



Tool Qualification Kit Outline

DO-178C / DO-330



This document outlines the contents of the Cantata Tool Qualification Kit for DO-178C & DO-330 available for each version of Cantata.

It contains extracts from the full Cantata Tool Qualification Kit Overview document, which forms part of the qualification kit and provides full guidance all the links tool qualification data contained in the qualification kit.

CONTENTS OF THE FULL KIT OVERVIEW DOCUMENT

The following is the full contents list of the Cantata Tool Qualification Kit Overview document which forms an integral part of the kit and index to the referenced data within the kit. The Contents list is presented here for information.

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The following sections are extracts from the Cantata Tool Qualification Overview for DO-178C & DO-330.

Introduction

Cantata (including the Cantata Hybrid subset) is used for the design and execution of unit/integration tests of C/C++ code modules, the generation of test results, and the measurement of structural code coverage achieved at run time. Cantata can be used in the software life cycle to eliminate, reduce or automate some processes. The DO-178C/DO-330 qualification process ensures that *“the tool provides confidence at least equivalent to that of the process(es) eliminated, reduced, or automated”* [DO-178C section 12.2.1].

QA Systems believes that the Cantata Tool Qualification Kit provides all the necessary qualification data required for Software Tool qualification defined in DO-178C/DO-330 for Software Levels E to A. For details of the contents see Navigation of Tool Qualification Kit Data. All materials within the Cantata Tool Qualification Kit should be treated as qualification data.

The DO-330 describes the process and the related requirements for software tool qualification in the context of software development subject to DO-178C, and is therefore the main resource for this qualification guideline. To understand the qualification of Cantata as a COTS (Commercial off the shelf) tool, the chapters *“Qualifying COTS Tools”* [DO-330 section 11.3] and *“Tool Qualification Objectives”* [DO-330 ANNEX A] contain the necessary guidance.

DO-330 section 11.3 states:

“For COTS tools, the tool qualification activities are typically performed by two entities:

- *Tool developer: The entity that developed the tool.*
- *Tool user: The entity that uses the tool in the scope of a given software project.*

Activities are defined below for both the COTS tool developer and tool user in order to satisfy all of the tool qualification objectives. It should be noted that for TQL-5 qualification, objectives may be satisfied without any tool qualification data from the tool developer.”

The content of this document is thus centred on the requirements applicable to the COTS tool developer. The objectives of tool qualification are bound to a given Tool Qualification Level (TQL). The DO-178C details TQL levels of tools in the chapter *“Determining the Tool Qualification Level”* [DO-178C section 12.2.2]. Tools are ranked on the basis of three different criteria:

- *Criteria 1: A tool whose output is part of the airborne software and thus could insert an error*
- *Criteria 2: A tool that automates verification process(es) and thus could fail to detect an error, and whose output is used to justify the elimination or reduction of:*
 1. *Verification process(es) other than that automated by the tool, or*
 2. *Development process(es) that could have an impact on the airborne software.*
- *Criteria 3: A tool that, within the scope of its intended use, could fail to detect an error.*

Five levels from TQL-1 to TQL-5 are considered in conjunction with the three criteria described above and the software level (from A to D) and shown in Table 12-1 of DO-178C (see below).

<i>Software Level</i>	<i>Criteria 1</i>	<i>Criteria 2</i>	<i>Criteria 3</i>
<i>A</i>	<i>TQL-1</i>	<i>TQL-4</i>	<i>TQL-5</i>
<i>B</i>	<i>TQL-2</i>	<i>TQL-4</i>	<i>TQL-5</i>
<i>C</i>	<i>TQL-3</i>	<i>TQL-5</i>	<i>TQL-5</i>
<i>D</i>	<i>TQL-4</i>	<i>TQL-5</i>	<i>TQL-5</i>

⇒ **Cantata (including the Cantata Hybrid subset) is a Criteria 3 COTS tool and thus its qualification efforts are conducted at TQL-5 level.**

Process of Software Tool Qualification

This document explains the process of software tool qualification for projects working to the DO-178C/DO-330 standard and how tool qualification can be achieved for a specific version of Cantata in accordance with Chapter 12.2 of DO-178C, and further auditing guidance from 'A Practical Tutorial on Modified Condition/Decision Coverage' [[NASA/TM-2001-210876](#)].

The tool qualification needs to be conducted in liaison with the certification authority. The Plan for Software Aspects of Certification (PSAC) *"identifies the need for tool qualification according to the specific use of the tool in the software lifecycle process"* [DO-178C Section 9.0].

The main input submitted to the certification authority is the PSAC. The other documents being:

- Tool Qualification Plan (TQP)
- Tool Configuration Index (TCI)
- Tool Accomplishment Summary (TAS)
- Software Life Cycle Environment Configuration Index (SECI)
- Software Accomplishment Summary (SAS)

According to DO-178C chapter *"Tool Qualification Liaison Process"* [DO-178C Section 9.0], *for TQL-5, the TQP, TCI and TAS are not required*. Regarding the remaining documents:

- SECI *should also include references to the tool qualification data (Tool Operational Requirements and tool operational verification and validation data)* [DO-178C Section 9.0].
- SAS *should provide identification of the tools, details of the certification credit sought through tools us (that is the software process(es) to be eliminated, reduced or automated), reference to the tool qualification data* [DO-178C Section 10.1.16]

In the DO-330 section 1.6.2.5 dedicated to *"Tool Verification"*, it is indicated that *Objective 5 of Table T-0 states "Tool Operation complies with the Tool Operational Requirements" and corresponds to sections 12.2.2 of DO-178B ("complies with its Tool Operational Requirements under normal operating conditions.")*. This demonstration is documented in the Software Accomplishment Summary (SAS). Sufficient verification data are needed to demonstrate normal operation only. For verification tools those portions of the Tool Operational Requirements used directly in the setting up, conducting, monitoring, and reporting of verification need to be verified as part of tool qualification. For Cantata, this involves only the Core Components of the product as defined in the Quality Plan (QP) and specific versions of which are identified in the Cantata Software Issue Form (SIF) for the specific Cantata version i.e. it excludes the Ancillary Tools.

The chapter entitled *"Tool Qualification Process"* [DO-178C Section 12.2.3] states that *"objectives, activities, guidance, and life cycle data required for each Tool Qualification Level are described in DO-330"*. The following chapter of this document is dedicated to the determination of the objectives for the COTS tool developer and the data/components fulfilling them in the Cantata Qualification Kit.

Tool Developer Objectives and Cantata Qualification Kit Data

DO-330 ANNEX A named “*Tool Qualification Objectives*” contains ten tables (from T-0 to T-9) which summarize the objectives of DO-330 by *showing the applicability of each objective by TQL*.

There is an additional table named “Table 11-1” [DO-330 section 11.3.2] that summarizes the objectives applicable to the tool developer.

The cross-analysis of ANNEX A tables and Table 11-1 helps to determine the Tool Developer Objectives for TQL-5 COTS tools. Each objective specifies activities and documents, which are summarized in the table below along with the relevant Cantata qualification kit section.

DO-330 ANNEX A TABLE	DO-330 Objectives	DO-330 Activities / Output Documents	Cantata Qualification Kit Section
T-0 (Tool Operational Processes)	#2: Tool Operational Requirements are defined [section 5.1.1.a]	- Activities of sections 5.1.2a, 5.1.2b and 5.1.2c - Output is the “Tool Operational Requirements” described in section 10.3.1 (developer TOR)	1
	#5: Tool operation complies with the Tool Operational Requirements [section 6.2.1.b]	- Activity of section 6.2.2.c - Output documents are: • Tool Operational Verification and Validation Cases and Procedures [section 10.3.3] • Tool Operational Verification and Validation Results [section 10.3.4]	2
T-8 (Tool Configuration Management Process)	#1: Configuration items are defined [section 7.1.a]	- Activities of section 7.2.1 & 7.2.7 - Output consists of “Tool Configuration Management Records” [section 10.1.13]	3
	#4: Archive, retrieval and release are established [section 7.1.g]		

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DO-330 ANNEX A TABLE	DO-330 Objectives	DO-330 Activities / Output Documents	Cantata Qualification Kit Section
T-9 (Tool Quality Assurance Process)	#2: Assurance is obtained that tool processes comply with approved plans [section 8.1.a]	- Activities of sections 8.2.a, 8.2.c, 8.2.d, 8.2.f, 8.2.h, 8.2.i and 8.3 - Output consists of “Tool Quality Assurance Records or Software Quality assurance Records” [section 10.1.14]	4
	#5: Tool conformity review is conducted [section 8.1.d]		
T-10 (Tool Qualification Liaison Process)	#4: Impact of known problems on the Tool Operational Requirements is identified and analyzed [section 9.0]	- Activity of section 9.0.d - Output is the “Tool-specific information in SAS” [Section 10.1.16]	1.2

Cantata Qualification Kit mapping with Tool Developer objectives/documents for TQL-5 Qualification

The Cantata Tool Qualification Kit Overview document is sectioned according to the relevant sections above for a TQL-5 software tool and is produced for each version of Cantata. Additionally, this document provides QA Systems guidance on the use of that specific version of Cantata for DO-178C/DO-330 projects.

The following questions are covered this section of this document:

- > Does Cantata have complete detailed and verifiable operational requirements?
- > Are the Cantata operational requirements verified?
- > Are the Cantata operational requirements controlled?
- > Does Cantata have been developed and audited with an appropriate quality assurance process?
- > Are Cantata known problems identified, analysed and documented?

Tool qualification will entail an audit of:

- > The tool qualification data presented in this Tool Qualification Kit
- > An appropriate version Cantata Deployment Zip for each environment (normal operating conditions) on which the tool used is to be qualified. This zip file is generated by the Cantata deployment process for each environment, so not included within the Qualification Kit, and contains the following:
 - o Cantata build.txt installation file
 - o Registered tool configuration file sections (cantpp.cfg) and deployment header file <configuration_section_name>.h
 - o Registered Cantata Deployed Library
 - o Registered Cantata Deployment Report
- > Demonstration by the applicant that the use of Cantata has been in accordance with the appropriate version Cantata Safety Manual and supplied user documentation.

Submission of the tool qualification data

Previous sections of the Overview document identified relevant tool qualification data. This section deals with qualification data submittal and availability which comprises:

- > The tool qualification data presented in this Qualification Kit
- > The appropriate version Cantata Safety Manual
- > A Cantata Deployment Zip for each environment (normal operating conditions) on which the tool used is to be qualified. This zip file is generated by the Cantata deployment process for each environment, so not included within the Qualification Kit, and contains:
 - o Cantata build.txt installation file
 - o Registered tool configuration file sections (cantpp.cfg) and deployment header file <configuration_section_name>.h
 - o Registered Cantata Deployed Library
 - o Registered Cantata Deployment Report

Navigation of Tool Qualification Kit Data

Hyperlinks to all qualification data items within the Qualification Kit are provided directly or indirectly throughout the Cantata Tool Qualification Kit Overview (provided as part of the kit).

Questions Regarding Data in the Tool Qualification Kit

QA Systems believes that the Cantata Tool Qualification Kit provides all tool qualification data required to audit the tool and provide a comprehensive Tool Qualification Plan, Tool Accomplishment Summary and Tool Configuration Index for certification as a TQL-5 COTS Tool for use on a DO-178C/DO-330 project.

Questions regarding the content of the Tool Qualification Kit may be submitted to QA Systems in writing via email (info@qa-systems.com). QA Systems will use commercially reasonable efforts to reply to any such questions relating to data within the Tool Qualification Kit.

Extending the Audit Beyond the Tool Qualification Kit

QA Systems believes that the Cantata Tool Qualification Kit provides all the necessary qualification data required for tool qualification to DO-178C/DO-330.

If, however, it is deemed that an audit requires access to any tool data, records or information not contained in the Cantata Tool Qualification Kit, QA Systems offer a Site Audit at QA Systems for a fee.

This Site Audit comprises:

- > Audit conducted at QA Systems offices in Bath, United Kingdom
- > QA Systems staff involved will be:
 - o Technical Director
 - o Cantata technical staff (as required)
- > Auditors may include:
 - o Certification applicant (Cantata End User)
 - o Separate Designated Engineering Representative (DER) if involved
 - o Project customers
 - o Representation of the certification authority
- > Records which may be inspected at QA Systems include:
 - o QA Systems Quality Management System documents
 - o Design documents for the appropriate version of Cantata
 - o Source code files for the appropriate version of Cantata
 - o System Acceptance Test code files and Extra Test code files for the appropriate version of Cantata
 - o QA Systems Technical Support Procedures (TSP) and records applicable to the appropriate version of Cantata
- > QA Systems will use commercially reasonable efforts to reply to any post visit Site Audit questions for up to one month.

The Audit Fee is a price list item, please contact your supplier to obtain pricing and arrange a Cantata Site Audit. A four (4) week notice period is required for a Cantata Site Audit.

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