U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject:	Development and Approval of Maintenance and/or Alteration Specifications	Date:	AC No.:	43-XXX
		Initiated by	Change:	

1. PURPOSE. This advisory circular (AC) sets forth acceptable methods for certificate holders authorized to perform maintenance, preventive maintenance and/or alterations to:

a. Develop maintenance and/or alteration specifications;

b. Develop technical data establishing that the article will be returned to its original or properly altered condition after the maintenance and/or alteration specification has been accomplished and,

c. Obtain approval of the technical and substantiating data supporting maintenance and alteration specifications that result in major repairs or major alterations.

2. APPLICABILITY: This AC does not constitute a regulation, but sets forth a methodology for developing maintenance and/or alteration specifications, for developing data that substantiates that result and when necessary obtaining approval of the substantiating data supporting maintenance and alteration specifications. This AC applies to:

a. Persons wishing to develop methods, techniques and practices (how-to instructions, that is maintenance and/or alteration specifications) to accomplish maintenance, preventive maintenance or alteration actions that are different from or in addition to those recommended by the manufacturer or contained in advisory material, standard practices or other documents acceptable to the FAA under 14 CFR § 43.13(a).

b. Designees of the FAA that are developing and approving substantiating data that support maintenance and/or alteration specifications that result in major repairs or major alterations.

c. Persons accomplishing maintenance, preventive maintenance or alterations in accordance with maintenance and/or alteration specifications that have been developed under this AC.

d. Although this AC provides guidance for any person developing a maintenance and/or alteration specification; it does not apply to persons that are using equivalent procedures for developing and approving repair and/or alteration data. For example, design approval holders, repair stations, air carriers and holders of organizational delegation with authority to develop and approve maintenance and alterations may have written procedures that are acceptable to and/or approved by the FAA.

3. SCOPE: This AC describes the role of the certificate holder and the FAA in the process of developing, assessing, approving (if necessary) and using maintenance and/or alteration specifications. In addition, the AC describes how to:

a. Assess the need for a maintenance and/or alteration specification.

b. Develop a maintenance and/or alteration specification and to determine whether that specification will result in a major repair or major alteration.

c. Obtain approval of the substantiating data supporting a maintenance and/or alteration specification that result in a major repair or major alteration.

d. Properly track, review and update the specification.

e. Record work performed in accordance with the maintenance and/or alteration specification.

4. BACKGROUND: Under 14 CFR § 43.13(a), a maintenance provider must use methods, techniques and practices (how-to instructions) contained in design approval holder issued documents such as maintenance manuals, instructions for continued airworthiness, service bulletins and the like. Alternatively, the person performing maintenance, preventive maintenance or alteration can use other methods, techniques and practices acceptable to the FAA.

a. A method, technique and practice is acceptable to the FAA if it returns an article to at least its original or properly altered condition as required by 14 CFR § 43.13(b). Additionally, the person performing the action must be able to describe the action taken appropriately in the maintenance record required by 14 CFR § 43.9.

b. If the action results in a major repair or major alteration of a product, the technical data must substantiate compliance with the applicable airworthiness standards and be approved.

c. There is a need for maintenance providers to have a clear methodology for developing maintenance and/or alteration instructions that enhance or differ from those provided by manufacturers or that are contained in FAA-issued documents.

5. RELATED MATERIALS

a. Code of Federal Regulations (CFR). Copies of 14 CFR sections can be obtained from the Superintendent of Documents, Government Printing Office, P.O. Box 37154, Pittsburgh, PA 15250-7954. Telephone (202) 512-1800; fax (202) 512-2250. The regulations are also available online at www.gpoaccess.gov/cfr/.

b. FAA Orders. Copies of the following orders are available online from the FAA's Flight Standards Information Management System (FSIMS) at http://fsims.gov.

(1) Order 8100.8, Designee Management Handbook.

(2) Order 8110.37, Designated Engineering Representative (DER) handbook.

c. FAA Advisory Circulars (AC). Copies of the following ACs are available from the FAA's Regulatory and Guidance Library (RGL) at www.airweb.faa.gov/rgl.

(1) AC 43-18, Fabricating Aircraft Parts by Maintenance Personnel. This AC establishes an acceptable method for maintenance providers to fabricate parts for consumption during a maintenance and/or alteration process.

(2) AC 120-77, Maintenance and Alteration Data. This AC establishes an acceptable method for making determinations of whether an action will result in a major repair or major alteration.

2. ACRONYMS

a.	14 CFR	Title 14 of the Code of Federal Regulations
b.	AC	Advisory Circular
c.	ACO	Aircraft Certification Office
d.	AD	Airworthiness Directive
e.	ALS	Airworthiness Limitation Section
f.	AMOC	Alternative Means of Compliance
g.	ASI	Aviation Safety Inspector
h.	CFR	Code of Federal Regulations
i.	CMACO	Certificate Management ACO

j.	CMO	Certificate Management Office
k.	DER	Designated Engineering Representative
l.	FAA	Federal Aviation Administration
m.	FSDO	Flight Standards District Office
n.	ICA	Instructions for Continued Airworthiness
o.	IFO	International Field Office (Flight Standards Service)
p.	ODA	Organization Designation Authorization
q.	PAH	Production Approval Holder
r.	PC	Production Certificate
s.	PMA	Parts Manufacturer Approval
t.	P/N	Part Number
u.	STC	Supplemental Type Certificate
v.	TC	Type Certificate
w.	TCDS	Type Certificate Data Sheet
x.	TSO	Technical Standard Order

3. DEFINITIONS AND TERMS: For purposes of this AC, the following definitions apply:

a. Article: An aircraft, airframe, aircraft engine, propeller, appliance, or component part. (See 14 CFR § 145.3.)

b. Approved Data: Substantiating data that is evaluated and found to establish compliance with applicable and enumerated airworthiness standard requirements and thereafter approved by the FAA. (See AC 120—77 for examples of approved data.) (FAA approval may be issued by the Aircraft Certification Service, the holder of an appropriately authorized organizational delegation or by an appropriately authorized Designated Engineering Representative (DER).)

c. Critical: A class of parts, characteristics, processes, maintenance procedures, or inspections where a failure, omission, or non-conformance may cause significant degradation of the airworthiness of a product during all phases of operation.

d. Critical Part: A part the failure of which could have a catastrophic effect upon the product and for which critical characteristics have been identified during the certification process which must be controlled to ensure the required level of integrity.

e. Design Data: Drawings and specifications that show the article's configuration and all information on dimensions, tolerances, materials, processes, and procedures necessary to define an article's characteristics. A master drawing list is the summary of these drawings and specifications. The design can also include the ALS of the ICA.

f. Elementary Operations: Processes that are documented and consistently repeatable.

g. Life-limited Part: Any part for which a mandatory replacement limit is specified in the type design, the Instructions for Continued Airworthiness or the maintenance manual. (See 14 CFR § 43.10.) (Life limits and changes to life limits can be established by ADs, which impose mandatory changes to type design.)

h. Maintenance and/or Alteration Specification: This type of specification is referred to by many names including "maintenance data", "repair data", repair specifications," "repair procedures," and "maintenance specifications."

(1) Contains methods, techniques or practices for accomplishing maintenance and/or alteration on an article that is not included in a manufacturer developed document (maintenance or overhaul manual, instructions for continued airworthiness, service bulletin, etc.). It may vary from adding or substituting a particular manufacturer recommended action to developing complete overhaul instructions for an article. One specification may contain information on accomplishing repair and/or alteration actions.

(2) Includes step-by-step (how to) instructions for performing a repair and/or alteration.

(3) When it results in a major repair or major alteration of a product, is supported by approved data that shows the repair or alteration returns the article to at least its original or properly altered condition, i.e., meets the appropriate airworthiness standards for the article after the work described in the specification has been accomplished.

(4) May incorporate by reference one or more process specifications.

i. Major Alteration: An alteration not listed in the aircraft, aircraft engine, or propeller specifications—

(1) That might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness; or

(2) That is not done according to accepted practices or cannot be done by elementary operations. (See 14 CFR § 1.1.)

j. Major Repair: A repair:

(1) That, if improperly done, might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness; or

(2) That is not done according to accepted practices or cannot be done by elementary operations. (See 14 CFR § 1.1.)

k. Metrics: A system of parameters or ways of quantitative and periodic assessment of a process that is to be measured, along with the procedures to carry out such measurement and the procedures for interpretation of the assessment. Metrics are usually specialized by the subject area, in which case they are valid only within the defined domain.

l. Minor Alteration: An alteration other than a major alteration. (See 14 CFR § 1.1.)

m. Minor Repair: A repair other than a major repair. (See 14 CFR § 1.1.)

n. Person: An individual, firm, partnership, corporation, company, association, joint-stock association, or governmental entity. It includes a trustee, receiver, assignee, or similar representative of any of them. (See 14 CFR § 1.1.)

o. Process Specification:

(1) Is a written standard that establishes a repeatable methodology for completing a specific requirement of the step-by-step (how-to) instructions contained in a manufacturer’s maintenance manual, Instructions for Continued Airworthiness, an air carrier or commercial operator’s CAMP or an independently developed maintenance and/or alteration specification. These specifications would include standard methods for accomplishing welding, heat-treating, plasma spraying and other processes referenced in maintenance and/or alteration instructions.

(2) Is inadequate to meet the requirements of a maintenance and/or alteration specification, because it is not limited to a particular article. Maintenance and/or alteration specifications may reference or incorporate process specifications. Examples include:

- o American Society for Testing and Materials (ASTM) B 0244, Eddy Current Inspection of Coatings
- o American Welding Society (AWS) D1.1, Welding
- o Society of Automotive Engineers (SAE) AMSP81728, Plating, Tin-Lead (Electrodeposited)
- o MIL-S-13165A, Shot Peening of Ferrous Metal Parts
- o AWS C2.23M/C2.23:2003, Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel
- o Design approval holder standard practice or standard operation manuals or instructions

(3) For a repair station with limited ratings for specialized services under 14 CFR § 145.61(c), is listed on the repair station's Operations Specifications.

p. Product: An aircraft, aircraft engine, or propeller. (See 14 CFR § 21.1(b).)

q. Production Approval Holder (PAH): The holder of a PC, approved production inspection system, PMA or TSO authorization.

r. Quality System: An organizational structure with responsibilities, procedures, processes, and resources that implements a management method that determines and enforces quality requirements. A quality system can encompass both quality control and quality assurance.

s. Source Control Drawing: A drawing used to purchase controlled articles and/or materials. The purchase of materials from manufacturers other than those listed on the drawing must be evaluated for equivalency of design and production qualities to those required by the approved design.

t. Substantiating Data: Design and/or technical data used to obtain approved data (show that an article complies with applicable airworthiness standard requirements, e.g., specific paragraphs and/or sections of part 25 or 33).

u. Supplier: Any person contracted to provide aviation articles, materials, or services to a certificate holder.

v. Technical Data: Design data, airworthiness limitations, and any other verifiable data necessary to determine applicable airworthiness standard requirements, noise characteristics, fuel venting, and exhaust emissions (if any). It also includes

engineering information, such as test data, analyses, engineering handbooks or approved military or industry specifications, operational and service experience, maintenance and alteration experience, reliability data, and other documented factual information that can be shown to directly apply to the article or process. (It will be developed from evaluating the effect of the step-by-step procedures or work instructions associated with the repair or alteration on the article.)

4. Responsibilities of the Certificate Holder and the FAA: To ensure an efficient and orderly development, evaluation and, if required, approval of a maintenance and/or alteration specification, it is important to understand the responsibilities of the certificate holder and FAA.

a. The Certificate Holder is responsible for:

(1) Coordinating activities among and between itself, the FAA-ACO/designee and the geographically responsible FSDO/CMO/IFO,

(2) Developing the maintenance and/or alteration specification and ensuring all elements identified in this AC are adequately addressed.

(3) Substantiating the validity and applicability of the maintenance and/or alteration specification,

(4) Determining whether the application of the maintenance specification will result in a major or minor repair or alteration and obtaining approval of the substantiating data for maintenance and/or alteration specifications resulting in a major repair or major alteration,

(5) Monitoring and updating the maintenance and/or alteration specification, and

(6) Using the maintenance and/or alteration specification within part 43 and under its part 65, 121, 135 or 145 certificate/ratings.

b. The FAA (or an appropriately authorized designee) is responsible for:

(1) Working with the certificate holder during any planning phase,

(2) Coordinating between offices within the FAA during planning and evaluation of the maintenance and/or alteration specification,

(3) Evaluating a certificate holder’s maintenance and/or alteration specification for compliance with the regulations,

(4) Evaluating, and if appropriate, approving technical data supporting the maintenance and/or alteration specifications that result in major repairs or major alterations, and

(5) Ascertaining the certificate holder's capability to use the maintenance and/or alteration specification.

Figure 1-1. Roles and responsibilities of certificate holder and FAA

Certificate Holder	Flight Standards	Aircraft Certification	Designees
Determine if a maintenance and/or alteration specification is appropriate.	Ensure compliance with regulations and procedures.	At its discretion, evaluate and approve (or delegate) test plans and/or witness tests.	When appropriately authorized and/or delegated by ACO:
Coordinating activities among the Flight Standards and Aircraft Certification Divisions and any appropriately authorized designees	Help certificate holder in coordinating activities.	When requested by the certificate holder or the FSDO/CMO/IFO, evaluate and approve substantiation/ engineering data.	Evaluate and approve test plans and witness tests.
Develop maintenance and/or alteration specification. Include all applicable elements identified in AC XX-XXX.	Evaluate certificate holder's capability to use its specification.	Evaluate and approve, when appropriate, all maintenance and/or alteration specifications affecting critical processes or critical/life-limited articles	Evaluate and approve substantiation/ engineering data.
Develop data to substantiate the maintenance and/or alteration specification.	Coordinate as needed with ACO for technical review and approval of technical data used to substantiate maintenance and/or alteration specifications.		
Determine whether the activity will result in a major or minor repair or alteration.			
Utilize appropriately authorized designees to approve maintenance and/or alteration specification substantiation data.			
Maintain capabilities needed to use the maintenance and/or alteration specification.			

Certificate Holder	Flight Standards	Aircraft Certification	Designees
Perform periodic review of the maintenance and/or alteration specification and revise as needed.			

2. Assessing the Need for a Maintenance and/or Alteration Specification: Development of a maintenance and/or alteration specification is not mandatory; however, maintenance providers that perform or intend to perform repairs or alterations that are not contained in manufacturers' documents on a repetitive basis should consider developing a maintenance and/or alteration specification to establish compliance with 14 CFR § 43.13.

a. The advantage of a maintenance and/or alteration specification is that it helps the maintenance provider plan for and operate under a consistent method acceptable to the FAA. This helps to ensure the facility has consistent quality in its independently developed repairs and/or alterations and reduces demand on FAA resources, which improves efficiency for both the agency and the industry.

b. Developing a maintenance and/or alteration specification is advisable when the maintenance provider does not or cannot use manufacturer's documents (maintenance and overhaul manuals, instructions for continued airworthiness or service bulletins) to accomplish a maintenance and/or alteration activity. The need for a maintenance and/or alteration specification may be due to a unique (one time only) condition or because the action is repeatedly used on numerous articles. For example:

(1) Persons performing maintenance, preventive maintenance and alteration can encounter conditions that were not contemplated by the design approval holder when it developed its maintenance instructions or service bulletins.

(2) The design approval holder may no longer support the article and methods, techniques and practices proscribed in the manufacturer's documentation may no longer be allowed or capable of being performed.

(3) The design approval holder may not have developed maintenance and/or alteration instructions.

(4) The maintenance provider may wish to perform an action in a different manner than proscribed by the design approval holder or in a different order.

(5) Existing instructions may not be appropriate for the article. For example, the article was previously repaired or altered and the instructions assume the article was not previously repaired or altered.

c. Whenever a repetitive maintenance and/or alteration action will result in a major repair or major alteration, the development of a uniform maintenance and/or alteration specification will alleviate the need for recurring evaluations.

3. Coordinating Activities: A formal planning phase is recommended to coordinate activities internally and with the FAA. This can be beneficial because it involves the FAA early in the process and it will help ensure FAA data approval in an efficient and timely manner.

a. A planning phase is recommended when:

(1) It is the first time the certificate holder is seeking approval of data supporting a proposed maintenance and/or alteration specification, which will be used repetitively that will result in a major repair or major alteration.

(2) The certificate holder expects to develop repetitively applied maintenance and/or alteration specifications for major repairs and major alterations frequently.

(3) The proposed maintenance and/or alteration specification will involve complex operations or will involve the use of complex techniques or equipment that will be applied for the first time.

(4) The proposed maintenance and/or alteration specification will involve a critical process or part or will be applied to a life-limited part.

b. The planning phase can be done in a manner that works best for the certificate holder, but it is recommended that the certificate holder schedule with the appropriate FAA Flight Standards local office and its designee(s) (particularly if more than one is used) to ensure all issues are adequately addressed and understood. Typically when planning the development and approval of a maintenance and/or alteration specification:

(1) Establish primary point of contacts internally and within the FAA for:
- Maintenance process questions
- Engineering questions
- Capability questions

(2) Briefly discuss the AC and the FAA's corresponding order and what the certificate holder can expect to happen.

(3) Discuss the proposed maintenance and/or alteration specification and the methodology used to determine whether the end result will be a major repair or major alteration.

(4) Discuss the certificate holder's capabilities to use the maintenance and/or alteration specification. This is an informal discussion of whether the certificate holder is qualified to undertake the proposed activities and what capability issues may need to be addressed.

(5) Assess the need for ACO involvement versus using appropriately authorized designee(s). If no designee will be used or if the contemplated maintenance and/or alteration specification is complex or applicable to a critical part or process or life-limited part or may need the services of more than one designee, the ACO will need to support the process and should be involved in the meeting.

(6) If the repair or alteration will be major, determine if testing will be necessary to obtain approved data. If testing is required, discuss:

- Whether the testing will be done in an informal or formal manner; if formal, determine:
- Who will approve test plan(s)?
- Who will conform test article(s)?
- Who will witness test(s)?
- What are the pass/fail criteria?

(7) Discuss an initial schedule for activities that will require FAA involvement.

(8) Schedule any necessary follow-up planning meeting(s).

c. Develop a summary of each meeting and submit it to all contacts for review, comment, and concurrence. This is not required but should be used to eliminate any misunderstandings of expectations, roles, and responsibilities.

d. Continually communicate with the contacts as schedules change to ensure all parties are kept abreast of developments.

4. Developing a Maintenance and/or Alteration Specification: Generally, a maintenance and/or alteration specifications should explain:

- What it does,
- When it is appropriate,
- How it will be accomplished, including inspection criteria,
- Whether the result is major or minor, and
- How it is substantiated.

a. Applicant Information. The maintenance and/or alteration specification should set forth the certificate holder's name, certificate number, address, and contact information. The specification should be uniquely identified and formatted so it may be tracked, referenced and updated.

b. Purpose. The applicant should provide a general description of the repair and/or alteration, including general limitations and applicability. The description can include the condition being corrected, a simple explanation of the procedure to be followed in the specification, and the outcome after the procedure(s) are followed.

c. Scope. A detailed description of how, when and where the repair and/or alteration outlined in the "Purpose" is appropriate and applicable to the article. Define the specific application, article eligibility, and limitations of the maintenance and/or alteration specification. For example, it should list, as applicable:

(1) All part numbers covered by the specification.

(2) The product eligibility of the top assembly by make and model.

(3) Any limitations resulting from the article repaired and/or altered in accordance with the specification.

(4) A statement of whether the specification will result in a major repair or major alteration. If it will be major, a reference to the applicable sections of 14 CFR (e.g., specific airworthiness regulations) under which the maintenance and/or alteration specification was evaluated. The FAA approval must show compliance with the applicable airworthiness standards.

(5) A statement of whether the activity will impact a critical part or process or life-limited part; if it does, FAA ACO involvement will be required.

(6) A list of any ADs that apply to the article or a statement that none apply.

d. Procedure. The detailed step-by-step (how to) instructions to be followed to perform the repair and/or alteration. The instructions should be sufficient in detail and clarity to be consistently repeatable; when the work is completed the article will be returned to at least its original or properly altered condition. These instructions should mirror the types of maintenance instructions provided by a manufacturer in maintenance manuals or service bulletins. They should include:

(1) A list of recommended or required housing, facilities and equipment (including tools and tooling);

(2) A list of recommended or required materials, including parts, particularly parts that will be fabricated during the course of the repair and/or alteration;

(3) A list of reference documents, such as standard operating practices or process specifications;

(4) Incoming inspection criteria, including when a condition will be beyond the scope of the instructions (describe the repairable/alterable condition and the limits on the repair/alteration, i.e., rejection criteria);

(5) Detailed repair and/or alteration steps that are sufficient to ensure repeatability and consistency. These steps should explain the use of the listed facilities, equipment (including tools and tooling) and materials in proper sequence so that an appropriately trained technician can complete the operations. If the manufacturer's maintenance information will also be used, ensure the developed instructions account for the interface between the steps developed and the manufacturer's instructions.

(6) Instructions on how to fabricate any parts that will be consumed during the course of the work (reference AC 43-18 for full requirements on fabrication of parts that will be consumed in a repair or alteration including part marking);

(7) In-process and final inspection(s) and test(s) with any necessary metrics, including instructions for the proper disposition of articles or materials that fail any inspection or test. Instructions for inspecting and/or measuring the article must ensure the expected result is achieved. Metrics can include physical measurements, visual inspection criteria, nondestructive testing methods and criteria, functional test methods and criteria, procedural controls, and other units of measure that ensure the article is returned to at least its original or properly altered condition upon completion of the procedures;

(8) Any applicable marking criteria; if the repair and/or alteration should be uniquely marked because, for example, it changes the eligibility for installation in a higher assembly.

e. Special Considerations. During the development of a maintenance and/or alteration specification, to ensure compliance with all applicable regulations, the certificate holder must perform an appropriate review of existing data applicable to the article.

(1) *Criticality and Life Limits*: Perform a search of the type certificate data sheet, manufacturer's instructions and any other information necessary to determine whether the article is critical or contains critical characteristics (controlled for example by S-FAR—88 requirements) or is life-limited. If the article is critical or contains a critical characteristic or is life-limited, the determination of whether or not the maintenance and/or alteration specification will result in a major repair or major alteration will be essential. The guidance applicable to these issues developed by the Flight Standards and Aircraft Certification can be located on the FAA's Web site (http://www.faa.gov/), under Regulation and Guidance Library in the Quick Find drop down menu and/or on the main page under Top Requests: Regulations & Policies.

(2) *Existing and Proposed ADs*: Performing a search for any existing or proposed ADs that may require corrective action to the article or to a higher assembly into which the article will be installed will ensure that if an AMOC is required, it can be appropriately addressed.

- o Existing ADs may be found on the FAA's Web site (http://www.faa.gov/) after searching under Airworthiness Directive or under the "Quick Find" drop down menu.
- o Proposed ADs may be found by linking to http://www.regulations.gov/search/index.jsp and typing Airworthiness Directive in the "Comment or Submission" box; which will bring up all ADs that are open for comment:

(3) *Service Difficulties*: Performing a search of the service difficulty database for any issues that have been reported on the article will ensure that the maintenance and/or alteration specification is adequate to address those problems. If the service difficulties are severe, a query to the product directorate (i.e., the Large Airplane Directorate in Northwest Mountain Region, the Small Airplane Directorate in Central Region, the Rotorcraft Directorate in Southwest Region, or the Engine and Propeller Directorate in New England Region) to determine whether an AD is being contemplated is strongly advised.

(4) *Existing ICA*. Determine if the activities affect the ICA or existing maintenance requirements of the article. It would be rare that a repair that restores an article to at least its original or properly altered condition would have an effect on the ICA. However, an evaluation should be included to ensure the proper categorization of the action is made and continued airworthiness of the article is assured. Major alterations may require a change in existing requirements.

- o Address whether or not the existing ICA are adequate to account for the new methodology and clearly state that finding.
- o If it is determined that the existing ICA are inadequate because of the proposed repair and/or alteration, the specification must contain the appropriately revised ICA.

f. Determination of Major or Minor. To state that a repair or alteration is minor, it must be determined that the action will not result in a major repair or major alteration. In other words, it must be shown that the repair or alteration is not major. To ensure compliance with the regulations that require all major repairs and major alterations to be supported by approved data, the certificate holder must evaluate the action to determine whether the technical data must be substantiated and approved. A methodology for making the determination is set forth in AC 120-77.

g. Substantiation Data. To ensure compliance with 14 CFR § 43.13(b), the certificate holder should develop data that ensures that the maintenance and/or alteration specification will return the article to at least its original or properly altered condition. Include a reference to the data used to substantiate the specification or to

support the determination that the action will result in a minor repair in the maintenance and/or alteration specification. The actual data need not be included in the specification, although it must be submitted to the FAA ACO or designee when the result is a major repair or major alteration. If it is included in the specification, it should be attached as an appendix.

(1) Data should be developed and documented whether or not the repair or alteration is determined to be major or minor to ensure compliance with the regulations and to answer any questions that may develop during the use of the repair or alteration or if a change to the specification is needed.

(2) The substantiation data may consist of any objective and verifiable design and technical data that establish the methodology will return the article to at least its original or properly altered condition.

(3) For major repairs and major alterations, the development of technical data may include testing and/or other engineering analyses that will require an evaluation of an article after the specification has been applied to it. In those cases, coordination with the appropriate FAA offices and/or designees will be necessary.

(4) *Test Plans and Test Results*. Tests may need to be performed to demonstrate that a repair or alteration done in accordance with the maintenance and/or alteration specification will result in the article being returned to at least its original or properly altered condition (i.e., complying with applicable airworthiness standard requirements). Testing may range from a functional comparison to component to flight. Simple, non-critical parts may need little or no testing. When formal testing is required and the FAA chooses to witness the activity, a test plan approved by the FAA (or a designee) must be developed.

- The test plan:
  - Describes the purpose of the test,
  - Lists specific airworthiness standard requirements and a description of how the applicant expects to show compliance with each,
  - Is used to ensure orderly and complete testing is accomplished, and typically includes sections on:
    - Safety controls,
    - Control of procedures, and
    - Conditions and duration.
  - Describes the items to be tested and lists all equipment necessary to conduct the test, and typically includes sections on:
    - Physical and functional description of the test article and setup,
    - Number of test units, and
    - Test unit identification.
  - Describes how the equipment is to be calibrated (when calibration is required) and approved before the test,

- Describes the instrumentation and equipment necessary to measure and record the results of the test,
- Lists required conformities of the test article and test setup,
- Includes a test procedure written in a step-by-step format,
- Defines the pass/fail criteria, and
- Describes who will witness the test.

- The test results report describes:
  - Any deviations from the test plan for the test setup and any effects on the test,
  - How and when the test equipment was last calibrated,
  - Any nonconformities found with the test article(s) and any effects on the test,
  - Any deviations from the test plan for the step-by-step test procedure and the effects on the test,
  - The performance of the test article using observation, post-test inspection, physical measurement, electronically recorded data, photos, video, etc.,
  - Whether or not the test article(s) passed or failed each criteria defined in the test plan,
  - Any anomalies that might have an effect on the outcome of the test, and
  - Who witnessed the test and made the pass/fail evaluation.

(5) *Considerations for Reverse Engineering*. If a maintenance and/or alteration specification includes design, technical and substantiating data based on reverse engineering, the data should include a determination of the performance and durability vis-à-vis the original article. This can be done using comparative test and analysis of the technical requirements of an original article in an acceptable repaired, overhauled or new condition and the article repaired and/or altered in accordance with the proposed maintenance and/or alteration specification.

- The data must demonstrate that the functional design of the proposed repair and/or alteration returns the article to at least its original or properly altered condition as established by the same (repaired/altered) condition in a TC, STC, PMA or TSO-approved part.
- The criticality of the article and the complexity of its design will dictate the rigor of the comparative analysis and the extent of testing.
- Side-by-side testing of a repaired and/or altered article and the original article in an acceptable altered, repaired, overhauled or zero service time condition under the same procedures and conditions provides the standard to evaluate the repaired and/or altered article.
- The results of the analyses and tests will note any differences and provide sound technical justifications for these differences.
- Repairs and/or alterations to simple, non-critical parts might not require the same level of evaluation to determine performance and durability as other articles.

(6) *Reverse Engineering for Fabricated Articles*. When establishing equivalency of fabricated replacement articles by reverse engineering, select the processes and techniques that are appropriate to the article's complexity. Reverse engineering alone may be enough to duplicate simple parts; however, complex articles may need other substantiating information to show equivalency between the original and the fabricated articles. Consider the following:

- Samples are new, unused articles from approved and traceable sources (i.e., documentation such as purchase orders and/or 8130-3s establish production authorization).
- The sample size should account for the design complexity and key attributes of the article. The sample should correctly represent the essential characteristics of a design is necessary. The essential characteristics include nominal dimensions, tolerances, material properties, fabrication processes, and so on.
- Various tests and documentation from the PAH or supplier define the material composition of a part. The fabricated part materials must be equivalent to the materials for the original part including the base part, any subparts, added welds, and coatings. A qualified laboratory can provide thorough destructive testing for the following information:
  - Composition of each material in the part,
  - Material properties (for example, strength and fatigue characteristics, hardness, grain structure),
  - Form of material (for example, casting, forging, bar stock, sheet), and
  - Use of special processes (for example, nitriding, heat treat, shot peening) and resulting effect on material properties.
- The mass properties of a part can be significant to its function and impact on the next higher assembly and/or the product. This assessment accounts for weight differences between the proposed fabricated repair part and the original part to ensure the absence of detrimental effects.
- Sampling used parts may provide some characteristics that don't deteriorate during use, such as material composition, grain size, grain flow, and depth of case hardening.
- Ensure the sample size can substantiate the validity of the required result with respect to the complexity of the article. Concurrence from the appropriate ACO or designee may be required.
- Variations in the sample measurements and accepted engineering practices determine the tolerances in part dimensions. The resulting tolerances for the fabricated part should not exceed the minimum and maximum dimensions measured on the sampled approved parts. Exceeding these limits will require additional substantiation.

5. Approval of the Repair or Alteration Specification:

a. Design and/or technical data supporting a minor repair or minor alteration does not need to be approved.

b. Certificate holders are encouraged to have all data reviewed by appropriately knowledgeable engineering persons to help ensure compliance with the applicable airworthiness standard requirements.

c. When a maintenance and/or alteration specification will result in a major repair or major alteration of a product, appropriately authorized designees and/or the ACO must review and approve the substantiation data.

(1) If the ACO will be used to approve the substantiation data, the entire package will be coordinated through the certificate holder's FSDO.

(2) If the article is a critical or life-limited part or if the action affects a critical process, the approval of data must be coordinated with the ACO.

(3) If the substantiating data will be approved by designees

- The certificate holder will be responsible for ensuring that all the applicable airworthiness standard requirements are covered.
- If more than one designee is necessary to approve the substantiation data, the certificate holder must coordinate activities between and among those individuals and the FAA.
- The certificate holder will also be responsible for ensuring that the designee has the appropriate authority to make the findings necessary to establish compliance with the applicable airworthiness standard requirements. It is advised that the certificate holder obtain a copy of the designee(s)' authorization and be prepared to present that information to the FAA upon request.

6. Periodic Review of Maintenance and/or Alteration Specification. The certificate holder should establish a process to review the specification on a periodic basis. The review process may be defined in the specification or in a separate document. If a separate document is developed, it should be referenced in the maintenance and/or alteration specification. In any event, to ensure continued compliance with 14 CFR § 43.13, the certificate holder should:

a. Monitor applicable regulations and revise the maintenance and/or alteration specification, if necessary.

b. Monitor service experience of the repairs and/or alterations to ensure the original specification is adequate for meeting all applicable sections of 14 CFR. If service experience shows that the specification needs to be revised, provide a methodology for ensuring the revision is made in a timely manner.

c. Monitor ADs to ensure AD compliance requirements do not supersede or conflict with the maintenance and/or alteration specification. If an AD becomes applicable to the article, an Alternative Means of Compliance to the AD may need to be developed and approved as required by part 39.

7. Use of Maintenance and Alteration Specifications. Certificate holders that will be using the maintenance and alteration specifications must ensure that they have the capability to perform the functions and that they record the use of the specification properly. Additionally, 14 CFR part 145 certificate holders must ensure compliance with 14 CFR § 145.205.

a. Capabilities. Certificate holders that will be using the maintenance and alteration specification must ensure they have the ability to successfully perform the step-by-step instructions. This will typically include the appropriate authority (rating or privilege), appropriate manual procedures, housing, facilities, equipment, material handling and storage requirements, and other factors necessary to follow the proposed maintenance and/or alteration specification. Prior to performing any maintenance and/or alteration in accordance with the specification, a self-evaluation is recommended to ensure:

(1) The certificate holder has the appropriate authority, rating or privilege to perform the maintenance and/or alteration specification. If additional authority or rating is needed, the appropriate application is made.

(2) The availability of the recommended or required:
- Housing
- Facilities
- Equipment (including tools and tooling)
- Materials
- Trained or experience personnel

(3) Any additions or changes to the procedures or manuals required by the regulations have been instituted and/or submitted. This may include but is not limited to:
- A change to the facility layout to accommodate new equipment;
- Additions to the calibrated tooling list;
- Additions to the approved maintenance function list of 14 CFR part 145 certificate holders;
- Additions to a vendor list;
- Development of travelers, routers and/or inspection records that ensure compliance with the regulatory recordkeeping requirements as set forth in the certificate holder’s manuals
- Procedures for developing, tracking and updating the maintenance and/or alteration specification; and,

- Procedures to ensure the maintenance and/or alteration specification is reviewed occasionally to ensure compliance with 14 CFR §§ 43.13 and/or 145.109(d).

b. Recordkeeping considerations. The maintenance provider must ensure it records the maintenance and/or alteration actions in accordance with the applicable maintenance record requirements.

(1) 14 CFR § 43.9 is the general recordkeeping requirement for mechanics and repair stations; it may also apply to any work performed for part 91, 125 and 129 operators. The record must include a description of the work performed or reference to the data used to perform the work performed (see 14 CFR § 43.9(a)(1)).

(2) 14 CFR § 43.9, appendix B requires the completion of an FAA Form 337 on all major alterations to products or appliances.

(3) 14 CFR § 91.417(2)(vi) requires the retention and § 91.419(a) requires the transfer of records of major alterations.

(4) 14 CFR § 121.707 requires the certificate holder to make a report of all major repairs and alterations to aircraft, aircraft engines and appliances. In order to ensure compliance with this requirement, the maintenance record required by 14 CFR §§ 121.380 and 380a must identify any major repairs or major alterations accomplished.

(5) Additional recordkeeping requirements may apply when performing work in accordance with data that is not supplied by the original design approval holder. For instance, if the certificate holder has authority to perform maintenance under other National Aviation Authority certificates, that authority's requirements must be taken into consideration.

c. Coordination with customers. Air carriers and commercial operators and their maintenance providers must ensure work is performed in accordance with the carrier/operator's manual and maintenance programs. Maintenance providers must ensure the air carrier/commercial operator customer has given them the authority to perform work in accordance with the developed maintenance and/or alteration specification. This is particularly essential when the specification will result in a major repair or major alteration.