

# Certification Position Paper

**Subject:** Software and Airborne Electronic Hardware Criteria for Supporting Conformity Inspections and Type Inspection Authorization (TIA) Issuance

**Reference No.** CPP-21.33-1B

**Regulatory Ref.:** 14 CFR 21.33, 21.35, 21.53, 25.1301, 25.1309

**National Policy Ref.:** AC 20-115D: Airborne Software Development Assurance Using EUROCAE ED-12( ) and RTCA DO-178( )  
AC 00-69: Best Practices for Airborne Software Development Assurance Using EUROCAE ED-12( ) and RTCA DO-178( )  
AC 00-71: Best Practice for Management of Open Problem Reports  
AC 00-72: Best Practice for Airborne Electronic Hardware Design Assurance Using EUROCAE ED-80( ) and RTCA DO-254( )  
AC 20-152A: Development Assurance for Airborne Electronic Hardware  
AC 20-189: Management of Open Problem Reports (OPRs)  
FAA Order 8110.4C Chg 6: Type Certification  
FAA Order 8110.49A: Software Approval Guidelines  
FAA Order 8110.105A: Simple and Complex Electronic Hardware Approval Guidance

**Statement of Issue:** This Certification Position Paper (CPP) guides Aircraft Certification Service (AIR) staff in addressing Software and Airborne Electronic Hardware (SW&AEH) in the context of conformity inspections and type inspection authorization (TIA) for transport category airplanes. This CPP also provides criteria that apply to SW&AEH when the associated development assurance activities have not been completed at the time of TIA issuance.

## Background:

- a. Pursuant to Title 14, Code of Federal Regulations (14 CFR) 21.33, each applicant must allow the Federal Aviation Administration (FAA) to make any inspection and any flight and ground test necessary to determine compliance with applicable airworthiness requirements. Type design data is used to demonstrate such compliance. When a TIA is issued for the purpose of FAA ground and flight-testing, a conformity inspection is required to show that the system under test conforms to the type design and is safe for flight. For SW&AEH, determination of an applicant's compliance to the type design is assessed through review of the SW&AEH development life cycle data.
- b. Ideally, all SW&AEH development activities should be completed and applicable life cycle data produced prior to issuance of a TIA. However, multiple TIAs may be issued in incremental stages (See FAA Order 8110.4C Chg 6 section 2.6r(1)). This incremental approach allows FAA ground or flight tests to be conducted as SW&AEH functionality becomes available, even though it may be prior to the completion of some SW&AEH development activities. Certain development activities, such as verification testing and

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coverage analysis, should not be a prerequisite for issuance of TIA and formal FAA flight-testing.

## FAA Position:

- a. When complying with §§ 21.33 and 21.35, and with FAA concurrence, an applicant may use an incremental approach to SW&AEH conformity inspections and TIA ground and flight testing. When using this approach, the applicant must define the functionality for each incremental TIA and show functional independence from other incremental TIAs. The applicant must show compliance with all applicable rules for each increment and satisfy the minimum SW&AEH criteria defined in this CPP (see paragraph d. below). The *minimum criteria* must be satisfied prior to issuance of an incremental TIA and the beginning of the FAA flight test program for all airborne systems that have not completed all applicable SW&AEH verification and validation activities. Since these are minimum criteria only, additional criteria may be required based on new and novel technologies.
- b. A conformity inspection is required prior to conducting TIA ground or flight-testing of a system or specific functions of a system implemented in software or AEH. Additionally, any SW&AEH installed on the aircraft under test that can contribute to Catastrophic, Hazardous, or Major failure conditions, must include sufficient evidence of life cycle data conformity, unless the risk is otherwise mitigated.
- c. For each incremental TIA, the function under test must be independent from subsequent TIAs, meaning that a current incremental TIA does not affect a previously approved TIA, unless the previous TIA-affected functionality is being addressed in the current proposed incremental TIA. The incremental SW&AEH functions presented for TIA must be a production equivalent. If system functions to be tested under the current TIA rely on the correct operation of other system functions to be tested under a separate TIA (i.e., system B relies on proper operation of system A), then the relied-upon system must have successfully completed incremental TIA testing prior to testing the current system functions (i.e., system A testing must be completed prior to testing system B, including incremental system B testing).
- d. The minimum SW&AEH criteria are:
  1. The functional requirements allocated to SW&AEH have been developed, verified, and have a baseline for the system under test.
  2. High-level software and hardware requirements have been developed, reviewed, and are bi-directional traceable to the system requirements. In addition, all derived requirements must be fed back and assessed by the system safety process.

# Certification Position Paper

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3. For Item Development Assurance Level (IDAL) A&B systems, the low-level software requirements must be developed, reviewed and are bi-directional traceable to the high-level software requirements. In addition, all low-level derived requirements must be fed back and assessed by the system safety process.
4. For IDAL A&B systems, source code must be developed, reviewed and is bi-directional traceable to the low-level software requirements.
5. High-level software and hardware requirements-based test cases and procedures have been successfully reviewed, executed, and passed for the incremental TIA.
6. Bi-directional traceability exists from the requirements to tests where applicable to the designated IDAL level, to show completeness.
7. The lab test environment(s), test plan, test cases, and test procedures used to establish the TIA configuration can be reproduced.
8. All SW&AEH OPRs that affect safety of flight or functionality for the incremental TIA must either be: (1) closed or (2) resolved as defined in AC 20-189. If resolved by mitigation, then the mitigation must be agreed upon by FAA flight test personnel.
9. The applicable test results for the TIA are retained and recorded in the Type Inspection Report.
10. The software executable object code was compiled/linked from configuration management control baselined source code that has been reviewed, analyzed, and known to be reproducible in documented procedures.
11. The Programmable Logic Devices/Field Programmable Gate Array programming file or Arrays Application Specific Integrated Circuits netlist was built from configuration management control baselined Hardware Description Language code that has been reviewed and known to be reproducible in documented procedures.
12. The SW&AEH used for the TIA must be documented in a baseline configuration with a Software Configuration Index (SCI) and Hardware Configuration Index (HCI). The SCI and HCI must contain the data identified in RTCA/DO-178C section 11.16 and AC 20-152A section 5.10, respectively, or an equivalent.
13. The released software object code loads and/or the AEH programming file programs correctly based on the approved load and/or programming procedures that are under a configuration management process.

# Certification Position Paper

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**Reference No.** CPP-21.33-1B

- e. The applicant must identify the required configuration of the systems, software, and AEH (e.g., modular avionics platform and resources, primary displays, real-time operating system, primary flight controls, etc.) which must be demonstrated to be safe for flight to support the incremental TIA testing for other independent system functions under test.
- f. Authority concurrence must be reached that the SW&AEH under test satisfies the minimum criteria defined in paragraph d. For delegated projects, a statement of compliance (e.g., Form 8110-3 or 8100-9) must be used for the SW&AEH under test to indicate technical acceptance.
- g. All post TIA SW&AEH changes must have a change impact assessment and safety analysis performed to assess the effects on the completed certification demonstrations. In addition, regression testing may be required to ensure there were no unintended change impacts.

## **Conclusion:**

Applicants may use this Certification Position Paper when:

- The airplane model(s) is a transport category airplane, and
- The applicant verifies with the FAA that the FAA position on this issue did not change, and
- The applicant refers to the reference number for this Certification Position Paper in their project specific certification plan.

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Policy & Innovation Division  
Aircraft Certification Service

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Date