U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Quality Control for the Manufacture of Non-Metallic Compartment Interior Components

Date: 08/31/2010
Initiated by: AIR–200

AC No: 21–31A

1. Purpose.

a. This advisory circular (AC) –

1) Provides information about Title 14, Code of Federal Regulations (14 CFR), part 21, Certification Procedures for Products, Articles, and Parts.

2) Provides information for both an applicant for, and a holder of, a production approval, and refers to both as a production approval holder (PAH).

3) Is not mandatory and does not constitute a regulation. This AC describes an acceptable means, but not the only means, to comply with these requirements. However, if you use the means described in the AC, you must follow it in all important respects.

b. The Federal Aviation Administration (FAA) will consider other methods of compliance that the applicant elects to present. More so than metallic articles, non-metallic articles obtain the majority of their attributes directly from their manufacturing process. Many quality systems established for the manufacture of metallic articles may be unable to provide the additional controls necessary to ensure conformance to design requirements of non-metallic articles. This AC addresses those areas of a quality system that may require expansion to adequately accommodate the manufacture of non-metallic compartment interior articles.

2. Audience. This AC affects all manufacturers of non-metallic compartment interior articles or approval holders producing under part 21, subparts F, G, K, and O.

3. Effective Date. This AC is effective April 16, 2011.

4. Explanation of Changes. This revision –

a. Updates all references to 14 CFR part 21, Certification Procedures for Products, Articles, and Parts, dated October 16, 2009.

b. Updates formatting to match current AC formatting policy.

5. Cancellation. This AC cancels, as of its effective date, AC 21-31, Quality Control for the Manufacture of Non-Metallic Compartment Interior Components, dated November 15, 1991.

6. Related Publications.

a. 14 CFR, part 21.

b. AC 21-26, Quality System for the Manufacture of Composite Structures.

c. AC 21-43, Production Under 14 CFR part 21, subparts F,G, K, and O.

d. AC 23-20, Acceptance Guidance on Material Procurement and Process Specifications for Polymer Matrix Composite Systems.

e. AC 25-853-1, Flammability Requirements for Aircraft Seat Cushions.

f. FAA Order 8110.42, Parts Manufacturer Approval Procedures.

g. FAA Order 8120.2, Production Approval and Certificate Management Procedure.

7. Quality System.

a. Purpose of a quality system. A quality system established for the manufacture of non-metallic compartment interior articles is an integral part of and similar to any quality system established to meet the requirements of § 21.137 of part 21. The quality system establishes and implements a process that verifies that the parameters affecting product integrity are operating under controlled conditions. The quality system also ensures that individual items, batches, or lots conform to specified quality standards. Many organizations that manufacture non-metallic articles differ greatly from those that manufacture metallic articles. Some aspects of the quality system for non-metallic compartment interior articles may need to be enhanced to ensure compliance to the design requirements. These aspects include, but are not limited to, the following:

(1) Development of nondestructive and destructive testing techniques and quality standards,

(2) In-process manufacturing controls,

(3) Safety and health information, and

(4) Use of process control panels or simulated parts for destructive tests.

b. Simulated articles or process control panels. Simulated articles or process control panels should be produced with each production lot. When a simulated article, production part, or a process control panel is used as a test specimen, the PAH must ensure that it is

representative of the article throughout its manufacturing process. The test specimen should be constructed from the same lot of raw materials as the production articles. When possible, the test specimen should represent an area vulnerable to flammability testing.

8. Material and Process Specifications.

a. Information requirements. Material and process specifications for production of non-metallic compartment interior articles should identify critical parameters in the manufacturing process to facilitate production and final inspection. Typical material and process specifications should contain, at a minimum, the following information:

(1) Scope.

(2) Applicable documents.

(3) Material requirements (material specifications only), including—

(a) Mechanical, physical, and chemical;

(b) Testing (for example, flammability);

(c) Safety and health information;

(d) Transportation, storage and handling; and

(e) Sampling plan.

(4) Processing (process specifications only), including—

(a) Process information;

(b) Process controls (for example, cure cycle parameters, documentation of material out time);

(c) Materials;

(d) Test specimen construction and processing for quality system inspection;

(e) Personnel qualifications; and

(f) Tool proofing and control.

(5) Quality control (material and process specifications), including—

(a) Material and process verification;

(b) Quality system and inspection records;

(c) Required tests (for example, flammability);

(d) Inspection criteria;

(e) Verification of personnel qualifications;

(f) Environmental controls; and

(g) Nondestructive testing.

b. Terminology. Specifications should not contain terms open to interpretation such as: "adequate," "as necessary," "as required," "room temperature," or "periodically." Any tolerances required to control the process should be clearly defined.

9. Materials.

a. Design data requirements. Since the FAA requires that all drawings submitted for design approval contain sufficient references to material specifications or other data, this information will clearly identify the materials and processes necessary to ensure production of like articles.

b. Proprietary data.

(1) The PAH may exclude this proprietary data from the design data they submit to the FAA when materials for non-metallic compartment interior articles are produced in accordance with a proprietary process or when the composition of the materials is proprietary.

(2) When a process or material composition is proprietary, the applicable design drawings should refer to a specification that contains this proprietary data to ensure complete traceability to material composition. These specifications will then be made available to the FAA for review and approval under an arrangement between the FAA and the PAH that protects the proprietary data. The FAA is authorized under §21.33, §21.140, §21.310 and §21.610 to review such data upon request.

c. Material acceptance procedure. The PAH should have an incoming-material acceptance procedure. These procedures should ensure that the purchased non-metallic compartment interior articles materials conform to the specifications identified in the approved design data and should include the following elements:

(1) Supplier laboratory test reports should accompany each batch of material received for review and approval in addition to adequate documentation to substantiate the materials' compliance to all specification requirements. The materials' physical, chemical, and mechanical properties should be periodically tested to demonstrate conformance to engineering and manufacturing requirements, and to verify the accuracy of the supplier's laboratory reports.

Also, the materials' conformity to flammability requirements should be tested in accordance with the applicable following airworthiness regulations:

(a) 14 CFR part 23, Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes, subpart D, Design and Construction, Fire Protection; § 23.853, Compartment interiors.

(b) 14 CFR part 25, Airworthiness Standards: Transport Category Airplanes, subpart D, Design and Construction, § 25.853, Compartment interiors.

(c) 14 CFR part 27, Airworthiness Standards: Normal Category Rotorcraft, subpart D, Design and Construction, § 27.853, Compartment interiors.

(d) 14 CFR part 29, Airworthiness Standards: Transport Category Rotorcraft, subpart D, Design and Construction, § 29.853, Compartment interiors.

(2) The PAH may perform these tests at its production facilities or at an independent laboratory approved for such testing under its quality system. The PAH's quality system can include a procedure to vary the frequency of such testing once the PAH establishes confidence in the quality of the products from a particular source.

d. Testing of hazardous or unreliable materials. The PAH should test all materials that experience has shown to be hazardous or unreliable to determine their suitability for use.

10. Manufacturing Controls. The manufacture of acceptable and reliable non-metallic compartment interior articles depends on the type and degree of process controls employed during manufacture. The FAA is more likely to find the produced articles and structures acceptable if all pertinent process variables are adequately controlled. To best meet quality system objectives, the PAH should ensure that process procedures clearly define the type and degree of process controls used. Manufacturing process controls that should be a part of the quality system include, but are not limited to, the following:

a. Integrated quality and production control procedures. These procedures should be used for operations that define:

(1) Design data control.

(2) Document control.

(3) Supplier control.

(4) Manufacturing process control.

(5) Inspecting and testing.

(6) Inspection, measuring, and test equipment control.

(7) Inspection and test status.

(8) Nonconforming product and article control.

(9) Corrective and preventive actions.

(10) Handling and storage.

(11) Control of quality records.

(12) Internal audits.

(13) In-service feedback.

(14) Quality escapes.

b. Training and qualification programs. These programs should train and qualify operators and inspectors, as appropriate. These programs should measure operator performance according to production standards and provide for requalification, as necessary.

c. Manufacturing processes.

(1) Before beginning production, manufacturing processes should be in place such that the combination of materials, equipment, procedures, and other controls making up the process result in the production of articles having consistent material properties that conform to design requirements.

(2) Once the PAH has established manufacturing processes, they should not change them unless they have completed a comparability study and necessary testing of differences. In addition, it is recommended that processes be reviewed and requalified, if necessary, whenever any significant changes are made to the process (for example, sources of material, equipment controls, and tool design changes). Process capability should be demonstrated by inspection and testing as necessary to determine conformity to design requirements.

d. Conformity to design processes and controls. After initial process qualification, testing for conformity to design requirements should continue regularly to ensure the manufacturing process, materials, and associated tooling continue to operate in a state of control and produce conforming articles. Simulated articles or process control panels should be processed with production lots for this purpose.

e. Repair controls. When repairs are performed, controls should be used to ensure the repair has not compromised the integrity of the article. These controls may involve additional testing and/or simultaneous processing of process control panels.

11. Nondestructive Testing.

a. Methods. The nondestructive testing methods selected should be able to detect the types of defects associated with the specific article manufacturing process and article configuration.

b. Visual inspection methods. Visual inspection is the most widely used nondestructive inspection method. Discrepancies that can usually be observed include discoloration, foreign matter, crazing, cracks, scratches, blisters, dents, orange peeling, pitting, air bubbles, porosity, resin rich and resin poor areas, and surface wrinkles. Reflected light reveals surface irregularities. Transmitted light (assuming both surfaces are accessible and the material is translucent) reveals subsurface discrepancies within the specimen.

c. Other nondestructive testing methods. These include coin tap, ultrasonic, radiographic, and holography testing methods. PAHs should use these methods if visual inspection cannot ensure full conformance to the design requirements.

12. Final Acceptance.

a. Final acceptance requirements and quality system procedures should further ensure that the completed structure meets its functional and design requirements.

b. Final acceptance records should provide evidence that the following significant production and QC activities, specifically designed to ensure the quality of compartment interior articles, have been completed:

(1) Incoming material acceptance,

(2) In-process manufacturing and assembly controls,

(3) Maintenance of tooling and facility equipment,

(4) Calibration of inspection and laboratory test equipment,

(5) Inspection acceptance of functional characteristics at detail and assembly levels,

(6) Configuration control, and

(7) Material Review Board disposition.

13. Storage and Handling. Some compartment interior raw materials such as adhesives and resins, may deteriorate if not controlled under proper environmental conditions. These temperature sensitive materials should be stored at low temperatures in freezers to retard partial curing of polymer materials and extend their shelf life. Therefore, the PAH should establish, follow, and subject to periodic independent auditing, raw material transportation, handling, and

storage procedures in order to ensure continued conformity to the materials' chemical, physical, and mechanical properties.

14. Where to Find This AC. You can find this AC at http://www.faa.gov/regulations_policies/advisory_circulars/.

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