Federal Aviation Administration

“Workshop on Modifications & Alterations affecting Composite Parts or Composite Structure”

- Background: Part 23, 21.9 NPRM -

Composite Team (SAD)
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"Workshop on Modifications & Alterations"
Part 23 & § 21.9 NPRM

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"Workshop on Modifications & Alterations" Background - Part 23 NPRM

Part 23 History - Overview

- Part 23 originated from performance-based requirements developed by the Bureau of Air Commerce and the Civil Aeronautics Administration in 1930s. Civil Air Regulations (CAR) [i.e., CAR 3, 4, and 4a]
- These requirements along with various bulletins & documents were subsequently revised and issued as 14 CFR part 23 in 1964.
- Over past 5 decades and after many amendments, part 23 has evolved into a body of highly complex and prescriptive requirements to include -
  - Specific design requirements
  - Specific lessons learned from prior cert. projects
  - Specific recommendations from NTSB

"Workshop on Modifications & Alterations" Background - Part 23 NPRM

- **Congressional Mandate: Small Airplane Revitalization Act of 2013**
  - **To create a regulatory regime that will improve safety and decrease certification costs,**
  - **To set safety objectives that will spur innovation and technology adoption,**
  - **To replace prescriptive rules with performance-based regulations, and**
  - **To use consensus standards to clarify how safety objectives may be met by specific designs and technologies.**

"Workshop on Modifications & Alterations" Background - Part 23 NPRM

- **Essential Intents**
  - To remove current prescriptive design requirements and replace with performance-based airworthiness standards.
  - To replace current weight and propulsion divisions in small airplane regulations with performance- and risk-based divisions.
  - To maintain the level of safety as the current regulations.
  - To add new certification standards for loss of control (LOC) and icing.
  - [To rename:] Part 23 - Airworthiness Standards: Normal Category Airplanes

"Workshop on Modifications & Alterations" Background - Part 23 NPRM

- **Current part 23: AIRWORTHINESS STANDARDS: NORMAL, UTILITY, ACROBATIC, AND COMMUTER CATEGORY AIRPLANES**
  - **Normal Category:** having a seating configuration, excluding pilot seats, of nine or less, a maximum certificated takeoff weight of 12,500 pounds or less, and intended for non-acrobatic operation.
  - **Utility Category:** [limited acrobatic operation]
  - **Acrobatic Category:** [without restrictions]
  - **Commuter Category:** having a seating configuration, excluding pilot seats, of 19 or less, a maximum certificated takeoff weight of 19,000 pounds or less, and limited to normal flying.
- **NPRM part 23: AIRWORTHINESS STANDARDS: NORMAL CATEGORY AIRPLANES**
  - **Normal Category:** having a seating configuration, excluding pilot seats, of 19 or less, a maximum certificated takeoff weight of 19,000 pounds or less. **Certification levels to be based on passenger seating and performance (speed).**

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- **Safety Continuum**
  - Single level of safety is not appropriate for all aviation activities.
  - Higher levels of risk, with corresponding requirements for less rigorous safety demonstration for products, are accepted as aircraft are utilized for more personal forms of transportation.
- **Airplane Certification Levels**
  - A division used for certification of airplanes that is associated directly with the number of passengers on the airplane.
  - FAA proposes: Level 1 (0-1 P), Level 2 (2-6 P), Level 3 (7-9 P), Level 4 (10-19 P)

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Background - Part 23 NPRM

- **Airplane Performance Levels**
  - **Low speed: Vc or Vmo ≤ 250 KCAS (or Mmo ≤ 0.6)**
  - **Hign speed: Vc or Vmo › 250 KCAS (or Mmo › 0.6)**
- **Simple Airplanes**
  - **Level 1 (0-1 P) Airplane**
  - **Vc or Vmo ≤ 250 KCAS (and Mmo ≤ 0.6)**
  - **Vso ≤ 45 KCAS**
  - **VFR Operations**

  Notes:

  ^ Similar to EASA's CS-VLA airplanes

  ^ Currently imported to US and certificated as special class airplanes per 14 CFR 21.17(b).

  ^ To be certificated via part 23 NPRM

"Workshop on Modifications & Alterations" Background - Part 23 NPRM

- **Means of Compliance (ref. NPRM §23.10)**
  - Applicant must use a means of compliance accepted by FAA when showing compliance with part 23.
  - FAA emphasizes that any means of compliance would require FAA review and acceptance.
  - Standards organizations (e.g., ASTM) could generate consensus-based standards for review, acceptance, and public notice of acceptance by FAA. Though, these standards would be one way, but not the only way, to show compliance with part 23.
  - AC 23.10 "Accepted Means of Compliance" would describe a process of submitting proposed means of compliance to FAA.

Part 23 NPRM: Subpart C - Structures

- **NPRM Subpart C would replace current subpart C and include those sections of current subpart D that are applicable to the airframe.**

  [Ref: Cross-Reference Table of Current and NPRM Rules]

- **A means of compliance to NPRM subpart C must maintain the level of safety provided by the current rules. Applicant would need to substantiate the level of safety for proposed means of compliance that deviate from the prescriptive regulations.**

- **NPRM Subpart C Regulations**

General

§ 23.300 Structural design envelope.

§ 23.305 Interaction of systems and structures.

Part 23 NPRM: Subpart C - Structures

- **NPRM Subpart C Regulations (cont.)**

Structural Loads

§ 23.310 Structural design loads.
§ 23.315 Flight load conditions.
§ 23.320 Ground and water load conditions.
§ 23.325 Component loading conditions.
§ 23.330 Limit and ultimate loads.

Structural Performance

§ 23.400 Structural strength.
§ 23.405 Structural durability.
§ 23.410 Aeroelasticity.

Design

§ 23.500 Structural design.
§ 23.505 Protection of structure.
§ 23.510 Materials and processes.
§ 23.515 Special factors of safety.

Structural Occupant Protection

§ 23.600 Emergency conditions.

Part 23 NPRM: Subpart C - Structures

NPRM vs. Current Rules on "Structural Performance"

NPRM	Current
§ 23.400 Structural strength.	23.305 (Strength & Deformation) 23.307 (Proof of Structure)
§ 23.405 Structural durability.	23.571 (Metallic ---) 23.572 (Metallic ---) 23.573 (DT & fatigue evaluation --) 23.574 (Metallic DT & ---) 23.575 (Inspections & other ---) 23.627 (Fatigue strength)
§ 23.410 Aeroelasticity.	23.629 (Flutter) 23.677(c) (Trim systems) 23.687 (Spring devices)

“Workshop on Modifications & Alterations” Background - Section 21.9 NPRM

- **Part 23 Reorganization ARC recommended simplifying certification requirements for non-required systems and equipment, with an emphasis on improvement in overall fleet safety from the prevailing level.**
- **In the past, FAA has not established different production requirements for required and non-required equipment that may enhance safety, or for articles whose improper operation or failure would not cause hazard.**
- **FAA is proposing to revise § 21.9 “Replacement and Modification Articles”, to provide applicants with an alternative method to obtain FAA approval to produce replacement and modification articles.**

"Workshop on Modifications & Alterations" Background - Section 21.9 NPRM (cont.)

- **This proposed change would allow a production approval applicant to submit production information for a specific article, without requiring the producer of the article to obtain approval of the article's design or approval of its quality system.**
- **FAA intends to use the flexibility to streamline the approval process for non-required safety enhancing equipment and other articles that pose little or no risk to aircraft occupants and the public.**

Proposed Change: In § 21.9, add paragraph (a)(7) which reads as follows:

"Produced in any other manner approved by the FAA"

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Part 23 & § 21.9 NPRM

Composite Team - Actions

- **SAD Chicago Meeting (May/16)**
  ^ Establish a small airplane industry working group for discussion of FAA Boding Initiatives.
  - **Jointly work with industry including GAMA, ASTM, CMH-17, SAE.**
  - **Link to existing CMH-17 initiatives relevant to bonding.**
  - **Aug/16 CMH-17 GWG / Airworthiness TG presentation.**

  ^ Interact with sibling directorates (RCD, TAD, E&PD) for AVS Plan support.
  ^ Review of Part 23, 2005 Bonding Policy.
  ^ Evaluate part 23 NPRM implementation on AC 20-107B.
- **Inclusion of actions in FAA/AVS Strategic Composite Plan (FY 2017).**

“Workshop on Modifications & Alterations” Background - Part 23 & Section 21.9 NPRM

- **Thanks for Opportunity.**
- **Questions and/or Thoughts?**
- **Further Discussion.**

Part 23 NPRM Section 23.10

Presentation Insertion

§ 23.10 NPRM is below presented for audience information.

§ 23.10 Accepted means of compliance.

(a) An applicant must show the FAA how it will demonstrate compliance with this part using a means of compliance, which may include consensus standards, accepted by the Administrator.

(b) A person requesting acceptance of a means of compliance must provide the means of compliance to the FAA in a form and manner specified by the Administrator.

Part 23 NPRM: Subpart C - Structures

Presentation Insertion

These proposed regulations are further presented for audience information & reference.

Structural Performance

§ 23.400 Structural strength.
§ 23.405 Structural durability.
§ 23.410 Aeroelasticity.

Design

§ 23.500 Structural design.
§ 23.505 Protection of structure.
§ 23.510 Materials and processes.
§ 23.515 Special factors of safety.

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Part 23 NPRM: Subpart C - Structures

Structural Performance

§ 23.400 Structural strength.

The applicant must demonstrate that the structure will support:

(a) Limit loads without—

(1) Interference with the operation of the airplane; and

(2) Detrimental permanent deformation.

(b) Ultimate loads.

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Structural Performance (cont.)

§ 23.405 Structural durability.

(a) The applicant must develop and implement procedures to prevent structural failures due to foreseeable causes of strength degradation, which could result in serious or fatal injuries, loss of the airplane, or extended periods of operation with reduced safety margins. The Instructions for Continued Airworthiness must include procedures developed under this section.

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§ 23.405 Structural durability. (cont.)

(b) If a pressurized cabin has two or more compartments separated by bulkheads or a floor, the applicant must design the structure for a sudden release of pressure in any compartment that has a door or window, considering failure of the largest door or window opening in the compartment.

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§ 23.405 Structural durability. (cont.)

(c) For airplanes with maximum operating altitude greater than 41,000 feet, the procedures developed for compliance to paragraph (a) of this section must be capable of detecting damage to the pressurized cabin structure before the damage could result in rapid decompression that would result in serious or fatal injuries.

(d) The airplane must be capable of continued safe flight and landing with structural damage caused by highenergy fragments from an uncontained engine or rotating machinery failure.

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§ 23.410 Aeroelasticity.

(a) The airplane must be free from flutter, control reversal, and divergence—

(1) At all speeds within and sufficiently beyond the structural design envelope;

(2) For any configuration and condition of operation;

(3) Accounting for critical degrees of freedom; and

(4) Accounting for any critical failures or malfunctions.

(b) The applicant must establish and account for tolerances for all quantities that affect flutter.

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Design

§ 23.500 Structural design.

(a) The applicant must design each part, article, and assembly for the expected operating conditions of the airplane.

(b) Design data must adequately define the part, article, or assembly configuration, its design features, and any materials and processes used.

(c) The applicant must determine the suitability of each design detail and part having an important bearing on safety in operations.

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§ 23.500 Structural design. (cont.)

(d) The control system must be free from jamming, excessive friction, and excessive deflection when—

(1) The control system and its supporting structure are subjected to loads corresponding to the limit airloads;

(2) The primary controls are subjected to the lesser of the limit airloads or limit pilot forces; and

(3) The secondary controls are subjected to loads not less than those corresponding to maximum pilot effort.

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§ 23.505 Protection of structure.

(a) The applicant must protect each part of the airplane, including small parts such as fasteners, against deterioration or loss of strength due to any cause likely to occur in the expected operational environment.

(b) Each part of the airplane must have adequate provisions for ventilation and drainage.

(c) For each part that requires maintenance, preventive maintenance, or servicing, the applicant must incorporate a means into the aircraft design to allow such actions to be accomplished.

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§ 23.510 Materials and processes.

(a) The applicant must determine the suitability and durability of materials used for parts, articles, and assemblies, the failure of which could prevent continued safe flight and landing. The applicant must account for the effects of likely environmental conditions expected in service.

(b) The methods and processes of fabrication and assembly used must produce consistently sound structures. If a fabrication process requires close control to reach this objective, the applicant must perform the process under an approved process specification.

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§ 23.510 Materials and processes. (cont.)

(c) Except as provided in paragraphs (f) and (g) of this section, the applicant must select design values that ensure material strength with probabilities that account for the criticality of the structural element. Design values must account for the probability of structural failure due to material variability.

(d) If material strength properties are required, a determination of those properties must be based on sufficient tests of material meeting specifications to establish design values on a statistical basis.

Part 23 NPRM: Subpart C - Structures

§ 23.510 Materials and processes. (cont.)

(e) If thermal effects are significant on an essential component or structure under normal operating conditions, the applicant must determine those effects on allowable stresses used for design.

(f) Design values, greater than the minimums specified by this section, may be used, where only guaranteed minimum values are normally allowed, if a specimen of each individual item is tested before use to determine that the actual strength properties of that particular item will equal or exceed those used in the design.

(g) An applicant may use other material design values if approved by the Administrator.

Part 23 NPRM: Subpart C - Structures

§ 23.515 Special factors of safety.

(a) The applicant must determine a special factor of safety for any critical design value that is—

(1) Uncertain;

(2) Used for a part, article, or assembly that is likely to deteriorate in service before normal replacement; or

(3) Subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods.

(b) The applicant must determine a special factor of safety using quality controls and specifications that account for each—

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Part 23 NPRM: Subpart C - Structures

§ 23.515 Special factors of safety. (cont.)

(1) Structural application;

(2) Inspection method;

(3) Structural test requirement;

(4) Sampling percentage; and

(5) Process and material control.

(c) The applicant must apply any special factor of safety in the design for each part of the structure by multiplying each limit load and ultimate load by the special factor of safety.

Section 21.9 NPRM

Presentation Insertion

§ 21.9 NPRM is below presented for audience information.

§ 21.9 Replacement and modification articles.

(a) If a person knows, or should know, that a replacement or modification article is reasonably likely to be installed on a type-certificated product, the person may not produce that article unless its is -

(1) Produced under a type certificate;

(2) Produced under an FAA production approval;

(3) A standard part (such as a nut or bolt) manufactured in compliance with a government or established industry specification;

(4) A commercial part as defined in § 21.1 of this part;

(5) Produced by an owner or operator for maintaining or altering that owner or operator's product;

Section 21.9 NPRM

§ 21.9 Replacement and modification articles. (cont.)

(6) Fabricated by an appropriately rated certificate holder with a quality system, and consumed in the repair or alteration of a product or article in accordance with part 43 of this chapter;

(7) Produced in any other manner approved by the FAA.

(b) Excepted as provided in paragraphs (a)(1), (a)(2) and (a)(7) of this section, a modification article for sale may not represent that part as suitable for installation on a type-cetificated product.

(c) Excepted as provided in paragraphs (a)(1), (a)(2) and (a)(7) of this section, a person may not sell or represent an article as suitable for installation on an aircraft type-cetificated under §§21.25(a)(2) or 21.21 unless that article -

(1) Was declared surplus by the U.S. Armed Forces, and

(2) Was intended for use on that aircraft model by the U.S. Armed Forces.