HEICO

“Critical?” Influencing Parts

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FAA §33.70 Rulemaking.

2007 Rule
Based on:
Sioux City,
Pensacola,
Los Angles &
Denver

1984-1989
MFG anomalies
40% of problems

Background

Manufacturing-induced anomalies in engine disks have caused several fatal airplane accidents, notably in Sioux City, Iowa, in 1989, and in Pensacola, Florida, in 1996. The DC-10 crash in Sioux City was caused by a titanium material anomaly created during the material melting process. The MD-88 accident in Pensacola was attributed to a fatigue crack which initiated from an abnormal microstructure created during manufacturing. Most of the uncontained engine failures have been traced to material, manufacturing or operations/maintenance induced anomalies. Recent examples include:

Failure of a CF6 engine high pressure stage 1 turbine disk on a Boeing 767 airplane during a ground test at Los Angeles International Airport in June 2006, that was attributed to a manufacturing-induced anomaly in a rim slot; and

In-flight failure of a CF34 engine fan disk on a Bombardier CRJ-200 airplane departing Denver International Airport on January 25, 2007. The root cause of this failure is currently under investigation.

Industry data has shown that manufacturing-induced anomalies have caused about 40 percent of recent rotor cracking and failure events. Data for the period 1984 to 1989 indicates that uncontained engine failures due to material, manufacturing and maintenance induced anomalies occur at the rate of 1.2 per 10 million flights or approximately 3 events per year. Due to these accidents and the supporting data, the FAA determined the need to revise engine certification standards related to the design of engine parts whose failure would result in a hazardous engine condition.

In addition, a group representing the FAA, the engine industry, and European aviation authorities has worked since 1989 to revise and harmonize the U.S. and European engine certification requirements. This rule, which is based on this group's recommendations, creates common U.S. and European engine requirements for turbine engine life-limited parts (called ``critical parts'' in European regulations).

FAA §33.70 Engine life-limited parts.

§33.70 Engine life-limited parts.

By a procedure approved by the FAA, operating limitations must be established which specify the maximum allowable number of flight cycles for each engine life-limited part. Engine life-limited parts are rotor and major static structural parts whose primary failure is likely to result in a hazardous engine effect. Typically, engine life-limited parts include, but are not limited to disks, spacers, hubs, shafts, high-pressure casings, and non-redundant mount components. For the purposes of this section, a hazardous engine effect is any of the conditions listed in §33.75 of this part. The applicant will establish the integrity of each engine life-limited part by:

(a) An engineering plan that contains the steps required to ensure each engine life-limited part is withdrawn from service at an approved life before hazardous engine effects can occur. These steps include validated analysis, test, or service experience which ensures that the combination of loads, material properties, environmental influences and operating conditions, including the effects of other engine parts influencing these parameters, are sufficiently well known and predictable so that the operating limitations can be established and maintained for each engine life-limited part. Applicants must perform appropriate damage tolerance assessments to address the potential for failure from material, manufacturing, and service induced anomalies within the approved life of the part. Applicants must publish a list of the life-limited engine parts and the approved life for each part in the Airworthiness Limitations Section of the Instructions for Continued Airworthiness as required by §33.4 of this part.

(b) A manufacturing plan that identifies the specific manufacturing constraints necessary to consistently produce each engine life-limited part with the attributes required by the engineering plan.

(c) A service management plan that defines in-service processes for maintenance and the limitations to repair for each engine life-limited part that will maintain attributes consistent with those required by the engineering plan. These processes and limitations will become part of the Instructions for Continued Airworthiness.

[Amdt. 33-22, 72 FR 50860, Sept. 4, 2007]

EASA CS-E 515 Engine Critical Parts

Regulations are harmonized between EASA and the FAA

CS-E 515 Engine Critical Parts
(See AMC E 515)

The integrity of the Engine Critical Parts identified under CS-E 510 must be established by:

(a) An Engineering Plan, the execution of which establishes and maintains that the combinations of loads, material properties, environmental influences and operating conditions, including the effects of parts influencing these parameters, are sufficiently well known or predictable, by validated analysis, test or service experience, to allow each Engine Critical Part to be withdrawn from service at an Approved Life before Hazardous Engine Effects can occur. Appropriate Damage Tolerance assessments must be performed to address the potential for Failure from material, manufacturing and service-induced anomalies within the Approved Life of the part. The Approved Life must be published as required in CS-E 25 (b).

(b) A Manufacturing Plan which identifies the specific manufacturing constraints necessary to consistently produce Engine Critical Parts with the Attributes required by the Engineering Plan.

(c) A Service Management Plan which defines in-service processes for maintenance and repair of Engine Critical Parts which will maintain Attributes consistent with those required by the Engineering Plan. These processes must become part of the instructions for continued airworthiness.

[Amdt. No.:E/1]

3 Plans: Engineering, Manufacturing, and Service Management

AC 33.70-1 and AMC E 515 Influencing Parts

FAA AC 33.70-1 paragraph 8. h.

h. Influencing Parts. Engine life-limited parts are part of a complex system in which other engine parts can affect the life-limited parts, including their life capability. Therefore, the engineering plan must consider these other parts and particularly any changes to them. Examples of influencing parts include a turbine blade, a mating flange or seal, and a static part that impacts the environment (temperatures, pressures, etc.) around a life-limited part. Examples of changes to these parts include a heavier blade; a new mating part with a different coefficient of thermal expansion; orifices and clearances affecting cooling air flow; and geometric or material changes to a static part that modify the thermal response and/or the mechanical response of the part.

EASA AMC E 515 paragraph (3) (h)

(h) *Influencing Parts*

Engine Critical Parts are part of a complex system and other parts of the engine can have an impact on the Engine Critical Parts and their life capability. Therefore, the Engineering Plan needs to address these parts, and particularly changes to them. Examples of influencing parts include a turbine blade, a mating part, and a static part that impacts the environment (temperatures, pressures, etc.) around the Engine Critical Part. Examples of changes to influencing parts include a blade with a different weight, centre of gravity, or root coating; a mating part made from a material having a different coefficient of thermal expansion; and a static part where changes in geometry or material modify the thermal and/or mechanical response of the component and could, as a result, affect the environment around the Engine Critical Part.

FAA Review of Changes to (Influencing) Parts

"Changes introduced to LLP influencing parts without the involvement of GE may affect engine performance, operability, thermal profiles, primary and secondary flow behavior, stress distribution, vibration modes including aero-elastic considerations, and material characteristics, including damage tolerance considerations."

Any change (TC holder, PMA holder, STC holder, or Repair Station) must be evaluated, reviewed and assessed to ensure that there is no effect to the Life Limit of any LLPs.

From FAA Order 8110.42C

d. Reviews Engineering and Test Data. Review the applicant's engineering design to determine if the design meets the applicable airworthiness standards. Seek FAA expertise from other ACOs, directorates, and Chief Scientific and Technical Advisors (CSTA) as needed. Dependent on the nature and complexity of the part:

- Review all differences between the proposed and original parts. Assess the technical justification for these differences and associated impacts on the next higher assembly and product. For example, weight and other mass properties can influence vibratory response and performance of rotating components. Also, assess the applicant's analysis of part weights and associated effects from any weight differences on an assembly and associated product.

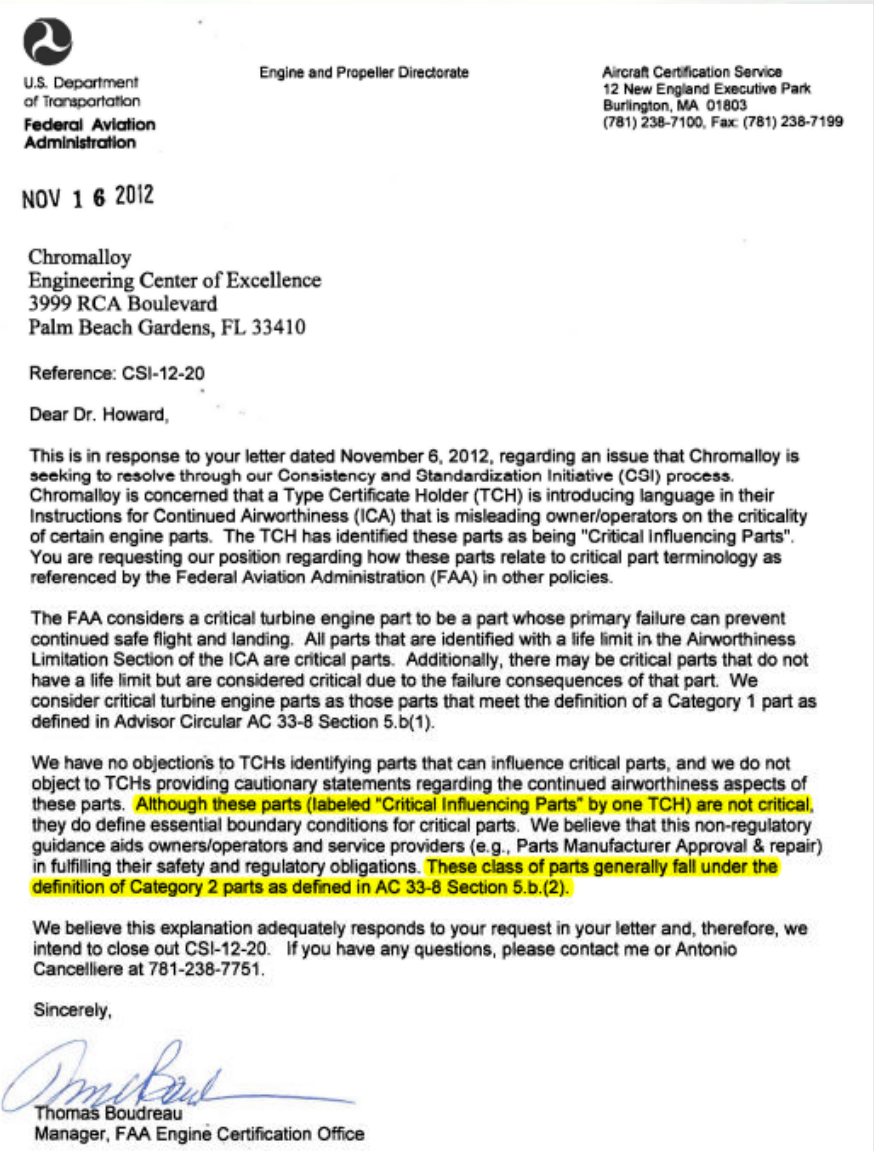
Critical Influencing Parts – AC 33-8

AC 33-8

Guidance for Parts Manufacturer Approval of Turbine Engine and Auxiliary Power Unit Parts under Test and Computation

This AC provides guidance to the FAA and applicants on how to develop alternate parts for Engines and provides templates for what type of information analyses and tests should be provided for various types of engine parts.

..these parts (labeled “Critical Influencing Parts” by one TCH) are not critical…



U.S. Department of Transportation
Federal Aviation Administration

Engine and Propeller Directorate

Aircraft Certification Service
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Burlington, MA 01803
(781) 238-7100, Fax: (781) 238-7199

NOV 16 2012

Chromalloy
Engineering Center of Excellence
3999 RCA Boulevard
Palm Beach Gardens, FL 33410

Reference: CSI-12-20

Dear Dr. Howard,

This is in response to your letter dated November 6, 2012, regarding an issue that Chromalloy is seeking to resolve through our Consistency and Standardization Initiative (CSI) process. Chromalloy is concerned that a Type Certificate Holder (TCH) is introducing language in their Instructions for Continued Airworthiness (ICA) that is misleading owner/operators on the criticality of certain engine parts. The TCH has identified these parts as being "Critical Influencing Parts". You are requesting our position regarding how these parts relate to critical part terminology as referenced by the Federal Aviation Administration (FAA) in other policies.

The FAA considers a critical turbine engine part to be a part whose primary failure can prevent continued safe flight and landing. All parts that are identified with a life limit in the Airworthiness Limitation Section of the ICA are critical parts. Additionally, there may be critical parts that do not have a life limit but are considered critical due to the failure consequences of that part. We consider critical turbine engine parts as those parts that meet the definition of a Category 1 part as defined in Advisor Circular AC 33-8 Section 5.b(1).

We have no objections to TCHs identifying parts that can influence critical parts, and we do not object to TCHs providing cautionary statements regarding the continued airworthiness aspects of these parts. Although these parts (labeled "Critical Influencing Parts" by one TCH) are not critical, they do define essential boundary conditions for critical parts. We believe that this non-regulatory guidance aids owners/operators and service providers (e.g., Parts Manufacturer Approval & repair) in fulfilling their safety and regulatory obligations. These class of parts generally fall under the definition of Category 2 parts as defined in AC 33-8 Section 5.b.(2).

We believe this explanation adequately responds to your request in your letter and, therefore, we intend to close out CSI-12-20. If you have any questions, please contact me or Antonio Cancelliere at 781-238-7751.

Sincerely,

Thomas Boudreau
Manager, FAA Engine Certification Office

AC 33-8 PMA Templates for Turbine Engines

FAA Engine and Propeller Directorate PMA Templates

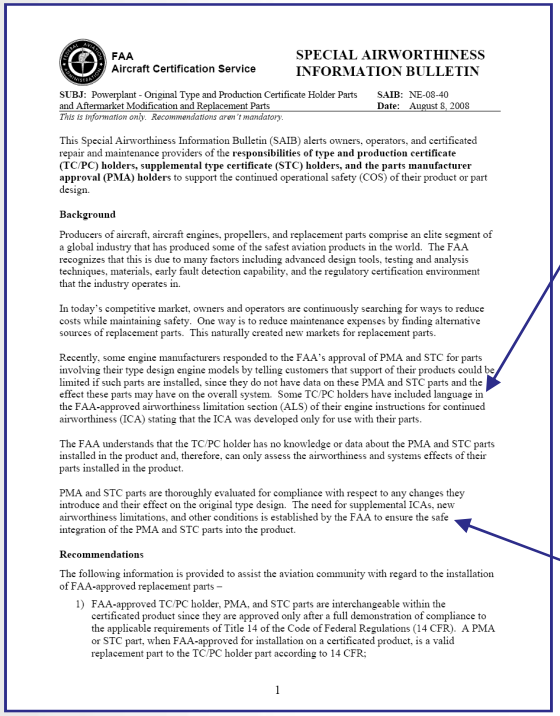
(2) Category 2. An engine or part(s) thereof whose failure would not prevent continued safe flight and landing; resulting consequences may reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions or subsequent failures. For the purpose of this AC, a Category 2 engine part is typically a complex part that may affect a critical part.

(a) Together with industry, we developed sample templates as aids to identify technical elements and regulatory requirements generally considered when developing test and substantiation plans. These templates are not all inclusive; rather, they are for a limited number of typical Category 2 engine parts. They are included in Appendix 2 of this AC.

(b) For Category 2 engine parts, we recommend applicants discuss any questions regarding the templates with the PACO. If a template is not available for a proposed PMA part, we suggest applicants consider developing a new template to identify technical considerations and regulatory requirements. We recommend applicants stay close to the template format provided to do this. We also recommend applicants review the new template with the PACO early in their project to determine if any additional data will be needed.

Templates developed through Industry and FAA collaboration.

FAA SAIB: NE-08-40 Use of PMA parts and DAH ICA



FAA
Aircraft Certification Service

SPECIAL AIRWORTHINESS INFORMATION BULLETIN

SUBJ: Powerplant - Original Type and Production Certificate Holder Parts and Aftermarket Modification and Replacement Parts

SAIB: NE-08-40
Date: August 8, 2008

This is information only. Recommendations aren't mandatory.

This Special Airworthiness Information Bulletin (SAIB) alerts owners, operators, and certificated repair and maintenance providers of the **responsibilities of type and production certificate (TC/PC) holders, supplemental type certificate (STC) holders, and the parts manufacturer approval (PMA) holders** to support the continued operational safety (COS) of their product or part design.

Background

Producers of aircraft, aircraft engines, propellers, and replacement parts comprise an elite segment of a global industry that has produced some of the safest aviation products in the world. The FAA recognizes that this is due to many factors including advanced design tools, testing and analysis techniques, materials, early fault detection capability, and the regulatory certification environment that the industry operates in.

In today's competitive market, owners and operators are continuously searching for ways to reduce costs while maintaining safety. One way is to reduce maintenance expenses by finding alternative sources of replacement parts. This naturally created new markets for replacement parts.

Recently, some engine manufacturers responded to the FAA's approval of PMA and STC for parts involving their type design engine models by telling customers that support of their products could be limited if such parts are installed, since they do not have data on these PMA and STC parts and the effect these parts may have on the overall system. Some TC/PC holders have included language in the FAA-approved airworthiness limitation section (ALS) of their engine instructions for continued airworthiness (ICA) stating that the ICA was developed only for use with their parts.

The FAA understands that the TC/PC holder has no knowledge or data about the PMA and STC parts installed in the product and, therefore, can only assess the airworthiness and systems effects of their parts installed in the product.

PMA and STC parts are thoroughly evaluated for compliance with respect to any changes they introduce and their effect on the original type design. The need for supplemental ICAs, new airworthiness limitations, and other conditions is established by the FAA to ensure the safe integration of the PMA and STC parts into the product.

Recommendations

The following information is provided to assist the aviation community with regard to the installation of FAA-approved replacement parts –

1) FAA-approved TC/PC holder, PMA, and STC parts are interchangeable within the certificated product since they are approved only after a full demonstration of compliance to the applicable requirements of Title 14 of the Code of Federal Regulations (14 CFR). A PMA or STC part, when FAA-approved for installation on a certificated product, is a valid replacement part to the TC/PC holder part according to 14 CFR;

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2) Unless stated otherwise as a limitation to an STC, the FAA has determined and the applicant has shown that FAA-approved life limits established for the TC/PC holder parts remain unchanged for those TC/PC holder parts when PMA or STC parts are installed elsewhere within the product. For example, the life limit for a TC/PC holder disk is unchanged and remains in effect when PMA blades are installed in that disk;
3) The FAA approves the content of an ALS and ICA based upon its review of the substantiating data provided by an applicant. Applicants for PMA or STC parts are required to assess the ICA requirements. A PMA or STC applicant either shows and states that the product's ICA are still valid with their part installed or provides a supplemental ICA for any differences; and
4) TC/PC holders, PMA holders, and STC holders are responsible for the COS support in accordance with the applicable standards for their parts and products which they have designed and produced.

Owners and operators are ultimately responsible for the safety and airworthiness of the product, which includes being responsible for the configuration control of the product. Owners and operators must ensure that any replacement part installed in the product is approved for that installation and further, they must also ensure that they follow any supplemental ICA that may have been developed for that part.

For Further Information Contact

Thomas A. Boudreau, Manager, Engine Certification Office, FAA, 12 New England Executive Park, Burlington, MA 01803; phone: (781) 238-7140; fax: (781) 238-7199; e-mail: thomas.boudreau@faa.gov; or Antonio Cancelliere, Aerospace Engineer; FAA, 12 New England Executive Park, Burlington, MA 01803; phone: (781) 238-7751; fax: (781) 238-7199; e-mail: antonio.cancelliere@faa.gov.

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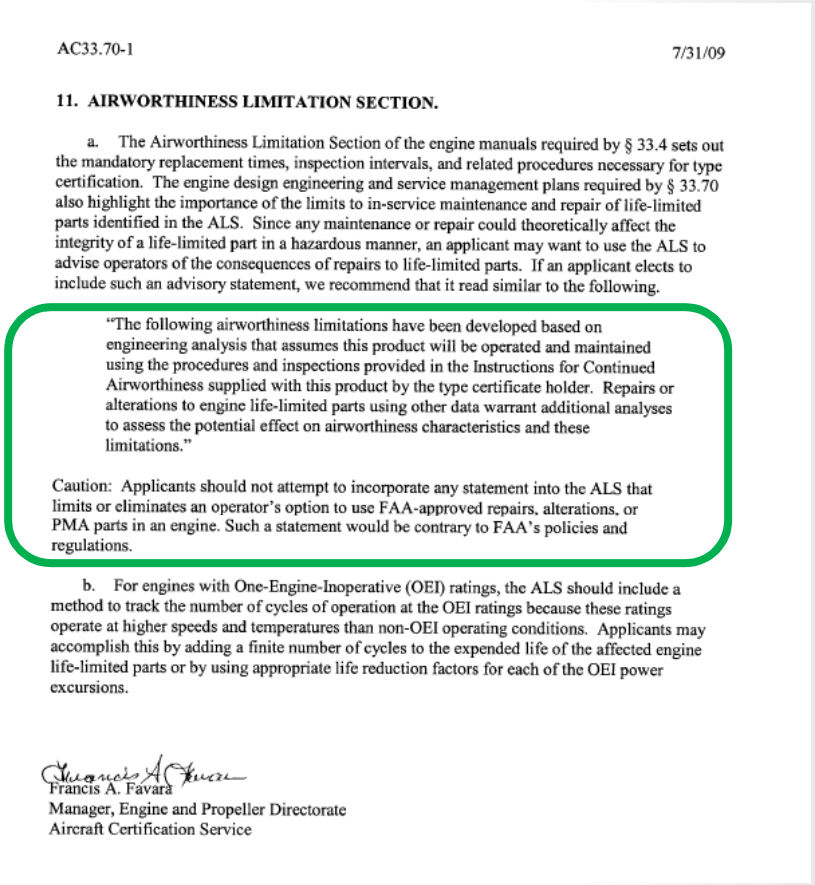
Critical Influencing Parts – AC 33.70-1

More on AC 33.70-1

In the final paragraph of AC 33.70-1 the FAA provides guidance on the ALS section.

Caution: Applicants should not attempt to incorporate any statement into the ALS that limits or eliminates an operator's option to use FAA-approved repairs, alterations, or PMA parts in an engine. Such a statement would be contrary to FAA's policies and regulations.



AC33.70-1 7/31/09

11. AIRWORTHINESS LIMITATION SECTION.

a. The Airworthiness Limitation Section of the engine manuals required by § 33.4 sets out the mandatory replacement times, inspection intervals, and related procedures necessary for type certification. The engine design engineering and service management plans required by § 33.70 also highlight the importance of the limits to in-service maintenance and repair of life-limited parts identified in the ALS. Since any maintenance or repair could theoretically affect the integrity of a life-limited part in a hazardous manner, an applicant may want to use the ALS to advise operators of the consequences of repairs to life-limited parts. If an applicant elects to include such an advisory statement, we recommend that it read similar to the following.

"The following airworthiness limitations have been developed based on engineering analysis that assumes this product will be operated and maintained using the procedures and inspections provided in the Instructions for Continued Airworthiness supplied with this product by the type certificate holder. Repairs or alterations to engine life-limited parts using other data warrant additional analyses to assess the potential effect on airworthiness characteristics and these limitations."

Caution: Applicants should not attempt to incorporate any statement into the ALS that limits or eliminates an operator's option to use FAA-approved repairs, alterations, or PMA parts in an engine. Such a statement would be contrary to FAA's policies and regulations.

b. For engines with One-Engine-Inoperative (OEI) ratings, the ALS should include a method to track the number of cycles of operation at the OEI ratings because these ratings operate at higher speeds and temperatures than non-OEI operating conditions. Applicants may accomplish this by adding a finite number of cycles to the expended life of the affected engine life-limited parts or by using appropriate life reduction factors for each of the OEI power excursions.

Francis A. Favara
Manager, Engine and Propeller Directorate
Aircraft Certification Service