[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Policy Statement Number ANM-01-04; System Wiring Policy for Certification of Part 25 Airplanes.

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of Final Policy.

SUMMARY: In this document, the FAA addresses public comments that were submitted in response to a previously published general statement of policy that is applicable to the type certification process of transport category airplanes. The policy provides guidance to FAA certification teams for the type design data needed. The policy is necessary to correct deficiencies associated with the submittal of design data and instructions for continued airworthiness involving airplane system wiring for type design, amended design, and supplemental design changes.

FOR FURTHER INFORMATION CONTACT: Gregory Dunn, Federal Aviation Administration, Transport Airplane Directorate, Transport Standards Staff, Airplane and Flight Crew Interface Branch, ANM-111, 1601 Lind Avenue SW., Renton, WA 98055-4056; telephone (425) 227-2799; fax (425) 227-1320; e-mail: gregory.dunn@faa.gov.

SUPPLEMENTARY INFORMATION:

Background

On July 2, 2001, the FAA published in the Federal Register (66 FR 34983) a general statement of policy comprising guidance to FAA personnel for reviewing certain certification plans for transport category airplanes. Specifically, the policy statement provides internal guidance to FAA certification teams that will enable them to more thoroughly examine all required information submitted in the type design data package

for compliance with wire installation safety standards. This policy will also advise applicants what information needs to be provided in their type design data package to avoid delays in the certification process caused by incomplete or ambiguous information.

The safety standards for civil transport category airplanes are specified in Title 14, Code of Federal Regulations (CFR), part 25. If an applicant demonstrates that a particular design (i.e., a particular model) complies with these standards, the FAA issues it a design approval. The drawings and other data that describe that design are known as the "type design." When an applicant submits the necessary documents required for type certification by the FAA, the compilation of those documents is known as the "type design data package."

Based on certification projects submitted to the FAA for review in recent years, the FAA has become aware that there is some confusion among applicants as to the definition of "type design," especially with respect to the inclusion of drawings and specifications necessary to define the wiring configuration associated with equipment installation. In a number of recent certification projects, type design data packages that were submitted did not include wiring diagrams showing the source and destination of all wire associated with the installation. Also, wire installation drawings showing airplane wire routing, grounding, shielding, clamping, conduits, etc., either were missing or lacked sufficient detail. The wiring diagrams and installation drawings did not contain the necessary information intended by the relevant regulations. These drawing packages did not adequately and clearly define the configuration of the model to be certificated. In addition, instructions for continued airworthiness, as required by the regulations, were not defined.

Current Regulatory Requirements

The type and quality of data required for type design data packages and requirements for instructions for continuing airworthiness are indicated in the regulations. The pertinent sections of 14 CFR are as follows:

Section (§) 21.31 ("Type design"): This section defines and describes "type design."

§ 21.33 ("Inspection and tests"): This section, specifically § 21.33(b), provides additional insight as to the contents of the type design data package.

§ 21.21 ("Issue of type certificate: normal, utility, acrobatic, commuter, and transport category aircraft; manned free balloons, special classes of aircraft, aircraft engines; propellers"): This section lists pertinent requirements for a type certificate.

§ 21.50 ("Instructions for continued airworthiness and manufacturer's maintenance manuals having airworthiness limitations sections"): This section requires applicants to submit instructions for continued airworthiness as part of their type design data package. Paragraph 21.50(b) is relevant to this policy statement.

§ 21.101 ("Designation of applicable regulations") and § 21.115 ("Applicable requirements"): These sections make it clear that these data requirements apply to changes to type certificates.

Procedures for accomplishing the evaluation and approval of airplane type design data can be found in FAA Order 8110.4B, "Type Certification," dated April 24, 2000. This document gives comprehensive guidance on what constitutes a design package and what is necessary to make acceptable findings of compliance.

Identified Problems

Ambiguous Definition of Configuration: As mentioned above, the FAA has identified a number of recently submitted type design data packages that did not meet the intent of § 21.31(a). Specifically, these packages did not completely define the

certification configuration. For example, these packages did not completely define specific routing and installation of wiring on the airplane, which then left an inordinate portion of the installation to the discretion of the installer.

The routing of wiring is an important aspect not only to the system being modified, but also to other systems that can be affected by that wiring. It is important that the routing of wiring strictly follow the criteria established by the FAA in the certification basis, as reflected in the holder's original or subsequently approved type design. This requires installation drawings and instructions that completely define the required routing and installation with sufficient detail to allow repeatability of the installation.

System Safety Assessment: A system safety assessment is done as part of the installation of any equipment on the airplane. This typically consists of a functional hazard analysis, failure mode and effects analysis, zonal analysis, or other safety analyses appropriate to the system being installed. In the past, insufficient emphasis has been placed on an examination of failures of wiring external to the actual line replaceable units being installed. Failure of wiring in bundles due to chafing, contamination, or other causes may affect the continued safe operation of the airplane.

References to General Guidance: Problems occur when applicants overly rely on "standard practices" or other general guidance for installation details. Often, type design data packages make references to FAA Advisory Circular (AC) 43-13, "Acceptable Methods, Techniques, and Practices - Aircraft Inspection and Repair," for installation instructions. That guidance is general in nature and offers applicants multiple options for compliance. Because the installer can choose from a number of options for installation details, it is difficult for the FAA to find that the configuration complies with the criteria established by the FAA in the certification basis for a previously approved type design.

An installer could make inappropriate choices of method, depending upon his or her previous experience and training.

The practice of referencing general guidance, on those occasions when safety assurances and certification criteria necessitate strict adherence to specified certification standards, could result in an incomplete definition of the installation configuration. This clarification of FAA policy does not mean that data packages cannot reference AC 43-13 or similar documents, but the applicant is required to provide installation instructions which are unambiguous.

Omission of Manufacturing Process Specifications: There also have been cases where crucial manufacturing process specifications were omitted in the type design data packages pertaining to wiring installation details. This has led to insufficient control of the production of parts, and consequent airworthiness problems related to faulty parts manufacturing. This omission error frequently occurs when the type design approval holder routinely uses a complex process, but has not carefully defined the process in the type design data. As a consequence, it can result in approval of replacement parts that may not comply with necessary but undefined processing requirements.

Modifications not Compatible with Original Type Design Standards: Another common problem occurs when a modifier is unaware of, or does not specify, installation and routing practices that are compatible with the certification standards established for the original type design.

Some manufacturers provide an abbreviated version of their installation and routing specifications in the maintenance manual that they prepare for their products. These specifications may not be readily available to modifiers. This can result in "inadvertent non-compliance" with certification requirements. One example of this kind of inadvertent non-compliance would be the installation of a power wire for a

modification in a wire bundle containing critical wiring that the original manufacturer was required to isolate from other systems. This type of situation can be prevented by the applicant using experienced design engineers, doing physical inspections of the airplanes to be modified to ensure compatibility, and using the original airplane manufacturer's wiring installation guidelines.

Instructions for Continued Airworthiness: A review of past certification projects indicates that the maintenance aspects of system wire external to the installed equipment is not being adequately addressed. The integrity of the wiring is typically left to those doing general airplane maintenance that relies on visual inspections. However, visual inspections may not be adequate for wiring routed in metal or opaque conduits, wire in high vibration areas, or wire located in difficult to inspect areas. Equipment installers need to address any special maintenance requirements for the airplane wiring associated with equipment installation.

Disposition of Comments

The FAA received comments on the policy statement from four commenters: two representing industry groups, one an aviation safety inspector, and one a private citizen. The comments generally fall within four specific subject areas. These are addressed below.

1. Editorial Changes for Clarification of Meaning

One commenter suggests that the terms "complete" and "completely," "strictly," "precise," and "definitive," used in the Statement of FAA Policy could be regarded as an absolute requirement, overly precise, or unclear. The commenter also requests that certain sentences be reworded.

The FAA accepts these comments with some modifications. The intent of this policy is to define the type design using drawings which are unambiguous with respect to

important design details. It is not the intent of the FAA to require that these drawings contain every minute detail. Tests and analyses must be sufficiently detailed so that conformity can be accomplished.

In response to this commenter:

- The following sentence in paragraph 1 has been deleted: "These packages should completely define the certification configuration."
- The sentence in paragraph 2, which begins "Installation drawings that completely define the configuration typically will identify:..." has been changed to the following: "Installation drawings should identify the configuration . Such drawings typically will identify:..."
- The sentence in paragraph 7 which begins "These tests and analyses require complete..." is changed to "These tests and analyses should define the parts so that:..."
- The sentence in paragraph 8 that contains "A complete definition ...requires a drawing package that clearly and completely identifies:..." is changed to "The definition of the parts, including wiring and wire installation hardware, requires a drawing package that clearly identifies:..."
- The word "strictly," as used in the fourth sentence in the first paragraph, beginning "It is important that the routing of wiring strictly follow the intent of the criteria ..." is deleted.
- The word "definitive" in the last sentence in paragraph 5 is deleted and the rest of the sentence is rewritten for clarity. The sentence now reads, "This, in turn, requires a knowledge of the configuration through design control and an understanding of the airplane manufacturer's relevant wire installation practices or procedures, especially any requirements that pertain to wire separation."

- In paragraph 6, “definitive drawings” is changed to “engineering drawings” in order to more accurately reflect the intended meaning, and, in the same paragraph, in the last sentence, the word “precise” is removed from “precise location or routing of the wiring” and the phrase now reads “location or routing of the wiring.”

A second commenter requests deletion, addition, or revision of sentences for clarification. Specifically, this commenter requests the following changes:

- Remove the following sentence in the “Background” section under “One-Only Approvals”: “The certification regulations for one-only approvals permit the use of photographs and other similar data to document the modification.” The commenter notes that this sentence implies that photographs are not acceptable for multiple approvals.

The FAA accepts this comment with modification. The sentence is revised as follows: “The certification regulations for one-only approvals often use photographs and other similar data to document the modification.”

- Add the following sentence to the end of “References to General Guidelines” section: “This clarification of FAA policy does not mean that data packages cannot reference AC 43-13 or similar documents, but the applicant is required to provide installation instructions which are unambiguous.”

The FAA concurs and the sentence is added as submitted.

- Modify the last sentence of paragraph 5 of “Statement of FAA Policy” to read, “This, in turn, requires definitive knowledge of the configuration through design control and an understanding of the airplane manufacturer’s wire installation rules, especially any requirements that pertain to wire separation, as described by the airplane manufacturer in the maintenance manual.”

The FAA does not concur. The purpose of this sentence is to address the need to understand the manufacturer’s design as well as installation requirements. These

requirements are not necessarily found in the maintenance manuals. However, as noted earlier, the sentence is revised to address a previous commenter's request to remove the word "definitive."

2. Consideration for modifications in process

One commenter requests that the policy give reasonable consideration to modification programs presently in process.

The FAA concurs with this comment. It is the Transport Airplane Directorate's position that we will not impose new policy on an applicant for projects well on the way to completion, unless there is a safety concern that calls for an Airworthiness Directive. Consequently, the following sentence is added to the section entitled "Effect of This Statement of Policy": "This policy applies to any new project initiated after July 2, 2001, the date of the original publication of this notice in the **Federal Register**. However, the applicant is encouraged to incorporate the guidance in this policy into any present project where feasible."

3. Electrical Load

One commenter suggests that the policy should address the need to improve the currency and quality of the airline operator's electrical load report.

The FAA does not concur. The policy is meant to address only those aspects of Part 21 related to type design data and continuing airworthiness for Part 25 airplanes. It is not the intent of this policy to address all design aspects of wire installations on airplanes.

4. Wire Types and Inspections

Another commenter submitted the following three comments relating to wire types and wire inspections:

- The policy should address approved wire types.

The FAA does not concur. As required by other regulations, wire must meet its intended function, pass applicable qualification testing, not pose a hazard to the airplane, and be properly maintained.

- Issues relating to the mixing of wire types are not addressed.

Mixing of wire types is not addressed in this policy statement. Wires in a bundle must be securely clamped and bound and be compatible with their environment (i.e., vibration, temperature, etc.). These details are addressed in the design and installation requirements of the wire. These requirements are called out in the installation drawings.

- Visual inspections were found to be totally inadequate in discerning wiring cracks.

The FAA does not concur. Generally, visual inspections are a very valuable tool in assessing the condition of wire. Additional tools are necessary to detect microscopic wiring cracks. This is an area of research and, currently, non-destructive inspection (NDI) techniques are being developed and/or evaluated. The policy addresses the need for specific wire inspection requirements.

Additional Changes

The words “when available” were added to the last sentence in the section on “Process Specifications and Modifications Compatible with Original Standards,” for clarification.

Conclusion

After due consideration of the public comments submitted, the FAA has modified the general statement of policy to add clarification. The final policy, as modified, and without preamble, appears below.

Statement of FAA Policy

Unambiguous Definition of Configurations: Type design data packages should meet the intent of § 21.31(a). Specifically, routing and installation of wiring on the airplane should be addressed. It is important that the routing of wiring follow the intent of the criteria established by the FAA in the certification basis as reflected in the original or subsequently approved type design approval holder's design. The installer should provide with each application for design approval the following:

- Wiring diagrams showing source and destination of all airplane wiring associated with equipment installation.
- Installation drawings.

Installation drawings should identify the configuration. Such drawings will typically identify:

- Equipment locations.
- Wiring routings.
- Mounting and support details.
- Other such details of features.

System Safety Assessment: Certain airworthiness criteria require failure analyses (i.e., failure mode and effect analysis, zonal analysis, or other safety analysis) to demonstrate that a failure of the system under consideration:

- Does not, in itself, constitute an unacceptable hazard.
- Does not result in damage to other systems that are essential to safety.

The system safety assessment should include an assessment of the effects of failures of the airplane wire and its associated wire bundle for equipment installed on the airplane. The analysis should consider the possible effects wire system failures would

have on systems required for safe flight and landing due to damage in collocated wiring bundles and the possibility of smoke and/or fire events.

Failure of other systems must not damage a system being modified if the modified system is essential to safety. Such analysis requires that any possible interaction between systems be examined. This, in turn, requires a knowledge of the configuration through design control and an understanding of the airplane manufacturer's relevant wire installation practices or procedures, especially any requirements that pertain to wire separation.

Specific Installation Drawings Instead of General References: The FAA expects the applicant to provide engineering drawings instead of merely statements such as "install in accordance with industry standard practices," or "install in accordance with AC 43.13." The FAA considers such statements inadequate because the standard practices cannot define the location or routing of the wiring.

Process Specifications and Modifications Compatible with Original Standards: As noted in § 21.21, certain of the airworthiness requirements require analysis or tests to define the strength, durability, and life of components associated with the installation of wiring in the airplane (i.e., connectors, brackets, wire constraints, grommets, ground terminations, etc.). These tests and analyses should define the parts so that:

- Conformity of the parts to the type design may be verified.
- The characteristics of the parts important for test or analysis may be determined.

The airplane wiring parts specification provides the basis for necessary stress, durability, and life analysis. The definition of the parts, including wiring and wire installation hardware, requires a drawing package that clearly identifies:

- Shape.
- Material.

- Production processes.
- Any other properties affecting strength or functionality of each part.
- The arrangement of each part in the final assembly.

As an example, the FAA expects drawings to identify the material specification, heat treatment, corrosion protection or other finish, and any other important characteristic of each part subject to test or analysis for showing compliance with the airworthiness requirements. Much of this information can be provided by reference on the drawings to material or process specifications; the references then become part of the drawing and, consequently, part of the type design data package.

Modifiers of aeronautical products should use practices that reflect the certification criteria applicable to the original airplane manufacturer (OAM). The applicant should demonstrate that installation specifications and routing practices for the wiring used by modifiers is either the same as, or compatible with, those that are used presently for showing compliance to the type design certification requirements. Specifically, wire separation, wire types, wire bundle sizes, brackets, and clamping should be consistent with the approved standards. This may require the applicant and/or modifier to:

- Obtain or determine the applicable OAM design standards and/or practices for a given installation.
- Do a physical inspection of the airplanes to be modified to ensure compatibility.
- Develop processes and procedures to address compatibility between the original installation and the modification.

Modifiers and installers should use the airplane manufacturer's maintenance manuals, such as Maintenance Manual Chapter 20 ("Standard Practices Airframe"), Maintenance Manual Chapter 70 ("Standard Practices Engines"), or Chapter 20

("Standard Practices Wiring") as the primary source of wiring installation information, when available.

Instructions for Continued Airworthiness: Paragraph 21.50(b) of the regulations requires that instructions for continued airworthiness (ICA) be supplied by the modifier for modifications to aircraft and related products. The ICA for any specific wiring maintenance should be addressed where § 25.1529 is included in the certification basis.

Assessment of wire condition relies heavily on visual inspection. Consequently, the ICA should address inspectability of wire in conduits and difficult to inspect areas of the airplane. Where wire cannot be inspected visually, the ICA should address wire removal for inspection, when necessary, and the use of inspection techniques that do not rely on visual inspection alone. For example, wire in metal conduits may require repeated inspections for wear.

The FAA expects applicants for modifications to provide airworthiness instructions for the proposed changes in a format compatible with other maintenance instructions for the aircraft involved.

Effect of this Statement of Policy

The general policy stated in this document is not intended to establish a binding norm. It does not constitute a new regulation and the FAA would not apply or rely upon it as a regulation. Those tasked with the responsibility of airplane certification should generally attempt to follow this policy, when appropriate. In determining compliance with certification standards, each certification office has the discretion not to apply these guidelines where it determines that they are inappropriate. However, the certification office should strive to implement this guidance to the fullest extent possible to facilitate standardization and ensure that wiring installation details are adequately addressed during certification. Applicants should expect that the certificating officials will consider this information when making findings of compliance relevant to certification actions. Applicants also may consider the material contained in this policy statement as supplemental to that currently contained in 14 CFR part 21 when developing a means of compliance with the relevant certification standards.

This policy applies to any new project initiated after July 2, 2001, the date of the original publication of this notice in the **Federal Register**. However, the applicant is encouraged to incorporate the guidance in this policy into any present project where feasible.

Finally, as with all advisory material, this statement of policy identifies one means, but not the only means, of compliance.

Issued in Renton, Washington, on January 28, 2002.

/s/Vi Lipski
Vi Lipski
Manager
Transport Airplane Directorate