U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: PROPOSED DRAFT – Turbine Engine Repairs and Alterations – Approval of Technical and Substantiation Data	**Date: DRAFT** Initiated By:	**AC No: DRAFT** **Change:**

1. PURPOSE.

a. This advisory circular (AC) provides guidance and acceptable methods, but not the only methods, that may be used to obtain Federal Aviation Administration (FAA) approval of technical data for turbine engine repairs and alterations in compliance with Title 14 of the Code of Federal Regulations (14 CFR part 33).

b. This AC provides guidance for developing the technical and substantiation data that demonstrates compliance with the applicable airworthiness standards in 14 CFR part 33.

c. These regulations require the use of FAA approved technical data for major repairs and alterations to type certificated products:

- 14 CFR part 43, §§43.7(d) and 43.17(e)(2)
- 14 CFR part 65, §65.95(a)(1)
- 14 CFR part 121, §121.379(b)
- 14 CFR part 135, §135.437(b)
- 14 CFR part 145, §§145.201(c)(1) and 145.201(c)(2)

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2. APPLICABILITY.

a. The guidance in this AC applies to 14 CFR part 33 compliance findings.

b. This material is neither mandatory nor regulatory in nature and does not constitute a regulation. It describes acceptable means, but not the only means, for demonstrating compliance with the applicable regulations. The FAA will consider other methods of demonstrating compliance that an applicant may elect to present. Terms such as “should,” “shall,” “may,” and “must” are used only in the sense of ensuring applicability of this particular method of compliance when the acceptable method of compliance in this document is used. While these guidelines are not mandatory, they are derived from extensive FAA and industry experience in determining compliance with the relevant regulations. On the other hand, if the FAA becomes aware of circumstances that convince us that following this AC would not result in compliance with the applicable regulations, we will not be bound by the terms of this AC, and we may require additional substantiation as the basis for finding compliance.

c. This material does not change, create any additional, authorize changes in, or permit deviations from existing regulatory requirements.

3. DEFINITIONS.

For the purpose of this AC the following definitions apply:

a. Aircraft hazard: Any failure of a repaired or altered part that will cause the engine to:

(1) Catch fire;

(2) Burst (release hazardous fragments through the engine case);

(3) Generate loads greater than those ultimate loads specified in 33.23(a); or

(4) Lose the capability of being shut down.

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b. Critical: A term applicable to parts, characteristics, processes, procedures, or inspections that when failed, omitted, or non-conforming, may cause significantly degraded airworthiness of the engine.

c. Independent DER: A consultant DER, or a company DER not associated with the TC holder of the product to be repaired or altered.

d. Independent repair entity: A repair station or person that proposes repairs not listed in the engine manuals and specifications, and does not have the TC holder agreement, or approval.

4. BACKGROUND.

a. FAA has observed a significant increase in the number of gas turbine engine repairs and alterations that (1) are not in the manufacturer's maintenance manual, and (2) are developed by a non-TC holder of an engine. Increasingly, independent repair entities and their Designated Engineering Representatives (DERs) are asking the FAA to approve critical parts repairs and alterations requiring complex engineering analyses and critical processes. These repairs and alterations require the highest level of technical substantiation since their failure could result in hazardous or catastrophic consequences.

b. Given this changing environment, the FAA is concerned that engines reliability and safety may be degraded by inadequate repairs and alterations. Therefore, this AC provides technical and regulatory guidance for aircraft turbine engine repairs and alterations to ensure that, when developing technical and substantiation data, independent repair entities and TC holders apply uniform standards.

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5. RELATED STUDIES.

a. The FAA Engine and Propeller Directorate Safety Analysis Team reported in 1997 that the leading causes of transport category aircraft accidents and serious incidents originated in the engines were the failure of high energy rotating structures (engine rotors). The majority of engine rotor failures (for example, disk, shaft, and spacers) were due to maintenance errors and manufacturing induced defects. Inadequate engine repairs were major contributors.

b. The FAA Certification Process Study (CPS) of March 2002, provided a number of findings and observations regarding transport category aircraft accidents. For example, the study found the following deficiencies in repairs, alterations, and DER activity:

(1) No standardization for determining when a repair or alteration required FAA approved data.

(2) Inconsistency between the safety analysis supporting engine repairs and that conducted at initial TC.

(3) Inadequate technical data to support independent DER approved repair designs.

(4) Lack of air carrier oversight of their outsourced maintenance.

c. The FAA also found when conducting repair stations audits, a lack of continuity with regard to critical process quality controls and validations when comparing a repaired part with its original certification type design. Independent repair entities are repairing increasingly complex and safety significant parts, for which critical processes were used in the original part design and/or are applied by the TC holder during repairs and alterations. They must, therefore, identify and validate the critical processes, as discussed in paragraph 24 of this AC. The FAA also made the following observations about current industry practices:

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(1) Standardized procedures for establishing a critical process validation plan equivalent to that of the original part certification are often missing. Specifically, methods for establishing and maintaining critical processes that result in material attributes that cannot be inspected using non-destructive inspection techniques are absent.

(2) Independent repair entities often do not have the engineering expertise available to substantiate new or revised critical processes needed for some repairs or alterations (for example, forging, casting, joining, coatings, surface treatments, machining, etc).

(3) Independent repair entities and DERs are often not providing adequate documentation of new, revised or modified critical process validation plans, which makes finding quality shortfalls and associated root causes difficult.

d. The above factors point to a need for guidance about what data supports engines repairs and alterations and about coordinating approval of certain repairs and alterations with the Aircraft Certification Office (ACO) and the Certificate Management Aircraft Certification Office (CMACO).

6. DISCUSSION.

a. This AC provides specific guidance for the repair and alteration of turbine engines and their components, and complements other guidance, such as that in AC120.77 and AC43-210. Additionally, this AC identifies part categories based on (1) part criticality to the continued safe operation of turbine engines, and (2) on the effect of the repair or alteration to the part.

b. This AC provides specific guidance to non-TC holders for the development of repairs, alterations and Instructions for Continued Airworthiness (ICAs) using same or equivalent

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practices as those used by the TC holder at certification or during post-certification. The guidance is equally applicable to TC holders in that, when developing repairs and alterations for their own products, TC holders must follow the same practices as those used during certification.

c. Existing regulations, listed in paragraph 1c of this AC, require that operators, repair stations, and other persons that perform major repairs and alterations use technical data approved by the FAA. Repairs and alterations of safety critical engine parts are considered major repairs and require technical data approved by the FAA.

d. The regulations assign the aircraft owner/operator the responsibility to ensure that all parts have been properly repaired or altered when maintenance is performed, including outsourced maintenance. The aircraft owner/operator must also ensure that the installation of repaired and altered parts complies with the owner/operators maintenance manuals.

7. REPAIRS AND ALTERATIONS THAT AFFECT ENGINE EMISSIONS. Some repairs and alterations affect engine emissions. DERs should coordinate with the appropriate ACO and CMACO if a repair or alteration will affect compliance with the requirements for engine exhaust emission of 14 CFR part 34.

8. REPAIRS AND ALTERATIONS THAT AFFECT ENGINE NOISE. Repairs and alterations that affect the engine noise characteristics may affect an aircraft's airworthiness. Most of the components affecting engine noise are located in the inlet and exhaust area. The DERs should consult their FAA advisor if not certain whether the repair or alteration may affect the engine noise. DERs should also coordinate with the appropriate aircraft ACO if a repair or alteration will impact 14 CFR part 36 aircraft noise compliance.

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9. DATA FOR REPAIRS AND ALTERATIONS – GENERAL.

a. Repairs and alterations are an integral part of maintaining a product in condition for safe operation. Comprehensive repair and alteration methods are needed throughout the service life of an engine to maintain the required level of safety for the flying public. Repairs and alterations of turbine engines and their parts must be properly assessed for criticality, and substantiated for compliance with the applicable requirements of 14 CFR part 33.

b. Independent DERs often approve data for operators and/or repair stations. In the study mentioned earlier, the FAA found that the documentation associated with DER-approved repairs or alterations often only contained the instructions for performing the repair (that is, methods, techniques, and practices), the engineering data was frequently incomplete, and the appropriate airworthiness standards were not fully identified or substantiated. These shortcomings are corrected when the DER evaluates each repair or alteration, develops the technical data needed to do the repair, and provides the supporting engineering data and substantiation data that address the effect on type design.

c. Data related to engine repairs and alterations is the sum of “technical data,” “substantiating data,” and “methods, techniques, and practices” that are discussed in more detail below. In addition, new or revised Instructions for Continued Airworthiness (ICAs) may be necessary when a repaired or altered part has deviated from its original type design and the original requirements for continued airworthiness no longer apply.

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10. TECHNICAL DATA.

a. Technical data are the drawings, specifications and any other data necessary to define the configuration and design features of a particular repair or alteration. Approved technical data is required for the performance of certain repairs and alterations, and must be provided to those that perform the work.

b. Technical data may also include requirements for tests and/or analyses, and other engineering information, such as data in engineering handbooks and military or industry specifications.

c. Some repairs and alterations critical to aviation safety require specific critical process validation plans, discussed in paragraph 24 of this AC.

11. SUBSTANTIATING DATA.

a. Substantiating data is used to show that the part repair or alteration maintains the engine model's compliance with 14 CFR part 33 airworthiness standards.

b. The complexity of substantiation data is determined by the complexity of the repair or alteration and by the criticality of the part to be repaired or altered. Substantiation data may include:

(1) Technical data needed by the repair entity for performing the repair or alteration work, as discussed in paragraph 10 of this AC.

(2) Analyses and/or computations appropriate to the repair or alteration being evaluated.

(3) Test results, operational and service experience, maintenance and alteration experience, reliability data, and other documented factual information that can be shown to be directly applicable to the airworthiness of the product.

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12. METHODS, TECHNIQUES AND PRACTICES. Methods, techniques, and practices are the step-by-step or "how-to" instructions for performing the repair or alteration. For repairs and alterations of safety critical parts, these instructions must be integrated with the applicable critical process validation plan identified in paragraph 24 of this guidance.

13. DATA ASSESSMENT FOR A REPAIR OR ALTERATION. To develop the technical and substantiation data the DER must do the followings:

a. Assess the repair or alteration suitability relative to the part's function, in-service reliability, and compliance with existing regulations.

b. Document the part service history (e.g., ADs, incident and/or accident investigations). Adequately address the ADs and significant service difficulties as applicable to the repair or alteration.

c. Determine the repaired or altered part classification and the corresponding FAA approval process, as indicated in paragraph 14 of this AC.

d. Determine the 14 CFR part 33 requirements affected by the repair or alteration and for which compliance must be maintained. Make that determination based on the repair or alteration affects to these part characteristics:

(1) Material properties and characteristics, such as but no limited to, modulus of elasticity, tensile and ultimate strength, fatigue strength, creep rupture strength, microstructure.

(2) Performance, structural strength, vibration, fatigue, oxidation or corrosion resistance, or any other characteristics as applicable.

(3) Form, fit and function at the part, assembly, or engine levels.

(4) Any other qualities affecting durability, reliability, and continued airworthiness.

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e. Generate a repair or alteration certification plan that identifies applicable 14 CFR part 33 requirements and the methods of compliance. Some methods of compliance may include component or engine tests. Determination of required tests is based on the criticality and complexity of the part and its repair or alteration.

f. Generate and document the technical and substantiation data, and the methods, techniques and practices, in accordance with the certification plan.

g. Identify the repair or alteration critical processes and develop a critical process validation plan as discussed in paragraph 24 of this AC.

h. Assess the continued applicability of the existing ICAs to the repaired or altered part, and if applicable, develop unique ICAs as discussed in paragraph 22 of this AC.

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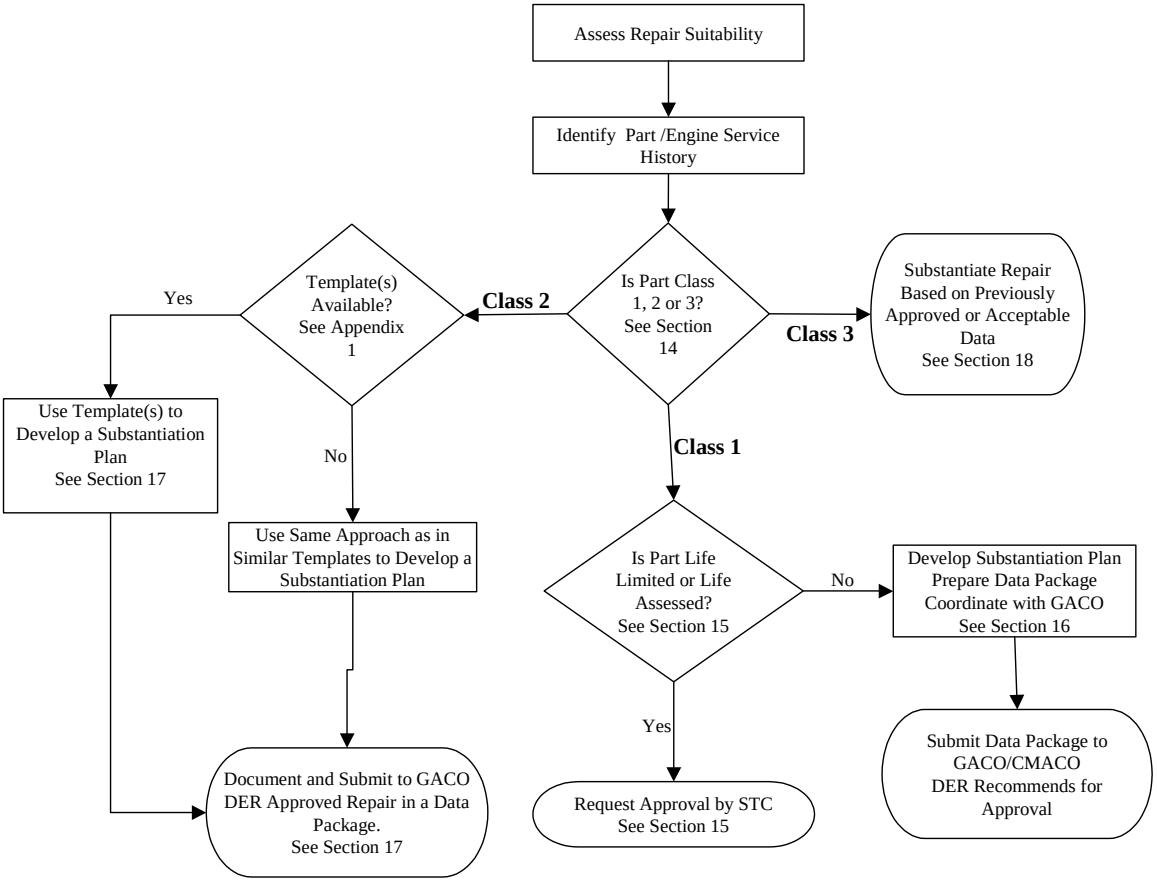
FIGURE 1 - This flowchart outlines the decision process to help identify the requirements for the development and approval of a part repair or alteration.



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14. REPAIR OR ALTERATION CLASSIFICATION.

a. The classification of repaired and altered parts is used in two ways: first, to communicate the level of documentation necessary to show a repair or alteration design complies with the applicable 14 CFR part 33 requirements, and second, to ensure the proper level of FAA oversight is applied to the part repair or alteration. Repairs and alterations are classified based on the part criticality and on the effect the repair or alteration has on the part.

b. Repaired or altered parts are classified in three categories:

(1) Class 1 parts, the failure of which could result in a hazard to the aircraft.

(2) Class 2 parts, the failure of which could adversely affect the engine operation, but would not likely hazard the aircraft, including, but not limited to, inflight shutdown, surge and stall, and loss of thrust control.

(3) Class 3 parts, the failure of which would have no measurable affect on engine operation.

NOTE: Class 1 and class 2 examples are provided in figures 2 and 3, respectively. The examples are not exhaustive; other parts not listed may also be class 1 or 2. Class 3 parts are all those that are not class 1 or 2.

c. The effect of a repair or alteration on the part may change the part classification. A repair or alteration to a class 2 or 3 part, that has any of the following effects on part characteristics, will automatically place that part in the next higher category defined in paragraph 14b of this AC:

(1) Increases the part's failure rate in service.

(2) Changes the part's weight or center of gravity.

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(3) Involves or replaces a major portion of the part's mass.

(4) Changes the part's physical properties, vibratory response, durability.

(5) Changes the part's function.

(6) Changes to the running clearances and gas-path leaks beyond engine manual limits.

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FIGURE 2: Examples of Class 1 Parts

A life-limited or life assessed part.

Any containment structure.

Any flammable fluid carrying component.

Any fuel shutoff component or feature of the engine.

A part that directly affects the life of a mating life-limited part.

A part affected by an airworthiness directive.

Any part of the engine mounts system, including major frames.

Any component of an electronic engine control system that is directly involved in the control of fuel flow, rotor overspeed, EGT exceedance, or thrust reverser, including the wiring harness associated with such controls.

Any component or feature of a main rotor overspeed control.

Any component of a thrust reverser control system involved in the locking of the thrust reverser.

NOTE: This list is a sample only. Other parts not listed may also be classified as class 1 parts.

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FIGURE 3: Examples of Class 2 Parts

Rotating parts, not life limited or life assessed.

Accessory gearbox assembly.

Transfer gearbox assembly.

Fuel Nozzle.

Burner liner or burner can.

Compressor or turbine stator vane.

Stationary seal in the gas path.

Stationary seal in a bearing compartment.

Main-shaft bearing.

Engine inlet cone (spinner).

Thrust reverser part in the gas path.

NOTE: This list is a sample only. Other parts not listed may also be classified as class 2 parts.

15. SUBSTANTIATION OF REPAIRS AND ALTERATIONS OF CLASS 1 PARTS THAT ARE LIFE LIMITED OR LIFE ASSESSED PARTS

a. Repairs and alterations of life limited and life assessed parts, that are not listed in the engine manual and are developed by an independent repair entity must be approved by a supplemental type certificate (STC), unless they are done under agreement with the TC holder. For the

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purpose of this AC, a life assessed critical part is a part evaluated for its low cycle fatigue life that does not have a safe life limit or a mandatory inspection requirement and is not listed in the Airworthiness Limitation Section of the ICAs. The independent DER should consult with the FAA advisor to determine whether a non- life limited part was life assessed when certified. For example, engine mounts, certain engine cases, or fan blades may have been assessed in low cycle fatigue but no life limit was required.

b. These repairs and alterations are major changes to type design since they require substantiation based on a life methodology approved by the FAA in accordance with 14 CFR 33.14 Start-Stop Cyclic Stress (low-cycle fatigue). The independent DER should consult with the FAA DER advisor to develop a fatigue life methodology that supports these repairs and alterations.

16. SUBSTANTIATION FOR REPAIRS OR ALTERATION OF CLASS 1 PARTS OTHER THAN LIFE LIMITED OR LIFE ASSESSED.

a. For repairs or alterations of class 1 parts, direct FAA approval of substantiating data is required, meaning that the DER can only recommend approval. Class 1 parts are defined as those parts the failure of which could result in a hazard to the aircraft. Some class 1 parts are listed in figure 2. Note that the list in figure 2 is a sample of part types considered class 1.

b. The data package submitted in support of repairs and alterations of class 1 parts other than life limited or life assessed must contain the substantiating data, the method, techniques and practices, and as needed, supplementary ICAs and/or a critical process validation plan. Class 1

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parts that are life limited or life assessed are discussed in paragraph 15 of this AC. The DER must prepare a substantiation plan and submit the data package for class 1 part repairs or alterations to the geographic ACO (GACO). The GACO will then coordinate with the certificate management ACO (CMACO) where the product was originally certified.

c. The data package should include the following information, as applicable:

(1) FAA Form 8110-3 with DER recommend for approval signature.

(2) The substantiation plan outlining the scope and detail of the repair, applicable 14 CFR part 33 requirements and the methods of compliance used (analysis, component or engine testing).

(3) The technical data as described in paragraph 10.

(4) Substantiation data as described in paragraph 11.

(5) The methods, techniques and practices described in paragraph 12.

(6) The critical process validation plan as discussed in paragraphs 16d and 24.

(7) Substantiation for continued applicability of existing ICAs, or supplemental ICAs if any, as discussed in paragraph 22.

(8) Copies of all applicable supporting information such as: service bulletins, maintenance manuals, and any other information used.

(9) Copies of applicable service history, including existing ADs, incident and/or accident investigations, or any other service difficulties. The DER should address the ADs and significant service difficulties applicable to the repair or alteration.

d. Critical Process Validation.

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(1) Repairs and alterations of parts in class 1 may involve certain critical processes that must be carefully controlled to ensure that the part is returned to its original or properly altered condition. Such processes may be critical to the airworthiness of repaired or altered class 1 parts and must be identified for the purpose of developing the substantiation data. Additionally, appropriate validation processes must be identified under a critical process validation plan. Therefore**,** the critical process validation plan must address all critical processes, related specifications and performance parameters, as well as the associated validation requirements. Some examples of such processes include, but are not limited to, machining, welding, casting, forging, melting, heat treatment, coatings etc. Some examples of parameters that must be carefully controlled are feeds, speeds, force, dwell time, flow rates, and temperature. The controls of these and any other processes are particularly necessary since in most instances verification of the intended result is not possible by non-destructive inspection of the finished part.

(2) The administrative, engineering, quality functions and procedures necessary to develop and substantiate critical processes and corresponding validations are outlined in paragraph 24 of this AC.

17. SUBSTANTIATION FOR REPAIRS OR ALTERATION OF CLASS 2 PARTS.

a. DERs may approve repairs and alterations of class 2 parts in accordance with their delegation authority and submit the data package to the GACO, or make it available upon request. Class 2 parts are defined as parts whose failure could adversely affect the engine operation, but would not likely hazard the aircraft. These effects include, but are not limited to,

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inflight shutdown, surge and stall, and loss of thrust control. Some class 2 parts are listed in figure 3. Note that the list in figure 3 is not considered all-inclusive.

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b. The FAA has identified a number of typical repairs and alterations on class 2 parts, and has coordinated with the aerospace industry representatives to develop certain "repair" templates, which are included as appendix 1 of this AC. For each specific repair, the templates identify the applicable part 33 requirements for which compliance substantiation is required. In addition, the templates identify the engineering and technical considerations associated with the particular repair type. The templates also assist the DER in assessing and developing the quality control requirements related to critical features on the part, component, or detail to be fabricated in the process of repair or alteration. For class 2 parts, the DER should review these templates and discuss any concerns with their FAA DER advisor. Once all concerns are resolved, the DER may approve the substantiating data, the technical data and the methods, techniques and practices in compliance with the applicable requirements identified in the templates. If no templates are available, DERs should use similar procedures to identify the applicable requirements and necessary substantiation data. DER approvals must agree with their delegated authority.

c. The data package should include the following information, as applicable:

(1) FAA Form 8110-3 with the DER approval signature.

(2) The substantiation plan outlining the scope and detail of the repair, applicable 14 CFR part 33 requirements and the methods of compliance used (analysis, component or engine testing). The DER may use the applicable templates when developing a substantiation plan, or the same approach as in any other similar template.

(3) The technical data as described in paragraph 10.

(4) Substantiation data as described in paragraph 11.

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(5) The methods, techniques and practices described in paragraph 12.

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(6) If needed, a critical process validation plan as discussed in paragraph 24. Some, not all class 2 parts may have been designed based on critical processes and specifications.

(7) Substantiation for continued applicability of existing ICAs, or supplemental ICAs if any, as discussed in paragraph 22.

(8) Copies of all applicable supporting information such as: service bulletins, maintenance manuals, and any other information used.

(9) Copies of applicable part service history (e.g., service difficulties, incident and/or accident investigations). Adequately address the significant service difficulties applicable to the repair or alteration.

18. SUBSTANTIATION FOR REPAIRS OR ALTERATION OF CLASS 3 PARTS.

a. Any repair or alteration that does not fall within a part class 1 or 2, is classified as repair class 3 part, unless the repaired or altered part characteristics are affected as indicated in paragraph 14c of this AC.

b. Repairs and alterations of class 3 parts may be substantiated based on previously approved data, or any other data acceptable to the FAA. Data acceptable to the FAA are:

(1) Manufacturers' technical information, not approved by the FAA

(2) Military specifications.

(3) Previously accomplished FAA field approvals for same parts and similar installations on comparable makes and models.

c. Parts and engine service history, like service difficulties and incident and/or accident investigations must be adequately addressed.

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19. CONTINUE IN SERVICE CONDITION. An applicant who proposes any serviceability criteria other than those identified in the TC holder manuals, must create unique ICAs that:

a. Maintain compliance with part 33 for engines, and

b. Follow the applicable guidance in this AC.

20. REPAIR OF ENGINE PARTS RECOVERED FROM ACCIDENTS.

Parts exposed to conditions associated with accidents or incidents must be evaluated for continued service eligibility using the TC holder's ICAs. The serviceability of such hardware will be dependent upon the circumstances of the accident, its impact on engine hardware, and on the subsequent preservation of the parts. Parts not acceptable under these ICAs, may be substantiated based on other data approved by the FAA, or approved by the TC holder. Repairs and alterations of eligible parts should follow the guidance in this AC, with the additional requirement for proof of eligibility, to be included in the substantiation package.

21. SOURCE SUBSTANTIATION REQUIREMENTS.

a. TC holder's source substantiation requirements ensure that repaired or altered parts meet the intent of the repair design and are airworthy. These requirements are usually generated by the TC holder for their repair vendors and may constitute proprietary data.

b. An independent repair entity may also need to generate repair source substantiation requirements for complex repairs and alterations if they do not have them or the requirements are not listed in the TC holder's manuals. In either case, the following guidance applies:

(1) If the independent repair entity is using the TC holder's manual but does not have source substantiation requirements, the DER should develop these requirements. The DER must assess all the steps in the repair or alteration process to identify those that are critical and that

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require further evaluation. The DER should consult with the FAA DER advisor before approving the repair or alteration.

(2) If the independent repair entity is making a repair or alteration that is not in the TC holder's manual, then the DER should assess the need for source substantiation requirements when seeking approval of class 1 parts repairs and alterations. Some class 2 parts may also require source substantiation.

22. INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICAs).

a. The DER must assess the repaired and altered parts to ensure the continued applicability of the existing ICAs. Revised ICAs may be necessary if the repair or alteration changed the original part's structural strength, durability, reliability, inspectability, or any other part capability. If revised ICAs are needed, the DER should recommend a maintenance and inspection plan for the repaired or altered part as applicable.

b. Repairs and alterations proposed by an independent repair entity and that necessitates changes to the Airworthiness Limitations Section of the ICAs, may be approved through a STC.

23. FABRICATION DURING THE COURSE OF REPAIR.

a. The independent DER must submit to the GACO the substantiation data, technical data, the methods, techniques and practices and the applicable ICAs discussed in this AC, in support of fabrication during a repair or alteration. The independent DER must identify the critical processes and the associated validation requirements that are discussed in paragraph 24 of this AC. Such critical processes apply to fabrications used during the repair or alteration of all class 1 parts and some class 2 parts, as discussed in paragraphs 16d, 17b and 24 of this AC.

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b. Fabrications in the course of repairs and alterations of class 1 parts that are life limited or life assessed may be approved by STC, as discussed in paragraph 15 of this AC.

c. The fabrication aspect of a part repair or alteration is addressed in AC 43-FAB.

24. CRITICAL PROCESS VALIDATION PLAN.

a. Critical processes (for example, laser drilling blocked cooling holes in turbine blades) may be needed to make some repairs or alterations, or when fabricating during the course of a repair (for example, fabricating a flange for a case repair). In these instances, a critical process validation plan is necessary to verify that repaired or altered parts meet the design intent for their particular repair or alteration. The TC holder may require a critical process validation plan during the process of source substantiation to verify that the repair entity can adequately and repeatedly perform the critical processes required by the repair or alteration drawings. The TC holder may also revise the validation plan when adding a new supply vendor, and when adding, or changing critical processes.

b. The independent repair entity should evaluate the processes involved in a repair or alteration. The DER should develop a plan and identify the validation requirements for the processes that are critical to the airworthiness of the part as repaired or altered, and to the engine. The validation plan must identify all critical processes, related specifications and performance parameters, as well as the associated validation requirements. A validation plan is necessary for all critical processes that involve class 1 parts repairs or alterations, and may be necessary for class 2 parts if the processes are complex, or if minor deviations to any process highly affect the results of a part repair or alteration. As a general rule, a critical process validation plan would be required for any repaired and altered part or assembly that contain critical airworthiness

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characteristics generated by critical processes, and that cannot be inspected by direct measurement or nondestructive test.

c. Parts requiring a critical process validation plan must have the validation plan and requirements included on the applicable drawings or any other controlling documents. This is to ensure proper administration of the critical process validation plan by the repair entity and to aid in finding any quality shortfalls.

d. A critical process validation plan should consider the following:

(1) Design intent. This includes information on, for example, the interrelationship of part performance, process parameters, material microstructure, part durability, mechanical properties, and stress environment that is not documented on the drawing. Assurance that the design intent is met for repaired or altered part ultimately requires knowledge of the interrelationship between the repair processes and component failure modes, structural capability, safety margin and fatigue life.

(2) Critical process. A process or process sequence that could affect the design intent, may affect material structure, physical, mechanical, chemical or electrical properties, and may not be suitable for evaluation by conventional Non-Destructive Inspection. A critical process validation plan may require destructive testing to demonstrate the process robustness.

(3) Critical process change. A critical process validation plan should consider any change to a process previously designated critical, a change from a non-critical process to one that has potential to be critical, or a change in facility location, supplier, equipment, or tooling.

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(4) Critical sequence change. A critical process plan should also consider any change in sequence of a discreet operation (for example, a change of order in the heat-treat process), or the order of operations (that is, inspections, tests or discreet operations).

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e. An independent repair entity must maintain a system capable of managing critical process validation plans.

25. PROCESS AUDIT. FAA engineers will periodically audit DER approved repairs and alterations. Findings will be communicated to the DER and the FAA DER advisor.

SIGNATURE BLOCK

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