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## **Product brief**

## **RapiCover Tool Qualification for DO-178C**

Tool qualification is essential in the development of critical embedded systems, and should be a key consideration from the earliest stages of DO-178C projects.

Our comprehensive tool qualification solution provides the resources and expertise you need to qualify Rapi**Cover** for use in DO-178C projects. Adopting our approach to qualification early on in your development process means you will benefit from:

- Early access to our expertise and experience in defining advanced tool workflows, and communicating with certification authorities.
- Comprehensive documentation and support that allows you to refine your qualification workflows and evidence ahead of time, as well as coordinate with your certification authority to reduce potential delivery delays.
- A flexible, collaborative approach to qualification that works for your project and organization and reduces costs and effort.

For background information on DO-178C and its objectives, see *About DO-178C and tool qualification* on the next page.

## **Qualification Kit**

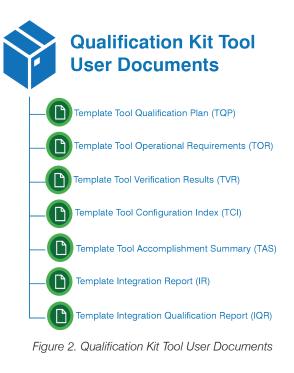
A Qualification Kit is a comprehensive documentation package that provides evidence that Rapi**Cover** meets the guidance given in DO-330 for commercial off-the-shelf (COTS) products. Our Qualification Kits include two sets of documents: Developer Documents and Tool User Documents. They also include checklists against which to check your compliance with DO-330 tool user objectives.

Developer Documents contain DO-330 tool qualification evidence, including a summary of the requirements, test plans and test results demonstrating that Rapi**Cover** complies with its requirements as per DO-178C (Figure 1 right).

Tool User Documents are template versions of documents that must be provided by a tool user to support their qualification of a COTS tool (Figure 2 right). These are pre-filled with crossreferences to our Developer documents, further reducing the effort needed to complete your DO-330 tool qualification evidence.

The documentation and processes we use to produce our Qualification Kits for Rapi**Cover** follow the guidance in DO-330 for a TQL-5 COTS tool. DO-330 complements DO-178C by providing specific guidance for tool qualification, and defines the Tool Qualification Levels (TQL) 1-5.





## **Qualified Target Integration Service**

To meet DO-178C guidance, you must provide evidence (in addition to our Qualification Kit documents) showing that the tool has been correctly installed and integrated into your specific development and target environment. To support you in this, we also offer a *Qualified Target Integration Service*.

Our Qualified Target Integration Service is delivered by Rapita Field Application and Software Quality Assurance experts, and includes comprehensive reporting, tests and expected results demonstrating that the integration works correctly.



Figure 3. Qualified Target Integration Service

Combined with the documentation provided in our Qualification Kits, the materials generated during the Qualified Target Integration Service complete the evidence you need for tool qualification.

## Delivery process

A Qualified Target Integration Service is delivered in three stages, as shown in Figure 4:

- Preliminary assessment
- Testing and interim reporting
- Final delivery

**Note:** See the *RapiCover Tool Qualification for DO-178C Order Information sheet* for a more detailed version of this process, including key milestones and responsibilities.

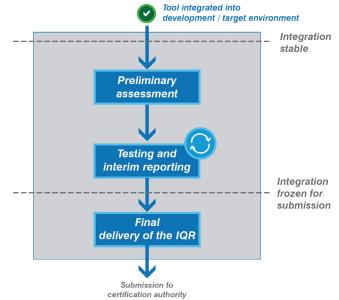
## Preliminary assessment

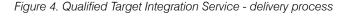
Rapita engineers review your integration and produce:

- A repro: An in-house integration that replicates your instrumentation and export settings as closely as possible.
- On-site tests: A suite of tests that exercise the integration in your specific build and target environment.
- A test oracle, which shows the expected output of the tests when run on your configuration.
- Preliminary Integration Qualification Report (IQR): A report which documents any issues that may affect the qualification of the tool.

## Testing and interim reporting

Rapita engineers work with you to configure your integration and obtain correct results from the onsite tests. During this





stage, we may produce one or more iterations of the IQR and the onsite tests. The number of iterations, and the length of time it takes to reach the final stage, depends on the complexity of your integration and whether your configuration changes during the process. Before moving to the final stage, your integration is frozen for submission, so no more changes can be made to it.

## Final delivery

We deliver the final version of the Qualified Target Integration Service deliverables, including the final IQR.

## About DO-178C and tool qualification

DO-178C contains guidelines that deal with safety-critical software in airborne systems. Certification authorities (including the FAA in the US, and EASA in Europe) use DO-178C to assess these software systems.

According to DO-178C, you must qualify the software tools used in your project if:

- The tool could potentially insert an error or fail to detect an existing error.
- The tool's output will not be verified or confirmed by another verification activity.
- Processes necessary for certification are eliminated, reduced or automated by the tool.

You are responsible for qualifying the software tools you use in DO-178C projects. This means you have to provide detailed evidence not only that the tools meet their functional and robustness requirements, but also that they have been correctly integrated into your development and target environment.

Our Qualification Kits, along with our expert Qualified Target Integration Service, reduce the costs and effort required throughout the process.

## **Qualification options**

We offer a flexible qualification approach for Rapi**Cover**, as shown in Table 1 below. We recommend you choose our comprehensive qualification solution (Option 5); however you may choose to undertake some of the qualification work yourself.

We can only provide a Qualified Target Integration Service if we have first integrated Rapi**Cover** into your development and target environment, via a Target Integration Service (TIS). See the *Target Integration Product Brief* for more information.

If you have undertaken the target integration work yourself, contact us to discuss your options.

				DUDITS	
		ТооІ		Qualification	
		Rapi <b>Cover</b> tool	Target Integration Service	Rapi <b>Cover</b> Qualification Kit	Qualified Target Integration Service
Option 1	Provided by:	Rapita	Customer	Customer	Customer
Option 2		Rapita	Rapita	Customer	Customer
Option 3		Rapita	Customer	Rapita	Customer
Option 4		Rapita	Rapita	Rapita	Customer
Option 5		Rapita	Raipta	Rapita	Rapita

#### Table 1. Qualification options

## Key features

## Clear qualification guidance

Our qualification kits include clear guidance on what to do during your tool qualification, including a qualification timeline.

Timeline of Activities
- Before Qualification
<ul> <li>identify whether you need to qualify ReciEnser</li> <li>Beview licensing options</li> </ul>
<ul> <li>Beview the assurance case, oualification scope, functional limitations, and the conditions of use</li> <li>Bit out the Tool Qualification Quastionneirs and return it to Repta Systems<sup>12</sup></li> </ul>
> Align integration qualification and approval submission timelines
- Tool Integration
$\geq$ Use our integration Report Template to document the integration $^{\rm III}$
Assessing the Custom Integration
Review the list of analysis and test orbina for integration scripts and libraries <sup>12</sup>
> Use our integration Qualification Report Template to document your analysis and testing. <sup>1</sup>
- Reviewing For Compliance
> Use our DO-330 tool developer compliance checklist #
Beview the list of open problem reports <sup>1</sup>
> Bevisit the qualification scope, functional limitations, and conditions of use
- Creating DO-330 Tool User Documentation
> Use our ore-loaded template documents to start your tool user documentation
> Use our one-loaded checklist to document addressing tool problems and limitations <sup>®</sup>
> Use our ore-loaded template to add tool qualification information to your DD-1780 documentation set
Use our DO-330 tool user compliance checklist <sup>2</sup>
- Submit for Approval
Process complete!

Figure 5. Qualification timeline

## Compliance checklists

Checklists are included in our qualification kits that help you check your compliance with DO-330 tool user objectives in each step from planning to approval.

#### Table T-0 - Tool Operational Processes

Objective	Details	Completion
T-0:1 The tool qualification need is established.	{{See developer TQP [QD/C1C/TQP 3.14] section 6 "Qualification Considerations."}}	
T-0:2 Tool Operational Requirements are defined.	{{Cross-reference developer TOR [QD/C1C/TQP 3.14] for individual requirements.}}	
T-0:3 Tool Executable Object Code is installed in the tool operational environment.	{{Cross-reference to the Integration Report.}}	
T-0:6 Tool Operational Requirements are correct and sufficient.	{{Reference your criteria. Also use TQS [QD/C1C/TQS 3.14] to scope the review.	
T-0:7 Software life cycle needs are met by the tool.	{{See developer TQP [QD/C1C/TQP] section 6 "Qualification Considerations.}}	

Figure 6. Compliance checklists help you check your compliance progress

#### Tool User Documents

Template Tool User Documents reduce the effort needed to develop your DO-330 tool user documents for Rapi**Cover** qualification. These are pre-filled with cross-references to Rapi**Cover** DO-330 Developer documents in the Qualification Kit.

	Tool Operational Requirements
<ten own o</ten 	plate Note: Tool user should refine these descriptions with further details and references to their speciares. >
The to	ol operational processes for RapiCover include:
ł	Establishing the tool qualification need Providing a TOR that supplements the developer-TOR (QDIC 18/TOR) Installation of Tool Discussible Object Code in the tool operational environment - Refer to IOF:
- 84	no use-TOR -
6.2	Tool Verification and Validation Process
fapiC	over verification activities are the following:
ł	Review of the tool configuration against (301C18/T00) otheria and (301C18/T03) scope. Execution of an-abit tests. Comparing the results of the above execution with the expected results. Archining the set insults.
Tool s qualifi	enflication will be completed before using the tool for the project integration and as part of the cation process.
6,3	Tool Quality Assurance Process
These	ol quality assurance process will be conducted in accordance with DO-330.
rente	plate Note: The steps in the quality assurance process as followed in the organisation can be ned here. This can include the audit performed by SGA, methods of reporting non compliance, ing qualification data provided by Rapita, performing review of the qualification antilacts provided to 4 etc
Tool C	sality Assurance Process for RapiCover shall include:
Tool C	sality Assurance Process for RapiCover shall include: Assurance is obtained that the tool processes comply with approved plans Canducting tool contamity review
	Assurance is obtained that the tool processes comply with approved plans
6,4	Assurance is obtained that the tool processes comply with approved plans Conducting tool conformity review
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Figure 7. Tool user documents

#### Streamlined qualification material

The documentation, requirements and tests included in our qualification kits are custom depending on your specific development environment, helping you minimize your review effort.

#### Qualified instrumenters

The instrumenters used by R**VS** tools are qualified, so there's no need to manually qualify them.

## Assurance issue notification

We notify you when we discover any assurance issues that might cause false positive results or introduce functional changes to your software. We keep you updated with the status of assurance issues regularly.

ANNOUNCED DATE: TRIDAY, DECEMBER 6, 2019
Tracking number: x180801
Status: Resolved
Fixed in: RVS 3.10 Products and versions affected:
Products and versions affected: RapiCover product
Versions of RVS from 3.2 up to 3.9 and all versions of RPF are affected
Profiles that include function exits (COV_178_DAL_A, COV_MIDC, COV_FUNCTION_EXITS) COV_178_DAL_B and COV_DECISIONS with -
instr-CASTIO-literal)
C, C++, Ada (all versions)
Summary of circumstances where the issue appears:
Unreachable explicit returns
Problem report:
The return statement explicitly exits from a subprogram. The end of the subprogram is an implicit return. If there is an explicit return, we hide
the unreachable implicit return. If there are unreachable explicit returns, this is usually an error in the code and needs to be addressed.
RapiCover should mark these as potential exits, even though they are normally unreachable. In the affected versions, it fails to report the
unreachable explicit return.
Example:
code:
wold test3(int A) (
r@Curly
my_dedt();
réfurit
}
export:
/ (J - justified, j - inherited justification)
/ / Functions (f = covered   F = not covered)
<pre>/ / / Function exits (x = covered   X = not covered) / / / / Calls (c = covered   C = not covered)</pre>
/////calls (c = covered   c = not covered) ///// Statements (s = covered   5 = not covered)
///// MCDC (n - covered   N - not covered)
/ / / / / / / Details (* - missing MC/DC condition)
////// */ 19  F    void test3(int à) {
21         ?   ?   = =y_esit() /
22         ?   #etueny
23             ]
In this example, the instrumenter fails to identify that the unreachable explicit return at line 22 requires function exit coverage. Thus RapiCover
does not report "Function exits" in the third column at line 22 as shown in the export.
Recommendation:
If you suspect that your source code and integration are affected, or are in any doubt:
We recommend manual analysis of unreachable explicit returns.
Upgrade to RVS 3.10 or later.
Upgrade to KVS 3.10 or later.

Figure 8. Example assurance issue



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