

Complex STC

The FAA is seeking public comment on this proposal. The FAA has published in the Federal Register a notice of availability and request for public comments on this subject. Send all comments on this proposed Certification Policy notice to: Federal Aviation Administration, Aircraft Certification Service, Aircraft Engineering Division, Room 815, 800 Independence Avenue SW, Washington DC 20591, ATTN: Steve Flanagan, AIR-110. Or, deliver comments to: Federal Aviation Administration, Room 815, 800 Independence Avenue SW, Washington DC 20591. You may electronically submit comments on this proposal to the following Internet address: 9-awa-avr-air-policycomments@faa.gov. Please include the words "Complex STC" in the subject line of your E-mail message. To help us to assemble and collectively respond to public comments, please include a text message version of your comments if your submittal is a PDF file.

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Proposed FAA Policy for Complex Supplemental Type Certificates (STC)

1. SPECIFIC POLICY FOR COMPLEX STCs. We, the FAA, are considering policy changes to support Title 14 of the Code of Federal Regulations (CFR) §§ 21.31, Type Design, and 21.53, Statement of Conformity. This policy introduces a new classification of supplemental type certificate (STC), titled -- the Complex STC. The policy changes require us to exercise increased rigor on applicants when approving Complex STCs. Further, these changes levy extra requirements and limitations on Complex STC applicants and on persons who install Complex STC modifications.

2. COMPLEX STC DEFINITION. A complex STC is: (a) an extensive design change to a type certificated (TC'ed) product, or (b) a simple design change that interfaces with an existing complex system, and incorrect assumptions about the complex system could have safety implications for the airplane. In either case, the installer needs access to both the STC substantiating and type design data to assure proper and safe subsequent installations of the Complex STC on in-service aircraft.

a. An extensive design change is broad in scope, encompassing many individual changes, and affecting a significant area of aircraft structure. Because of these two conditions, the potential exists for critical adverse effects when deviating from the originally approved STC design data. This potential for a hazard is controlled by an extensive STC type design data review and approval by both our engineering and manufacturing inspection personnel. This review of STC type design data assures that critical and major characteristics affecting the fabrication and installation of the modification are identified and controlled by combination of fixtures, tooling,

or approved processes as appropriate. An extensive design change classified as a complex STC may require coordination among multiple engineering disciplines and manufacturing inspection offices. A required element of all Complex STC extensive design changes is a feedback loop between design and manufacturing approval process and the installation process. Information obtained through this feedback loop allows for changes to the complex STC design and installation data package as further knowledge and experience is gained during subsequent installations following the initial modification done to obtain the STC. Note that for a complex STC the intended modification will have extensive installation requirements, and may require specialized knowledge concerning different variations of the aircraft being modified. Figure 1 contains examples of what we characterize as extensive design changes that we would consider complex STC's.

b. A simple design change may have safety implications because it interfaces with, or modifies, existing highly integrated systems on the aircraft. The effect of the change that is the Complex STC is difficult to determine. This difficulty is because the change interfaces with highly integrated systems on the aircraft, and all of the possible combinations of initial conditions of the integrated system would be difficult to specify. Any changes to the original STC design package may have adverse safety consequences for the airplane if there are parameters of the integrated system on the aircraft being modified that are different from those used in the initial approval of the STC. See Figure 1 for examples of what we consider to be interfaces that are highly integrated systems with potential safety implications that we want to characterize as complex STC's.

c. Whether an extensive change, or a change affecting a highly integrated system, a consequence of the complex STC is an FAA judgment. We believe that for a complex STC an installer cannot safely make a determination of the compatibility of the approved modification on subsequent aircraft without access to all STC data. Proper compatibility evaluation of a complex STC requires the installer to review both the engineering substantiating data and the STC type design data that was used to approve the initial development and installation of the STC. This is to be aware of the initial assumptions that were used in the initial approval of the STC. For the extensive design change, particular variations of in-service aircraft could mean that internal load paths for structure are different from those consistent with the assumptions that were the basis for the initial STC approval. Because neither the TC nor the STC clearly identify these internal load paths, FAA does not believe that an installer can determine that the installation on a subsequent aircraft is compatible without access to all the STC data. Similarly, for the STC involving highly integrated systems, because it is difficult to specify all the parameters and assumptions of highly integrated systems, it is difficult to assure that all of the interfaces of the STC have been considered when deviating from the initially approved STC.

3. DEFINING THE COMPLEX STC TYPE DESIGN AND FABRICATION AND INSTALLATION PROCEDURES

a. To assure the complete transmittal of all required information to the installer of a Complex STC, we will more rigorously apply the type design requirements specified in 14 CFR § 21.31, Type design, when addressing the design, fabrication, and installation information in the STC data package. This review is especially important when the STC holder allows licensees (or

others not involved in the initial development and installation of the STC modifications) to install the STC.

b. As required by 14 CFR §21.31, we will review and evaluate detailed installation data, including drawings, procedures (such as work cards), fabrication processes, wire and cable routing instructions, special tooling or any other documentation necessary to help installers duplicate the STC modification. We will direct our Aircraft Certification Office (ACO) engineers and Manufacturing Inspection District Office (MIDO) inspector, or their designees, to evaluate this data in detail to assure that follow-on installations are consistent reproductions of the approved modification.

c. All installation drawings must contain a note that restricts installations to only aircraft that meet the aircraft baseline configuration defined in paragraph 4 below.

4. AIRCRAFT BASELINE CONFIGURATION. Different airplane configurations result from production changes, and from in-service changes made to individual aircraft such as STCs, ADs, alterations and repairs. Thus, an aircraft that was used to prototype an STC may differ significantly from an aircraft for which a follow-on modification is intended. We need to ensure that such differences do not result in an unsafe condition or non-compliance with the aircraft's certification basis

a. To ensure that a baseline aircraft configuration is specified at the time of initial issuance of the STC approval, we will require all Complex STC applicants to submit an aircraft eligibility report. This report will specify the aircraft baseline configurations eligible for installation of the STC. Upon its completion and approval, this report will be identified in the “Limitations and Conditions” section of the STC certificate document (FAA Form 8110-2). This report is to define all interfaces between the aircraft and the STC that were considered in the initial approval of the Complex STC. Further, the aircraft eligibility report will specify those aircraft configurations, including production line changes, major repairs to in-service aircraft, known major alterations and other STCs that are compatible with installation of the Complex STC, as substantiated by the applicant. The Complex STC will include a limitation restricting the installation to aircraft configurations listed in the eligibility report. In light of this limitation, we will limit the STC to only the prototype aircraft installation until that applicant completes the aircraft eligibility report for reference on the STC document.

b. The aircraft eligibility report must describe in detail the aircraft/STC interfaces and the prototype aircraft baseline configuration. This information includes:

(1) Aircraft interfaces (defined by lowest-level interfacing drawing numbers), such as:

- (a)** Tie-ins to aircraft skin and stiffening structure.
- (b)** Electrical system connections to aircraft power distribution busses.
- (c)** Compatibility with pneumatic, hydraulic, and fuel systems connections.

(d) Routing drawings for electrical wire, and for pneumatic and fluid (fuel, oil, hydraulic, etc) carrying conduits where such routings are determined to be critical.

(e) Aerodynamic fairings and components.

(2) Aircraft baseline configuration, including information such as:

(a) Aircraft model(s) and dash number(s).

(b) Applicable aircraft serial number(s) and if applicable any additional production details necessary to identify the aircraft's build state, such as production line number(s).

(c) All relevant interfacing aircraft configurations and systems as defined by system, assembly or detail drawings.

(d) All STCs, repairs or alterations installed on the prototype aircraft that interface with the STC modification.

(e) Other documented modifications, not on the prototype aircraft model, if proved compatible with this STC installation.

(f) All airworthiness directives compatible with the installation. The report may also document any previously approved "Alternate Methods of Compliance" (AMOC) directives compatible with the installation.

(g) Any other aircraft configuration details necessary to assure compliance of a follow-on installation with the certification basis and to prevent an unsafe condition.

(3) Instructions for recording and dispositioning deviations from the defined baseline configuration for each follow-on STC installation. The instructions should include a way to incorporate additional configurations to the aircraft eligibility report. While the STC applicant/holder may propose unique instructions, those instructions must address the intent of the aircraft baseline records review, and the engineering evaluation of potential STC incompatibilities.

c. We at the FAA will approve the aircraft eligibility report and all subsequent changes thereto.

5. Control of follow-on installations.

Our goal is to prevent installations that are unsafe due to incompatibilities between the follow-on aircraft and the Complex STC. We accomplish this by increasing the installer's and the STC holder's engineering staffs' technical involvement in the substantiation of the Complex STC's compatibility with all follow-on aircraft configurations that are different from the baseline configuration. This is especially important when installers lack installation experience with the original STC. The policy change includes a structured and auditable method to ensure that all

the necessary data for the alteration is transferred to the STC installer, and that the STC installer properly evaluates the eligibility of the aircraft to be modified.

a. Evaluating Follow-On Aircraft Configurations. Before each follow-on installation, the STC installer must evaluate the configuration of the candidate aircraft, by inspecting the aircraft and reviewing records to verify that the configuration is eligible. The installer must formally document and keep this evaluation with their STC installation records. If the configuration differs from the baseline configuration(s), the installer must evaluate the differences to verify:

(1) That all prior repairs, alterations, STC installations or airworthiness directives do not affect the intended STC installation, either physically or functionally;

(2) That all interactions between the proposed STC installation and any previous modifications, alterations, or repairs on the candidate aircraft do not produce a non-compliance with the airworthiness standards;

(3) That all interactions between the proposed STC installation and any airworthiness directives do not produce a non-compliance- with the airworthiness standards, and

(4) That all interactions between the proposed STC installation and the aircraft configuration do not cause or create an unsafe condition.

b. Resolving Potential STC Incompatibilities With the Cognizant ACO. If an installer finds an incompatibility of the Complex STC with the specific configuration of the candidate aircraft, they must substantiate and resolve the incompatibility with the ACO that originally approved the STC in accordance with the revision instructions in the aircraft baseline eligibility report. We encourage Complex STC installers to involve the STC holder to ensure proper resolution of all potential installation incompatibilities. When determining that a deviation from the baseline configuration is functionally and physically compatible with the STC installation requiring no further modification, the STC may be installed on that aircraft. All substantiating data must be FAA approved.

c. Recording Deviations. The installer must record deviations from the baseline configuration including the disposition of such deviations per the instructions in the aircraft eligibility report.

d. Amending the Aircraft Eligibility Report. The installer may: (1) ask the STC holder to obtain an amended STC that accounts for the candidate aircraft's deviations and revises the aircraft eligibility report; (2) may ask us to approve the installation deviations; or (3) may apply for their own STC for the installation with the deviations. If the installer chooses to apply for their own STC, the FAA will require the installer's data package address all the changes to the aircraft being modified, rather than just the differences between the approved STC data and the deviations in the installer's proposal.

6. ECONOMIC IMPACT. The Regulatory Flexibility Act of 1980 requires Federal agencies to consider the economic effect that proposed rules might have on a substantial number of small

entities. We cannot make that determination at this time, nor can we estimate the paperwork burden.

7. BACKGROUND. We at the FAA issue an STC when any person alters a product by introducing a major design change to a type-certificated product, and the effects of the major design change is not so great as to require a new application for a TC. The STC process is widely used throughout the U.S. aviation industry, and since adopting the process, we have issued more than 30,000 STCs to more than 5,500 entities. Most STC applicants are persons other than the original product's TC holder. We believe that the basic STC process ensures an appropriate level of safety for most STCs. However, recent FAA Special Certification Reviews (SCR) show that we need to reinforce our policy for the more complex STCs. Based on the results of the SCR's, we made the following conclusions:

a. While the STC and TC processes are fundamentally the same, the STC environment has become less rigorous than the TC environment. Certain STCs extensively affect an aircraft's compliance with the airworthiness regulations either directly or indirectly, through an inherent interface with complex aircraft systems. These STCs require more certitude and rigorous interdisciplinary review of both the substantiating and the type design data. The substantiating data is the engineering analysis and test reports that shows the aircraft with the STC installed complies with all the requirements of the certification basis for the project. The type design data consists of the drawings specifications, processes, and procedures to manufacture and install the modification on similar type-certificated products following the initial approval of the Complex STC. This detailed review of engineering, fabrication, and installation data is especially necessary when we consider that STC replications typically occur at maintenance facilities other than the one used by the original STC holder for the prototype installation.

b. STC holders and repair stations often have less engineering capability, configuration control and manufacturing data when compared to TC holders. As such, we have received packages for extensive and complex interfacing STCs that lacked sufficient data, especially regarding installation instructions and the definition of aircraft configuration eligibility.

c. Quality systems at STC holder and repair station facilities vary much more than those at production approval holders. In addition, STCs are often installed on aircraft by entities other than the original STC holder. This further increases the possibility of incompatibilities between the STC installation and the aircraft.

d. Applicant's installation drawings or other installation instructions have not always been detailed enough for accurate replication of the design. This is especially true when follow-on STC installations occur at facilities other than that used by the STC holder for the prototype installation.

e. We typically issue STCs that permit installation on any aircraft of a specific type and model designation. Aircraft compatibility is addressed by the following limitation: "The installer is responsible for determining the compatibility of this STC with other previously approved modifications." Nevertheless there have been installations on inappropriate aircraft. These inappropriate installations could have been prevented if STC approvals were restricted to a

specified baseline aircraft configuration that includes details of the STC physical and functional interfaces with the prototype aircraft.

f. The certification process does not adequately address how to evaluate the compatibility of an STC with other previously installed STCs, major alterations or repairs. We need a more rigorous compatibility evaluation for certain STCs. This proposed policy ensures that the modified aircraft will be airworthy.

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FIGURE 1 EXAMPLES OF COMPLEX STC'S

To better understand what FAA considers to distinguish a complex STC it may be helpful to know that the changes listed below were generated by a review of the significant changes listed in Appendix 1 of Advisory Circular (AC) 21.101-1, "Establishing the Certification Basis of Changed Aeronautical Products", dated 4/15/03. In comparing this list, one can see that complex STC's are a subset of significant changes as defined in 14 CFR §21.101, "Designation of applicable regulations." Also, when comparing extensive changes that are Complex STC, one sees the differences in the complexity of the airplane between 14 CFR part 23 and part 25 aircraft.

Examples of "extensive" changes considered as Complex STC

Part 23 Significant Changes

- Change empennage to/from conventional/(T-tail, Y-tail)
- Change wing (empennage) configuration or layout
- Change pax to freighter or combi (with increased floor loads) - only for pressurized aircraft weighing over 6000 lbs)
- Change in basic materials for primary structure
- Add cabin pressurization

Part 25 Significant Changes

- Change pax to freighter or combi (increased floor loads)
- Add leading edge slats
- Change fuselage length (long/short)
- Extensive structural mod (cutout)
- Change landing gear footprint and increase weight
- Change metallic to composites on primary structure
- Change wing layout (not relocate or new wing)
- Change in type or # emergency exits or increase pax
- Change PFCS to FBW (not increase FBW capability)
- Change reciprocating to turboprop engines (if engine mount changed)

Part 27/29 Significant Changes

- Fixed flying controls from mechanical to FBW
- Extensive primary structure changes from metallic to composite
- Change tail anti-torque device (e.g., tail rotor, ducted fan, other)

Examples of "Interface with integrated systems" changes considered as Complex STC

Part 23 Significant Changes

- Major flight deck upgrade
- Add Autoland capability

Part 25 Significant Changes

Major flight deck upgrade/reduce flight crew

Comprehensive flight deck upgrade

Initial installation of autoland system

Complex electric power systems with elaborate automatic load-sharing schemes

Fuel systems with multiple tanks and complex fuel movement control systems

Powered flight control systems

Part 27/29 Significant Changes

Comprehensive flight deck upgrade