardous consequences;

(iii) Emphasize the need for careful handling and protection against damage or corrosion during maintenance, overhaul, storage, and transportation and accurate recording and control of service life (if applicable);

(iv) Require notification of the manufacturer of any unusual wear or deterioration of critical parts and the return of affected parts for investigation when appropriate;

(3) Procedures should be established for identifying and controlling critical characteristics.

(4) To the extent needed for control of critical characteristics, procedures and processes for manufacturing critical parts (including test articles) are defined (for example material source, forging procedures, machining operations and sequence, inspection techniques, and acceptance and rejection criteria). Procedures for changing these manufacturing procedures should also be established.

(5) Any changes to the manufacturing procedures, to the design of a critical part, to the approved operating environment, or to the design loading spectrum are evaluated to establish the effects, if any, on the fatigue evaluation of the part.

(6) Materials review procedures for critical parts (i.e., procedures for determining the disposition of parts having manufacturing errors or material flaws) are in accordance with paragraphs (4) and (5) above.

(7) Critical parts are identified as required, and relevant records relating to the identification are maintained such that it is possible to establish the manufacturing history of the individual parts or batches of parts.

(8) The critical characteristics of critical parts produced in whole or in part by suppliers are maintained.

AC 29.917A. § 29.917 (Amendment 29-40) DESIGN.

a. Explanation. Amendment 29-40 introduces a new § 29.917(b). The previous § 29.917(b) has been redesignated as § 29.917(c). Section 29.917(a) sets forth a definition of the rotor drive system and its associated components and § 29.917(b) requires a design assessment to be performed. The intent of this paragraph (b) is to identify the critical components and to establish and/or clarify their design integrity to show that the basic airworthiness requirements, which are applicable to the rotor drive system, will be met.

b. Procedures.

(1) Section 29.917(a) General. The method of compliance for this section is unchanged.

(2) Section 29.917(b) Design Assessment. A design assessment of the rotor drive system should be carried out in order to substantiate that the system is of a safe design and that compensating provisions are made available to prevent failures classified as hazardous and catastrophic in the sense specified in paragraph (c) below. In carrying out the design assessment, the results of the certification ground and flight testing (including any failures or degradation) should be taken into consideration. Previous service experience with similar designs should also be taken into account (see also § 29.601(a)).

c. Definitions. For the purposes of this assessment, failure conditions may be classified according to the severity of their effects as follows:

(1) Minor. Failure conditions which would not significantly reduce rotorcraft safety, and which involve crew actions that are well within their capabilities. Minor failure conditions may include, for example, a slight reduction in safety margins or functional capabilities, a slight increase in crew workload, such as routine flight plan changes, or some inconvenience to occupants.

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(ii) Physical distress or higher workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely;

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(6) Health Monitoring. Equipment, techniques, and/or procedures by which selected incipient failure or degradation can be determined.

d. Failure Analysis.

(1) The first stage of the design assessment should be the Failure Analysis, by which all the hazardous and catastrophic failure modes are identified. The failure analysis may consist of a structured, inductive bottom-up analysis, which is used to evaluate the effects of failures on the system and on the aircraft for each possible item or component failure. When properly formatted it will aid in identifying latent failures and the possible causes of each failure mode. The failure analysis should take into consideration all reasonably conceivable failure modes in accordance with the following:

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(iii) The most critical operational phase/mode associated with the failure mode.

(iv) The effects of the failure mode on the item/component under analysis, the secondary effects on the rotor drive system and on the rotors, on other systems and on the rotorcraft. Combined effects of failures should be analyzed where a primary failure is likely to result in a secondary failure.

(v) The safety device or health monitoring means by which occurring or incipient failure modes are detected, or their effects mitigated. The analysis should consider the safety system failure.

(vi) The compensating provision(s) made available to circumvent or mitigate the effect of the failure mode (see also paragraph (1) below).

(vii) The failure condition severity classification according to the definitions given in paragraph (c) above.

(2) When deemed necessary for particular system failures of interest, the above analysis may be supplemented by a structured, deductive top-down analysis, which is used to determine which failure modes contribute to the system failure of interest.

(3) Dormant failure modes should be analyzed in conjunction with at least one other failure mode for the specific component or an interfacing component. This latter failure mode should be selected to represent a failure combination with potential worst-case consequences.

(4) When significant doubt exists as to the effects of a failure, these effects may be required to be verified by tests.

e. Evaluation of Hazardous and Catastrophic Failures.

(1) The second stage of the design assessment is to summarize the hazardous and catastrophic failures and appropriately substantiate the compensating provisions that are made available to minimize the likelihood of their occurrence. Those failure conditions that are more severe should have a lower likelihood of occurrence associated with them than those that are less severe. The applicant should obtain early concurrence of the cognizant certificating authority with the compensating provisions for each hazardous or catastrophic failure.

(2) Compensating provisions may be selected from one or more of those listed below, but not necessarily limited to this list.

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(ii) A high level of integrity: All parts with catastrophic failure modes and critical characteristics are to be identified as Critical Parts and be subject to a Critical Parts Plan (see AC 29.602.). Where a high level of integrity is used as a compensating provision, parts with a hazardous failure mode which would prevent continued safe flight may be included in a Critical Parts Plan or subjected to other enhancements to the normal control procedures for parts.

(iii) Fatigue tolerance evaluation.

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