FAS Topic Paper (FTP)		
TITLE	**REVISION**	**REVISION DATE**
FTP1052 Complier Clarifications	2	03-Dec-2019
ABSTRACT/PURPOSE: This FTP addresses Unmanned Aircraft System (UAS) industry concerns that they will no longer be allowed to use compilers such as the GNU Compiler Collection (GCC), and that they'll have to buy expensive, certified compilers.		
RELATED DO/ED DOCUMENTS: _**X**__ DO-178C/ED-12C: SW Airborne Sys & Equip _**X**__ DO-278A/ED-109A:SW (CNS/ATM) Systems _**X**__ 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: OO Technology and Related Techniques Supplement ____ DO-333/ED-216: Formal Methods Supplement ____ 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 (FTPs) relative to RTCA's and EUROCAE's publications or other related aeronautical software industry topics. These FTPs 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".

The FAS user group does not have the authority to change the content of any approved RTCA/EUROCAE documents. Any publications of the FAS user group may be taken into consideration by a future RTCA/EUROCAE working group.

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Abstract / Purpose of the FAS Topic Paper:

This FTP addresses Unmanned Aircraft System (UAS) industry concerns that they will no longer be allowed to use compilers such as the GNU Compiler Collection (GCC), and that they'll have to buy expensive, certified compilers.

FTP Discussion:

Question from Industry:

Does DO-178C/ED-12C or DO-278A/ED-109A require a certified compiler to be used?

Response from FAS:

No. This misconception may result from the fact that many other standards do mandate the use of certified compilers. For example, IEC 61508 highly recommends the use of certified tools and certified translators.

DO-178C/ED-12C and DO-278A/ED-109A do not require the use of certified compilers. The compiler is considered acceptable once all the verification objectives have been satisfied, but the compiler is only acceptable for that product and not necessarily for other products. This does not qualify the compiler as a software tool or validate it against a language standard. DO-178C/ED-12C and DO-278A/ED-109A only requires a software tool to be qualified when DO-178C/ED-12C or DO-278A/ED-109A processes are eliminated, reduced or automated using the tool without its output being verified.

Many applicants have used compilers such as GCC successfully on DO-178C/ED-12C Software Level A projects and DO-278A/ED-109A Assurance Level 1 projects.

It should be noted that any run-time libraries provided by the compiler may form part of the Executable Object Code and therefore need to satisfy the same DO-178C/ED-12C objectives as the remainder of the airborne software, and likewise the same DO-278A/ED-109A objectives as the remainder of the software for Communication, Navigation, Surveillance, and Air Traffic Management (CNS-ATM) systems.

Several documents provide guidance and supporting information on compilers:

- DO-178C/ED-12C and DO-278A/ED-109A Paragraph 4.4.2 describes planning activities relating to compilers:
  - Care should be taken when selecting the level of compiler optimization.
  - Some compilers can introduce additional object code that is not directly traceable to the Source Code.

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- Changing the compiler version or the compiler options selected can invalidate tests and coverage analyses that were carried out before the change.
- DO-178C/ED-12C and DO-278A/ED-109A Paragraph 6.4.4, item c defines an objective to verify additional object code that is not directly traceable to Source Code. This objective is only applicable at DO-178C/ED-12C Software Level A and DO-278A/ED-109A Assurance Level 1. DO-178C/ED-12C and DO-278A/ED-109A Subparagraph 6.4.4.2, item b describes activities relating to this objective.
- DO-248C/ED-94C Frequently Asked Question (FAQ) #42 discusses the impact of compiler options and optimizations on performing structural coverage at the object code level.
- DO-248C/ED-94C FAQ #73 discusses the impact of compiler options on calculation of the worst-case execution time.
- DO-248C/ED-94C FAQ #80 discusses what needs to be considered when using inlining.
- DO-248C/ED-94C FAQ #83 discusses compiler errata.
- DO-248C/ED-94C Discussion Paper (DP) #12 discusses the impact of compiler optimization on traceability from object code to Source Code.
- DO-330/ED-215 FAQ D.8 Scenario 3 explains that the low-level requirements-based test objectives can be satisfied through qualification of the auto code generator and verification of a set of representative input files. This is not the same thing as qualifying the compiler.

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