



FAS Topic Paper (FTP)		
TITLE	REVISION	REVISION DATE
FTP1055 Tool Qualification Impacts	3	03-Dec-2020
ABSTRACT/PURPOSE: An issue raised by the Unmanned Aircraft System (UAS) Community concerned Software Tool Qualification: “Software tools may require qualification in accordance with DO-330/ED-215, and this potentially limits the use of available tools that can be advantageous in other aspects of the software development process and restrains the innovation opportunities.” This paper addresses this concern and provides clarification on DO-330/ED-215 Software Tool Qualification.		
RELATED DO/ED DOCUMENTS: <input checked="" type="checkbox"/> DO-178C/ED-12C: SW Airborne Sys & Equip <input checked="" type="checkbox"/> DO-278A/ED-109A:SW (CNS/ATM) Systems <input type="checkbox"/> DO-248C/ED-94C: Supporting Information <input checked="" type="checkbox"/> DO-330/ED-215: Software Tool Qualification Considerations <input type="checkbox"/> DO-331/ED-218: Model Based Development & Verification Supplement <input type="checkbox"/> DO-332/ED-217: OO Technology and Related Techniques Supplement <input type="checkbox"/> DO-333/ED-216: Formal Methods Supplement <input type="checkbox"/> Other		
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FAS Team Definition and Goals:

The FAS user group monitors and exchanges information on the application of the following “software document suite” that was developed by joint RTCA/EUROCAE committee SC-205/WG-71:

- DO-178C/ED-12C - Software Considerations in Airborne Systems and Equipment Certification
- DO-278A/ED-109A - Software Integrity Assurance Considerations for Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) Systems
- DO-248C/ED-94C - Supporting Information
- DO-330/ED-215 - Software Tool Qualification Considerations
- DO-331/ ED-218 - Model Based Development & Verification Supplement
- DO-332/ED-217 - Object Oriented Technology and Related Techniques Supplement
- DO-333/ ED-216 - Formal Methods Supplement

The goals of the FAS user group are as follows:

1. To share lessons learned in the use of the RTCA/EUROCAE “software document suite” and to encourage good practices and promote the effective use of RTCA’s and EUROCAE’s publications.
2. To develop FAS Topics Papers (FTP’s) relative to RTCA’s and EUROCAE’s publications or other related aeronautical software industry topics. These FTP’s may include clarification to the “software document suite” or a discussion on a new topic.
3. To identify and record any issues or errata showing the need for clarifications or the need for modifications to the “software document suite”.

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Abstract / Purpose of the FAS Topic Paper:

An issue raised by the Unmanned Aircraft System (UAS) Community concerned Software Tool Qualification: “Software tools may require qualification in accordance with DO-330/ED-215, and this potentially limits the use of available tools that can be advantageous in other aspects of the software development process and restrains the innovation opportunities.” This paper addresses this concern and provides clarification on DO-330/ED-215 Software Tool Qualification.

FTP Discussion:

People are better at certain tasks while tools can work better at tedious and detail oriented repetitive tasks. The need for tool qualification should not deter applicants from using tools where warranted. Tool qualification is merely a check to provide assurance that the tool is not introducing any errors in the product or masking errors. Tool qualification is not limited to commercially developed tools. Tools that are developed in-house may also be used once their appropriateness and correctness of use are established via tool qualification. DO-330/ED-215, Software Tool Qualification Considerations, gives guidance on considerations for tool qualification. Qualification of emulators and simulators is also clarified in this document. Finally, tools must be used as intended in the qualification by a user who understands the right way of using the tool.

DO-178C/ED-12C defines the term “tool qualification” as:

“The process necessary to obtain certification credit for a software tool within the context of a specific airborne system.”

Similarly, DO-278A/ED-109 defines the term “tool qualification” as:

“The process necessary to obtain approval credit for a software tool within the context of a specific CNS/ATM system.”

This should not be confused with other guidance materials that use the term “qualification” differently (e.g. IEC 61508 uses the term to describe a level of quality that a tool is subject to prior to it being used).

Qualification of a tool is needed when processes of DO-178C/ED-12C or DO-278A/ED-109A or the supplements are eliminated, reduced, or automated by the use of a software tool without its output being verified. The objectives identified in these documents are satisfied by the qualification processes. This is further clarified by:

1. If the tool is not used to establish compliance to an objective, then no qualification is necessary.
2. For a tool which could introduce an error in the software (tool criteria 1):



- If the tool outputs (requirements, architecture, Source Code, Executable Object Code, and DO-178C/ED-12C Parameter Data Item / DO-278A/ED-109A Adaptation Data Item) are verified independently of the tool, then no qualification is necessary.
3. For a tool which cannot introduce an error in the software but could fail to detect an error (tool criteria 2 or 3):
If the output of the tool is independently verified including confirmation of the activity the tool is eliminating, reducing, or automating, then no qualification is necessary.
 4. In all other cases qualification is necessary.

The criteria identifying whether a tool needs to be qualified is found in DO-178C/ED-12C (or DO-278A/ED-109A) Subsection 12.2 and the guidance for this qualification is provided in DO-330/ED-215.

DO-330/ED-215 makes tool qualification look more daunting than it is. Similar to DO-178C/ED-12C (or DO-278A/ED-109A), the full set of DO-330/ED-215 objectives apply only to the highest tool qualification level (TQL)-1 (i.e., highest safety critical level for tool software). TQL-1 applies when some development objectives of airborne software at level A (or CNS/ATM software at level 1) are automated by the software tool. An example of a TQL-1 tool is an auto-code generation tool that creates source code from diagrams within the context of DO-178C/ED-12C software level A (or DO-278A/ED-109A assurance level 1), and that source code is not reviewed for accuracy and completeness against the diagrams. Most tools are TQL-5, and only need to meet 14 DO-330/ED-215 objectives (versus TQL-1 must meet 76 objectives). TQL-5 tools are those that are used in a verification manner and cannot directly modify the software product itself. These tools may fail to identify an issue with the software, but they cannot introduce errors directly into the airborne (or CNS/ATM) software. Qualifying a tool at TQL-5 does not require any artifact on how the tool has been developed: it is a full black box approach.

Typical safety-critical aerospace projects utilize many tools not requiring qualification, including the source code compiler as the output from this tool is verified via system and software testing of the application.

Many tool vendors provide tool qualification packages; users need to establish appropriateness of the use environment before using the tool and its qualification package.

Note: Further clarification related to the necessity of tool qualification and/or the reuse of tool qualification data can be found in the following references:

- DO-248C/ED-94C Frequently Asked Question (FAQ) 59: What type of non-flight software is covered by DO-178C/ED-12C?
- DO-248C/ED-94C FAQ 62: What are the requirements for flight test analysis software and ground-based test software?
- DO-248C/ED-94C FAQ 65: What is meant by “equivalent software verification process activity” in DO-178C/ED-12C (DO-278A/ED-109A) sections 12.3.2.4 (Tool Qualification for Multiple-Version Dissimilar Software) and 12.3.2.5 (Multiple Simulators and Verification)?



- DO-330/ED-215 Appendix C FAQ C.3: How Can One Maximize Reusability of Tool Qualification Data?
- DO-330/ED-215 Appendix D FAQ D.2: Can TQL Be Reduced?
- DO-330/ED-215 Appendix D FAQ D.3: When Do Target Computer Emulators or Simulators Need to Be Qualified?
- DO-330/ED-215 Appendix D FAQ D.4: What Credit Can Be Granted for Tools Previously Qualified Using DO-178B/ED-12B (DO-278/ED-109)?
Note that AC 20-115D/AMC 20-115D provides guidance on tool qualification efforts under different versions of DO-178/ED-12 (DO-278/ED-109).
- DO-330/ED-215 Appendix D FAQ D.7: How Might One Use a Qualified Tool to Verify the Outputs of an Unqualified Tool?
- DO-330/ED-215 Appendix D FAQ D.8: How Might One Use a Qualified Autocode Generator?
- DO-330/ED-215 Appendix D FAQ D.9: Is Qualification of a Model Simulator Needed?
- FAS FTP1009: Qualification of Tools Used to Develop or Verify a Software Tool
- FAS FTP1018: DO-330/ED-215 Subsection 11.5 Dissimilar Tools