

DO Qualification Kit

User's Guide

R2012b

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DO Qualification Kit User's Guide

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Revision History

| | | |
|----------------|-------------|------------------------------------------------------------|
| March 2009 | Online only | New for Version 1.0 (Applies to Releases 2008b, 2009a) |
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Product Description

Qualify Simulink® and Polyspace® verification tools for DO-178 and DO-278

DO Qualification Kit provides documentation, test cases, and procedures that let you qualify Simulink and Polyspace software verification tools for projects based on DO-178C, DO-278A, and related supplements. The kit contains tool qualification plans, tool operational requirements, and other materials required for qualifying software verification tools. With the kit, you can streamline certification of embedded systems developed using supported Simulink and Polyspace products.

Tool qualification kits are available for specific versions of Simulink and Polyspace verification tools based on DO-330, Software Tool Qualification Considerations. You can modify the artifacts in the tool qualification kit for your specific project and include them in the DO-178C and DO-278A certification packages submitted for certification.

Key Features

- Tool Qualification Plan and Tool Operational Requirements documents
- Test case models and code, test procedures, and expected results
- Traceability matrix generation covering requirements, models, and generated code
- Qualification materials for Simulink verification, validation, and test tools
- Qualification materials for Polyspace code verification tools
- Artifacts explorer for navigating and viewing artifacts for each supported product
- Checks for tool-associated bug reports

What Is Software Tool Qualification for DO-178C and DO-278A?

Software that is included in avionic systems must be certified by meeting objectives of the DO-178C standard. Software that is included in ground- or space-based systems must be approved by meeting objectives of the DO-278A standard. Both of these standards reference DO-330 as the means to qualify software tools. To achieve credit for the use of a tool in the certification of an avionic system or approval of a ground- or space-based system, you must qualify that tool if the output of the tool is not verified. The DO Qualification Kit product provides resources for qualifying MathWorks® software verification tools. The tool user (not the tool vendor) is responsible for the qualification.

For guidance on how to use the DO Qualification Kit product to qualify MathWorks software verification tools, see “Qualification Process” on page 2-2.

For information on criteria used to determine whether a tool needs to be qualified, and the determination of the tool qualification level, see the “Requirement for Qualification” section of the Tool Qualification Plan for the relevant MathWorks verification tool.

Can You Apply the DO Qualification Kit Product to Other DO Standards?

DO-254

You can use the DO Qualification Kit product to qualify verification tools for projects that follow DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*. The process for tool qualification is described in Section 11.4 of DO-254. The following verification tool capabilities are applicable to DO-254 projects:

- Simulink Verification and Validation™ — DO-178C/DO-331 checks
- Simulink Verification and Validation — Model coverage
- Simulink Report Generator™ — System Design Description report
- SystemTest™ — Limit Check element

To take credit for DO-254 for the verification tool capabilities that are applicable to your project, modify references to DO-178C to refer to the applicable sections of DO-254. For example, modify references to DO-178C Section 12.2 to refer to DO-254 Section 11.4. The following tables list the items to modify and what files correspond to these items.

Simulink Verification and Validation Verification Tool

| Item to Modify | File |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Document templates | qualkitdo_slvvn_tqp.docx qualkitdo_slvvn_tor.docx qualkitdo_slvvn_tcpr.docx |
| Test cases, procedures, and results | qualkitdo_slvvn_tcpr1.xls* qualkitdo_slvvn_tcpr2.xls qualkitdo_slvvn_tcpr3.xls qualkitdo_slvvn_tcpr4.xls qualkitdo_slvvn_tcpr5.xls qualkitdo_slvvn_tcpr6.xls |

*The Model Advisor checks **Check safety-related optimization settings** and **Check safety-related code generation settings** are not applicable

Simulink Verification and Validation Verification Tool (Continued)

| Item to Modify | File |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| to DO-254. In <code>qualkitdo_slvvn_tcpr1.xls</code> , delete the rows corresponding to these checks. After deleting the rows, when you generate the report using <code>qualkitdo_slvvn_tcpr1.rpt</code> , the report does not include these two checks. Therefore, the report you generate does not match the example report <code>qualkitdo_slvvn_qualificationreport1.html</code> . | |

Simulink Report Generator Verification Tool

| Item to Modify | File |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Document templates | <code>qualkitdo_rptgenext_tqp.docx</code> <code>qualkitdo_rptgenext_tor.docx</code> <code>qualkitdo_rptgenext_tcpr.docx</code> |

SystemTest Verification Tool

| Item to Modify | File |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Document templates | <code>qualkitdo_systemtest_tqp.docx</code> <code>qualkitdo_systemtest_tor.docx</code> <code>qualkitdo_systemtest_tcpr.docx</code> |
| Test cases, procedures, and results | <code>qualkitdo_systemtest_tcpr.test</code> |

DO Qualification Kit Components

| In this section... |
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| “Model-Based Design Workflow for DO-178C” on page 1-6 |
| “Supported MathWorks Software Verification Tools” on page 1-7 |
| “Simulink® Verification and Validation™ Product” on page 1-8 |
| “Simulink® Report Generator™ Product” on page 1-8 |
| “Simulink® Code Inspector™ Product” on page 1-9 |
| “Qualification Documents for Polyspace Products for C/C++” on page 1-10 |
| “SystemTest Product” on page 1-11 |

To view the document templates, test cases, and test procedures that are part of the DO Qualification Kit product, use the Certification Artifacts Explorer. Artifacts included in the kit are not accessible from the MathWorks web site. For more information, see “Artifact Management”.

Model-Based Design Workflow for DO-178C

The DO-178C software life cycle consists of objectives that must be met for each of the life cycle stages. In Annex A of DO-178C, these objectives are summarized in tables. The *DO Qualification Kit Model-Based Design Workflow for DO-178C* document summarizes those tables and provides recommendations on meeting the objectives using a Model-Based Design process.

The workflow document is in the following folder:

```
matlabroot/toolbox/qualkits/do/
```

The following table lists available workflow documents.

| Workflow Document | File |
|-----------------------------------------|------------------------|
| Model-Based Design Workflow for DO-178C | qualkitdo_workflow.pdf |

Supported MathWorks Software Verification Tools

The DO Qualification Kit product includes document templates, test cases, and test procedures that you need to qualify the following MathWorks software verification tools:

- Simulink Verification and Validation (DO-178C/DO-331 checks; model coverage)
- Simulink Report Generator (System Design Description report)
- Simulink Code Inspector™ (Code inspector report)
- Polyspace Client™ for C/C++; Polyspace Server™ for C/C++
- SystemTest (Limit Check element)

Note By qualifying the model coverage capability of the Simulink Verification and Validation product, you can claim credit for demonstrating completeness and adequacy of the test cases generated by Simulink Design Verifier™. Use the model coverage capability instead of reviewing the Simulink Design Verifier report. You can demonstrate completeness and adequacy by running the generated test cases against the model, measuring the model coverage, and reviewing the model coverage report. You can run the test cases on the executable object code and compare the actual results to the simulation results. The model coverage capability does not assess the adequacy of the simulation results, only the test case coverage of the model. Therefore, you must verify that the expected results from the model are acceptable.

In addition to this documentation, the DO Qualification Kit product consists of the qualification documents described in the following sections. The qualification documents are located in your MATLAB® installation folder at *matlabroot/toolbox/qualkits/do*. Although the kit contains the documents and tests that you need to qualify the supported tools, you must determine how to apply the documents and tests to your specific project or application.

Refer to the PDF version of a qualification document to become familiar with the qualification process and the required content. To customize the qualification documents for your specific project or application, modify the DOCX versions.

Simulink Verification and Validation Product

The DO Qualification Kit product supports qualifying the following versions and features of the Simulink Verification and Validation verification tool:

- Version 3.4 (R2012b): DO-178C/DO-331 checks
- Version 3.4 (R2012b): Model coverage

Document templates, test cases, and test procedures are in the following folder:

`matlabroot/toolbox/qualkits/do/slvnv/r2012b/`

The following table lists qualification documents, and the primary files associated with the qualification documents.

| Qualification Documents | Files |
|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tool Qualification Plan (TQP) | qualkitdo_slvnv_tqp.pdf qualkitdo_slvnv_tqp.docx |
| Tool Operational Requirements (TOR) and supporting documentation | qualkitdo_slvnv_tor.pdf qualkitdo_slvnv_tor.docx qualkitdo_slvnv_ma_ui.pdf qualkitdo_slvnv_mc_ui.pdf |
| Test Cases, Procedures, and Results (TCPR), and supporting documentation | qualkitdo_slvnv_tcpr.pdf qualkitdo_slvnv_tcpr.docx qualkitdo_slvnv_tcpr*.rpt qualkitdo_slvnv_tcpr*.xls tests/*.slx outputs/ qualkitdo_slvnv_qualificationreport*.html |

Simulink Report Generator Product

The DO Qualification Kit product supports qualifying the following version and feature of the Simulink Report Generator verification tool:

Version 3.13 (R2012b): System Design Description report

Document templates, test cases, and test procedures are in the following folder:

`matlabroot/toolbox/qualkits/do/rptgenext/r2012b/`

The following table lists qualification documents, and the primary files associated with the qualification documents.

| Qualification Documents | Files |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tool Qualification Plan (TQP) | qualkitdo_rptgenext_tqp.pdf qualkitdo_rptgenext_tqp.docx |
| Tool Operational Requirements (TOR) and supporting documentation | qualkitdo_rptgenext_tor.pdf qualkitdo_rptgenext_tor.docx qualkitdo_rptgenext_sdd_ui.pdf |
| Test Cases, Procedures, and Results (TCPR), and supporting documentation | qualkitdo_rptgenext_tcpr.pdf qualkitdo_rptgenext_tcpr.docx qualkitdo_rptgenext_tcpr.rpt outputs/ qualkitdo_rptgenext_qualificationreport.pdf qualkitdo_rptgenext_qualificationreport_*.html qualkitdo_rptgenext_qualificationreport_*.doc qualkitdo_rptgenext_qualificationreport_*.docx qualkitdo_rptgenext_qualificationreport_*.pdf |

Simulink Code Inspector Product

The DO Qualification Kit product supports qualifying the following version and feature of the Simulink Code Inspector verification tool:

Version 1.2 (R2012b): Code inspection report

Document templates, test cases, and test procedures are in the following folder:

`matlabroot/toolbox/qualkits/do/slci/r2012b/`

The following table lists qualification documents, and the primary files associated with the qualification documents.

| Qualification Documents | Files |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tool Qualification Plan (TQP) | qualkitdo_slci_tqp.pdf qualkitdo_slci_tqp.docx |
| Tool Operational Requirements (TOR) and supporting documentation | qualkitdo_slci_tor.pdf qualkitdo_slci_tor.docx qualkitdo_slci_ui.pdf |
| Test Cases, Procedures, and Results (TCPR), and supporting documentation | qualkitdo_slci_tcpr.pdf qualkitdo_slci_tcpr.docx qualkitdoSlciTraceMatrix.xlsx qualkitdoSlciRunTests.m qualkitdoSlciRunTests.rpt qualkitdoSlciRunTests.xlsx tests/ *.slx *.m *.mat outputs/ qualkitdoSlciQualificationReport_*.html |

Qualification Documents for Polyspace Products for C/C++

The DO Qualification Kit product supports qualifying the following version and feature of Polyspace code verification tools:

Version 8.4 (R2012b): Polyspace Client for C/C++; Polyspace Server for C/C++

Document templates, test cases, and test procedures are in the following folder:

`matlabroot/toolbox/qualkits/do/polyspace/r2012b/`

The following table lists qualification documents, and the primary files associated with the qualification documents.

| Qualification Documents | Files |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Theoretical Foundation (TF) | qualkitdo_polyspace_tf.pdf qualkitdo_polyspace_tf.docx |
| Tool Qualification Plan (TQP) | qualkitdo_polyspace_tqp.pdf qualkitdo_polyspace_tqp.docx |
| Tool Operational Requirements (TOR) | qualkitdo_polyspace_tor.pdf qualkitdo_polyspace_tor.docx |
| Tool Development and Verification Process Considerations (PROC) | qualkitdo_polyspace_proc.pdf qualkitdo_polyspace_proc.docx |
| Tests Cases, Procedures, and Results (TCPR), and supporting documentation | qualkitdo_polyspace_tcpr.pdf qualkitdo_polyspace_tcpr.docx Matrix_*.txt tests/qualkitdo_polyspace_tcpr.* tests/tor-checks/tor-checks.txt tests/**_rules.txt tests/**/*.c tests/**/*.cpp outputs/ qualkitdo_polyspace_qualificationreport_*.txt qualkitdo_polyspace_qualificationreport_summary.pdf |

SystemTest Product

The DO Qualification Kit product supports qualifying the following version and feature of the SystemTest verification tool:

Version 2.6.4 (R2012b): Limit Check element

Document templates, test cases, and test procedures are in the following folder:

`matlabroot/toolbox/qualkits/do/systemtest/r2012b/`

The following table lists qualification documents, and the primary files associated with the qualification documents.

| Qualification Documents | Files |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tool Qualification Plan (TQP) | qualkitdo_systemtest_tqp.pdf qualkitdo_systemtest_tqp.docx |
| Tool Operational Requirements (TOR) and supporting documentation | qualkitdo_systemtest_tor.pdf qualkitdo_systemtest_tor.docx qualkitdo_systemtest_lc_ui.pdf |
| Test Cases, Procedures, and Results (TCPR), and supporting documentation | qualkitdo_systemtest_tcpr.pdf qualkitdo_systemtest_tcpr.docx qualkitdo_systemtest_tcpr.test outputs/qualkitdo_systemtest_tcpr_report/ qualkitdo_systemtest_qualificationreport.html |

What Certification Credit Can Be Achieved?

For a list of areas of the DO-178C standard for which some certification credit (meet or replace DO-178C objectives) can be achieved by qualifying MathWorks verification tools, see the “Certification Credit” section of the Tool Qualification Plan for the relevant tool. The amount of credit that can be achieved is dependent upon the development processes used and how verification tools are applied within the processes.

Required Knowledge

Before using the DO Qualification Kit product, make sure that you have:

- Knowledge about developing safety-critical software.
- Knowledge of DO-178C, Software Considerations in Airborne Systems and Equipment Certification, DO-331 Model-Based Development and Verification Supplement to DO-178C and DO-278A, or DO-254, Design Assurance Guidance for Airborne Electronic Hardware.
- Experience using features of MathWorks verification tools that you want to qualify (and related required software, such as MATLAB and Simulink):
 - Simulink Verification and Validation (DO-178C/DO-331 checks, model coverage)
 - Simulink Report Generator (System Design Description report)
 - Simulink Code Inspector (Code inspection report)
 - Polyspace Client for C/C++, Polyspace Server for C/C++
 - SystemTest (Limit Check element)

Also, become familiar with the following information:

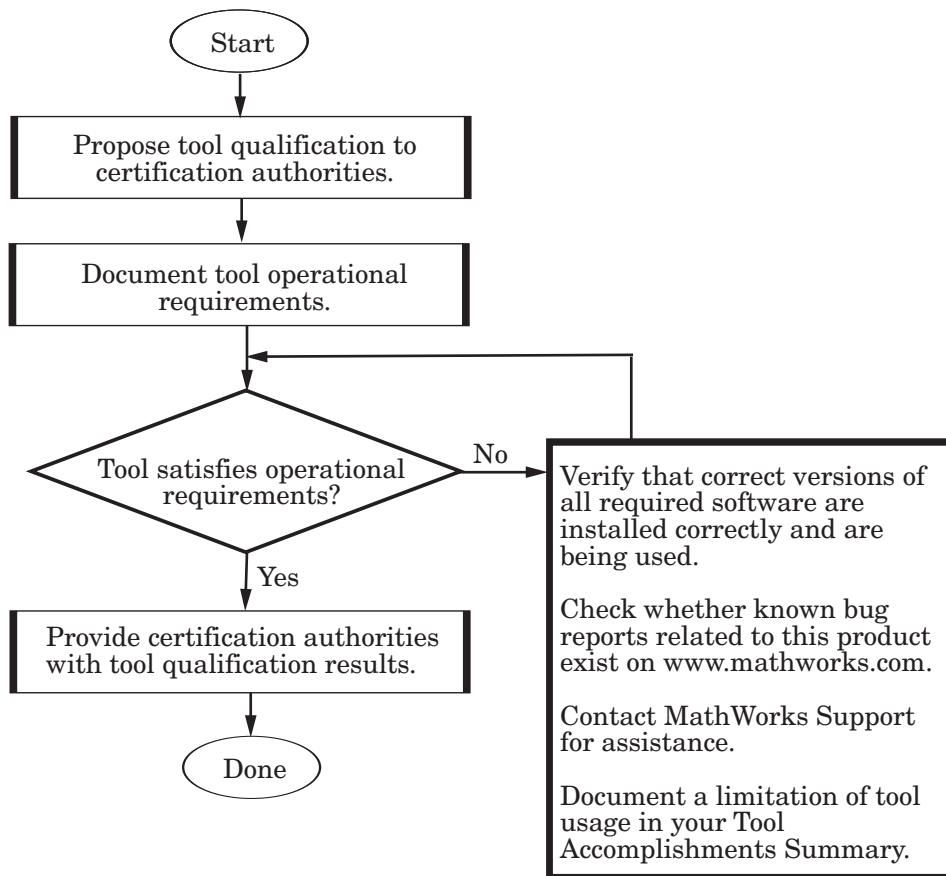
- “High-Integrity System Modeling” in the Simulink documentation.
- If you have a Embedded Coder™ license, “DO-178C Standard” in the Embedded Coder documentation.

Tool Qualification

- “Qualification Process” on page 2-2
- “Propose Tool Qualification Plan to Certification Authorities” on page 2-4
- “Document Tool Operational Requirements” on page 2-6
- “Verify That the Tool Satisfies Tool Operational Requirements” on page 2-7
- “Provide Certification Authorities with Tool Qualification Results” on page 2-9

Qualification Process

- 1 Provide certification authorities with a tool qualification plan.
- 2 Document tool operational requirements.
- 3 Verify that the tool satisfies tool operational requirements and define limitations and restrictions of the tool.
- 4 Provide certification authorities with tool qualification results, including limitations and restrictions.



Note The `rights.txt` file, located at `matlabroot/toolbox/qualkits/do`, describes allowed uses of the MathWorks DO Qualification Kit product.

Propose Tool Qualification Plan to Certification Authorities

The first step of the qualification process is to propose a Tool Qualification Plan to the DO-178C certification authorities. To propose a Tool Qualification Plan, complete the following steps for each tool that you plan to qualify:

- 1** Identify a MathWorks software verification tool that you plan to qualify.
- 2** Locate the PDF version of the Tool Qualification Plan document provided for the tool in the DO Qualification Kit product. Review the document for applicability to your project.
- 3** Locate and make a copy of the .docx Tool Qualification Plan template file for that tool.

The Tool Qualification Plan provides the following information:

- Introduction
 - Title and version of the Tool Operational Requirements (TOR)
 - Certification considerations — basis for qualifying the tool and objectives for which you are seeking certification credit
 - Tool development lifecycle — planning, requirement documents and activity, verification documents and activity
 - Tool lifecycle data — mapping of application documents to the DO-178C process lifecycle
 - Qualification schedule
- 4** Edit the template, as required for your application, and make the document available for review. This typically includes adding the following information:
 - In the table located in “Tool Lifecycle Data”, where indicated, references to the documents:
 - Plan for Software Aspects of Certification (PSAC)
 - Software Accomplishment Summary (SAS)
 - Tool Qualification Accomplishment Summary (TQAS)
 - Tool qualification schedule located in a section titled “Schedule”

- 5** Add a reference to the tool that you are qualifying and justification why the tool requires qualification to the application PSAC, indicating your intent to use the verification tool.
- 6** Submit the PSAC to the certification authorities. If you want, you can also submit the Tool Qualification Plan with the PSAC. These documents inform the certification authorities of your intent to use a tool and initiates a dialog regarding your plans for certification.

After you complete this procedure, document the Tool Operational Requirements, as described in “Document Tool Operational Requirements” on page 2-6.

Document Tool Operational Requirements

After you propose a Tool Qualification Plan to certification authorities, develop a Tool Operational Requirements document. To do this, complete the following steps for each tool that you plan to qualify:

- 1** Locate the PDF version of the Tool Operational Requirements document provided for the tool in the DO Qualification Kit product, and review the document for applicability to your project.

The Tool Operational Requirements document provides the following information:

- Introduction
 - Operational requirements — description of the functionality of the tool and how it is used
 - Installation information
 - Operational environment
- 2** Install and configure the required software in your project configuration management system, as cited in the Tool Operational Requirements document.
 - 3** Locate and make a copy of the .docx Tool Operational Requirements document template file for the tool.
 - 4** Edit the template, as required for your application, and make the document available for review by certification authorities.

After you complete this procedure, verify that the tool satisfies Tool Operational Requirements, as described in “Verify That the Tool Satisfies Tool Operational Requirements” on page 2-7.

Verify That the Tool Satisfies Tool Operational Requirements

After you document the Tool Operational Requirements, verify that the tool satisfies the Tool Operational Requirements. To do this, complete the following steps for each tool that you plan to qualify:

- 1** Locate the PDF version of the Test Cases, Procedures, and Results (TCPR) document provided for the tool in the DO Qualification Kit product, and review the test cases and procedures described in the document for applicability to your project.

The Test Cases, Procedures, and Results document provides the following information:

- Introduction
- Description of test cases and procedures
- Traceability matrix between operational requirements and test cases and procedures
- Procedure for executing the test cases and procedures
- Test results

- 2** Locate and make a copy of the .docx Test Cases, Procedures, and Results document template file for the tool.
- 3** Edit the test cases and procedures sections of the template, as required for your application, and finalize the document. For example, you might need to modify content in the Expected Result column of the table in the traceability matrix.
- 4** Locate and configure the test cases and procedures in your project configuration management system.
- 5** Execute the test cases and procedures in the installed and configured environment. For more information, see “Executing the Test Cases and Procedures” in the Test Cases, Procedures, and Results document for the verification tool you are qualifying.
- 6** Review the test results. If the results are not expected:

- Verify that you correctly installed and are using the specified versions of all required MathWorks software.
 - Check whether known bug reports related to this product exist on the MathWorks Web site (www.mathworks.com).
 - Contact MathWorks support for assistance.
 - Document a limitation of the tool usage in your Tool Accomplishments Summary if you cannot resolve the test failure.
- 7** Configure the test results in your project configuration management system.

After you complete this procedure, document and provide the results to certification authorities, as described in “Provide Certification Authorities with Tool Qualification Results” on page 2-9.

Provide Certification Authorities with Tool Qualification Results

After you verify whether the tool satisfies tool operational requirements, complete the following steps for each tool that you are qualifying.

- 1** Document the test results in a Tool Accomplishment Summary.
- 2** Add an entry that summarizes the results of the tool qualification to the Software Accomplishment Summary (SAS). You can also submit the Tool Accomplishment Summary with the SAS.
- 3** Submit the SAS to the certification authorities so that they can approve the results. The data can provide a record of the qualification status of the tool.

Access and Manage Qualification Artifacts

- “Access Artifacts Using the Certification Artifacts Explorer” on page 3-2
- “Manage Artifacts Using the Certification Artifacts Explorer” on page 3-4
- “Delete Certification Packages from the Certification Artifacts Explorer” on page 3-6
- “Certification Artifacts Explorer Limitations” on page 3-7

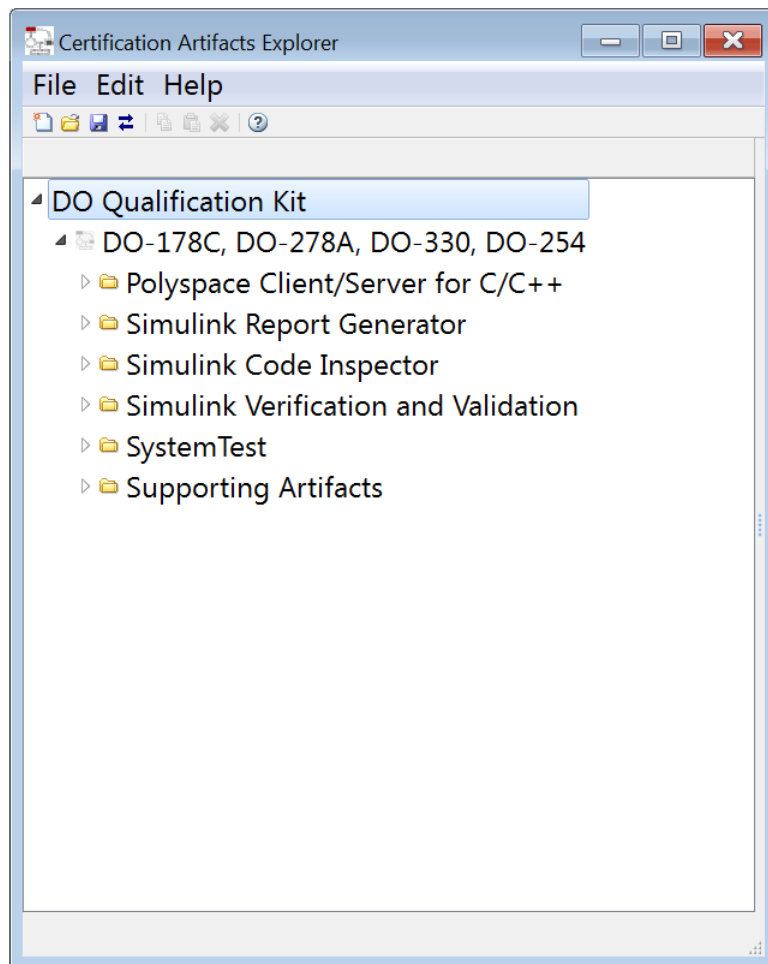
Access Artifacts Using the Certification Artifacts Explorer

You can use the Certification Artifacts Explorer to access qualification artifacts. To start the Certification Artifacts Explorer, use one of the following methods.

| To start the Certification Artifacts Explorer... | Do this: |
|---------------------------------------------------------|--------------------------------|
| From the MATLAB command line | Enter <code>qualkitdo</code> . |

The Certification Artifacts Explorer window displays the qualification artifacts that are available with the DO Qualification Kit product. If the DO Qualification Kit product contains artifacts for more than one release, the Certification Artifacts Explorer lists the artifacts for each release. As you select folders and files, relevant information about the current selection is dynamically displayed in the status bar. Additionally,

- To display the properties of a certification package, right-click the package name and select **Properties**.
- To open an artifact, right-click the artifact and select **Open File**.
- Other right-click actions might be available depending on the type or state of an artifact, including **Copy**, **Paste**, **Delete**, **Open Folder**, and **Generate Traceability Matrix**.



Manage Artifacts Using the Certification Artifacts Explorer

To manage tool qualification artifacts using the Certification Artifacts Explorer:

- 1 Create a new certification package.

Tip Most certification package actions can be initiated in multiple ways. For example, to create a new package, you can:

- Select the menu item **File > New**.
 - Click the toolbar icon **Create new certification package**.
 - Right-click an existing package and select **New**.
-

- 2 Name the certification package.
- 3 Define the location where the Certification Artifacts Explorer stores the certification package (use right-click > **Properties**).
- 4 Save the certification package. The saved package has a KIT extension.
- 5 Copy the tool qualification artifacts for the product of interest into the certification package.
- 6 Delete qualification artifacts that are not required for your project.
- 7 Optionally, add related files to the certification package using a file browser such as Microsoft® Windows® Explorer.

Tip When you add files, to refresh the file list, use **File > Refresh**.

- 8 Use the Certification Artifacts Explorer to access tool qualification artifacts.

When you create and save new certification packages, the Certification Artifacts Explorer displays them. The certification packages that are listed

remain visible unless you delete them from the Certification Artifacts Explorer.

Delete Certification Packages from the Certification Artifacts Explorer

The Certification Artifacts Explorer displays certification packages that you create or open. If you delete a certification package from the Certification Artifacts Explorer, the files associated with the package are still available on your computer. To delete the files, use a file browser such as Windows Explorer.

Certification Artifacts Explorer Limitations

The Certification Artifacts Explorer has the following limitations:

- The Certification Artifacts Explorer works on Microsoft Windows platforms only.
- For optimal performance, Microsoft Internet Explorer® should be available on your machine. Internet Explorer does not have to be your default web browser.

Traceability Matrix Creation

- “Generate a Traceability Matrix” on page 4-2
- “Add Comments to a Traceability Matrix” on page 4-6
- “Traceability Matrix Limitations” on page 4-8

Generate a Traceability Matrix

| In this section... |
|------------------------------------------------------------------|
| “About Traceability Matrices” on page 4-2 |
| “Prerequisites for Generating a Traceability Matrix” on page 4-3 |
| “Generate a Traceability Matrix” on page 4-4 |

About Traceability Matrices

When you use Model-Based Design and production code generation to develop application software components, you can generate a *traceability matrix*. The traceability matrix provides traceability among model objects, generated code, and model requirements. You can add comments to the generated traceability matrix. If you change the model and regenerate the traceability matrix, the software retains your comments.

For a given model, the generated traceability matrix can provide information about:

- Model objects that are traceable between the model and generated code, such as Simulink blocks, Stateflow[®] objects, and MATLAB functions.
- Model objects that are untraceable between the model and generated code, such as eliminated and virtual blocks.
- Requirements documents that you link to model objects using the Simulink Verification and Validation Requirements Management Interface (RMI).

Generate the traceability matrix using either the `do178c.ExportTraceReport` function from the MATLAB Command Window or the **Generate Traceability Matrix** button in the generated HTML code generation report for your model. Either method creates an XLS file that contains the following worksheets:

- **Model Information** — Summary of the model configuration and checksum. The summary includes the model name, version, author, creation date, last saved by, last updated date, checksum, and the selection of **Traceability Report Contents** parameters.

- **Code Interface** — Information about the generated code interface, such as function prototype and timing information for the model initialize and step functions.
- **Code Files** — File folders and names of the generated code files.
- **Report** — Traceability information for each model object, including model, generated code, and requirements. Each row in the worksheet pertains to a single occurrence of a model object. The information for a model object is in more than one row if the object:
 - Appears more than once in the generated code.
 - Links to more than one requirement.

Prerequisites for Generating a Traceability Matrix

Before generating a traceability matrix for model objects, generated code, and model requirements, perform the following steps:

- 1 Optionally, attach requirements documents. For more information, see “Links Between Models and Requirements” in the Simulink Verification and Validation documentation.
- 2 In the Configuration Parameters dialog box, on the **Code Generation > Report** pane, select:
 - a “**Create code generation report**”
 - b At least one of the following **Traceability Report Contents** parameters:
 - “**Eliminated / virtual blocks**”
 - “**Traceable Simulink blocks**”
 - “**Traceable Stateflow objects**”
 - “**Traceable MATLAB functions**”

Tip If you want to generate the traceability matrix directly from the code generation report, select “**Open report automatically**”.

- 3 Generate code for the model.

Tip You do not have to build an executable to generate a traceability matrix. To generate code only, on the **Code Generation > General** pane, select **Generate code only**.

Generate a Traceability Matrix

To generate a traceability matrix:

- 1 Open the model if it is not already open.
- 2 Verify that you have completed the “Prerequisites for Generating a Traceability Matrix” on page 4-3.
- 3 Generate the traceability matrix using one of the following methods:
 - In the MATLAB Command Window, enter the following command, where *model_name* is the name of the model:

```
do178c.ExportTraceReport('model_name')
```

The software generates the traceability matrix.

- Open the code generation report for the model if it is not already open. Go to the **Traceability Report** section and click the **Generate Traceability Matrix** button. For example:

Traceability Report for rtwdemo_hyperlinks

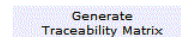
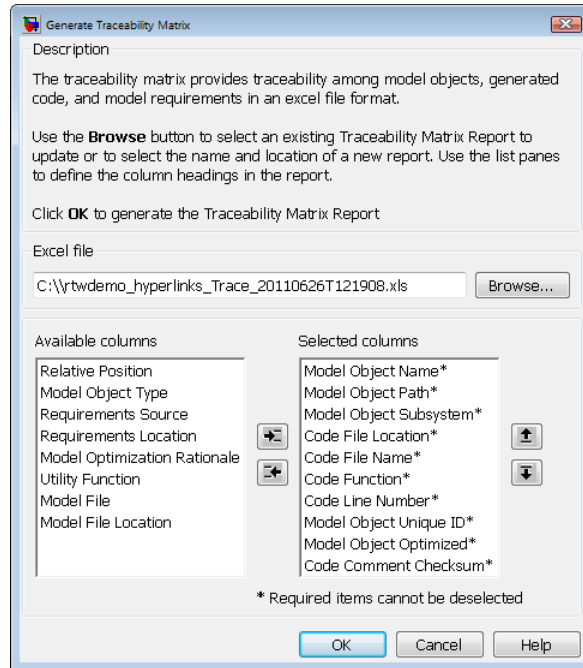


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 - o [rtwdemo_hyperlinks](#)
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 - o [rtwdemo_hyperlinks/Chart:43](#)

When you click the button, the Generate Traceability Matrix dialog box appears.



You can use this dialog box to browse to an existing matrix file to update or specify a new matrix file to create. Optionally, you can also use this dialog box to select and order the columns that appear in the generated matrix. Click **OK** to update or create the specified report.

- 4 Review the traceability matrix and add comments in new columns. For more information, see “Add Comments to a Traceability Matrix” on page 4-6.

Add Comments to a Traceability Matrix

| |
|----------------------------------------------------------------------------------------------------------|
| In this section... |
| “Requirements for Adding Comments to a Traceability Matrix” on page 4-6 “Retain Comments” on page 4-7 |

Requirements for Adding Comments to a Traceability Matrix

You can add comments to the traceability matrix that you generated using the `do178c.ExportTraceReport` function.

To add comments to the traceability matrix, you must:

- Create new columns for your comments.
- Use unique column headings. Columns that you add must have headings.
- Add at least one entry to the column, other than the column heading.
- Retain the following columns:
 - Model Object Name
 - Model Object Path
 - Model Object Subsystem
 - Code File Location
 - Code File Name
 - Code Function
 - Code Line Number
 - Model Object Unique ID
 - Model Object Optimized
 - Code Comment Checksum

Note All comments must resolve to a text string. For example, a link to an image resolves to a text string, but a copy of the image does not.

Retain Comments

To regenerate a traceability matrix and retain your comments:

- 1** Navigate to the working folder of the model.
- 2** Optionally, regenerate code for your model. Regenerating code before generating the traceability matrix ensures that you have the latest model-to-code traceability information.
- 3** In the MATLAB Command Window, enter the following command. *file_name* is the name of the existing traceability matrix that you are regenerating. If the existing traceability matrix is in a different folder, include the full path to that folder in *path*.

```
do178c.ExportTraceReport('model_name', 'file_name', 'path')
```

The traceability matrix regenerates.

Traceability Matrix Limitations

The traceability matrix generation capability has the following limitations:

- Works with the Microsoft Windows platform only.
- Does not support referenced models. When you generate a traceability matrix for a model that contains referenced models, the traceability matrix contains information about the Model block only. The traceability matrix does not contain information about the contents of the referenced model. If your model contains referenced models, generate a traceability matrix for the top-level model and each referenced model separately.
- Does not support models that use the model configuration option **Classic call interface** (GRTInterface).
- In most cases, identifies comments that you add to the traceability matrix, but when comments cannot be identified, the traceability matrix includes the text:

Row is not unique: *comment*

- Does not support information stored in external .req files. For example, when you generate a traceability matrix for a model with externally stored requirements information, the traceability matrix does not include the requirements information.

Function Reference

Qualification Artifacts Management Manage qualification artifacts
(p. 5-2)

Qualification-Related Development Document generated code
Activities (p. 5-3)

Qualification Artifacts Management

qualkitdo

Open Certification Artifacts Explorer

Qualification-Related Development Activities

do178c.ExportTraceReport

Generate XLS file that contains
traceability matrix

Functions — Alphabetical List

do178c.ExportTraceReport

Purpose Generate XLS file that contains traceability matrix

Syntax

```
do178c.ExportTraceReport('model_name')
do178c.ExportTraceReport('model_name', 'file_name')
do178c.ExportTraceReport('model_name', 'file_name',
    'path')
```

Description

do178c.ExportTraceReport('model_name') generates an XLS file that contains a “Traceability Matrix” on page 6-3. *model_name* is the name of the model.

do178c.ExportTraceReport('model_name', 'file_name') generates an XLS file that contains a “Traceability Matrix” on page 6-3. *file_name* is a string that specifies the name of the file. The first time that you call do178c.ExportTraceReport, *file_name* is optional. If you do not provide *file_name*, the function names the file using the following convention. *modelUpdate* is the date and time that you last updated the model:

```
model_name_Trace_modelUpdate.xls
```

To regenerate the traceability matrix, you must specify *file_name*.

do178c.ExportTraceReport('model_name', 'file_name', 'path') generates an XLS file that contains a “Traceability Matrix” on page 6-3. *path* is an optional string that specifies the full path to the location where you want the software to save the file.

- Tips**
- The do178c.ExportTraceReport function works on Microsoft Windows platforms only.
 - To include requirements documentation in the traceability matrix, attach requirements documents to the model before using do178c.ExportTraceReport.
 - You must generate a code generation traceability report (requires an Embedded Coder license) for your model before using do178c.ExportTraceReport.

- The `do178c.ExportTraceReport` function does not support referenced models. When you generate a traceability matrix for a model that contains referenced models, the traceability matrix contains information about the Model block only. The traceability matrix does not contain information about the contents of the referenced model. If your model contains referenced models, generate a traceability matrix for the top-level model and each referenced model separately.
- The `do178c.ExportTraceReport` function does not support models that use the model configuration option **Classic call interface** (GRTInterface).
- In most cases, the `do178c.ExportTraceReport` function identifies comments that you add to the traceability matrix. When the function cannot identify comments, the traceability matrix includes the text:

Row is not unique: *comment*

For more information, see “Prerequisites for Generating a Traceability Matrix” on page 4-3.

Definitions

Traceability Matrix

A traceability matrix provides traceability among model objects, generated code, and model requirements. You can add comments to the generated traceability matrix. If you change the model and regenerate the traceability matrix, the software retains your comments.

Examples

Generate a traceability matrix with traceability between model objects and generated code for the `rtwdemo_hyperlinks` model:

Note This example requires an Embedded Coder license.

```
% Open the model.  
open_system('rtwdemo_hyperlinks');  
% Generate code only.
```

do178c.ExportTraceReport

```
set_param('rtwdemo_hyperlinks', 'GenCodeOnly', 'on');
% Initiate the build process.
rtwbuild('rtwdemo_hyperlinks');
% Generate a traceability matrix.
do178c.ExportTraceReport('rtwdemo_hyperlinks');
```

Generate a traceability matrix with traceability among model objects, generated code, and model requirements for the `slvndemo_fuelsys_docreq` model:

Note This example requires a Simulink Verification and Validation license.

```
% Open the model.
open_system('slvndemo_fuelsys_docreq');
% Select the code generation report and traceability report parameters.
set_param('slvndemo_fuelsys_docreq', 'GenerateReport', 'on');
set_param('slvndemo_fuelsys_docreq', 'GenerateTraceReport', 'on');
set_param('slvndemo_fuelsys_docreq', 'GenerateTraceReportSl', 'on');
set_param('slvndemo_fuelsys_docreq', 'GenerateTraceReportSf', 'on');
set_param('slvndemo_fuelsys_docreq', 'GenerateTraceReportEmI', 'on');
% Generate code only.
set_param('slvndemo_fuelsys_docreq', 'GenCodeOnly', 'on');
% Initiate the build process.
rtwbuild('slvndemo_fuelsys_docreq');
% Generate a traceability matrix.
do178c.ExportTraceReport('slvndemo_fuelsys_docreq');
```

Alternatives

You can generate a traceability matrix directly from the code generation report for your model. Go to the **Traceability Report** section and click the **Generate Traceability Matrix** button.

How To

- “Generate a Traceability Matrix” on page 4-2
- “Add Comments to a Traceability Matrix” on page 4-6
- “Code Tracing”
- “Links Between Models and Requirements”

qualkitdo

| | |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose | Open Certification Artifacts Explorer for DO Qualification Kit |
| Syntax | qualkitdo |
| Description | qualkitdo opens the Certification Artifacts Explorer and displays qualification artifacts. |
| Tips | <ul style="list-style-type: none">• The qualkitdo function works in Microsoft Windows platforms only.• For optimal performance, Microsoft Internet Explorer should be available on your machine. Internet Explorer does not have to be your default web browser. |
| How To | <ul style="list-style-type: none">• “Artifact Management” |

Model Advisor Checks

DO Qualification Kit Checks

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| “Display bug reports using DO Qualification Kit checks ” on page 7-3 |
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| “Display bug reports for Simulink® Code Inspector™” on page 7-6 |
| “Display bug reports for Simulink® Report Generator™” on page 7-7 |
| “Display bug reports for SystemTest” on page 7-8 |
| “Display bug reports for Polyspace products for C/C++” on page 7-9 |
| “Display bug reports for Embedded Coder” on page 7-10 |

Display bug reports using DO Qualification Kit checks

You can use the DO Qualification Kit Model Advisor checks to display bug reports for supported products.

Display bug reports for Simulink Verification and Validation

Display bug reports for the Simulink Verification and Validation R2012b product.

Description

Run this check to display the bug reports for Simulink Verification and Validation R2012b that are available at www.mathworks.com/support/bugreports.

Note This check does not determine whether your model might be affected by these bugs.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

| Condition | Recommended Action |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| There are bug reports for the Simulink Verification and Validation R2012b product. | Review the bug report descriptions and workarounds provided in the links listed in the ID column of the Model Advisor window. |

See Also

“Simulink Verification and Validation”

Display bug reports for DO Qualification Kit

Display bug reports for the DO Qualification Kit R2012b product.

Description

Run this check to display the bug reports for DO Qualification Kit R2012b that are available at www.mathworks.com/support/bugreports.

Note This check does not determine whether your model might be affected by these bugs.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

| Condition | Recommended Action |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| There are bug reports for the DO Qualification Kit R2012b product. | Review the bug report descriptions and workarounds provided in the links listed in the ID column of the Model Advisor window. |

See Also

“DO Qualification Kit (for DO-178)”

Display bug reports for Simulink Code Inspector

Display bug reports for the Simulink Code Inspector R2012b product.

Description

Run this check to display the bug reports for Simulink Code Inspector R2012b that are available at www.mathworks.com/support/bugreports.

Note This check does not determine whether your model might be affected by these bugs.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

| Condition | Recommended Action |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| There are bug reports for the Simulink Code Inspector R2012b product. | Review the bug report descriptions and workarounds provided in the links listed in the ID column of the Model Advisor window. |

See Also

“Simulink Code Inspector”

Display bug reports for Simulink Report Generator

Display bug reports for the Simulink Report Generator R2012b product.

Description

Run this check to display the bug reports for Simulink Report Generator R2012b that are available at www.mathworks.com/support/bugreports.

Note This check does not determine whether your model might be affected by these bugs.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

| Condition | Recommended Action |
|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| There are bug reports for the Simulink Report Generator R2012b product. | Review the bug report descriptions and workarounds provided in the links listed in the ID column of the Model Advisor window. |

See Also

“Simulink Report Generator”

Display bug reports for SystemTest

Display bug reports for the SystemTest R2012b product.

Description

Run this check to display the bug reports for SystemTest R2012b that are available at www.mathworks.com/support/bugreports.

Note This check does not determine whether your model might be affected by these bugs.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

| Condition | Recommended Action |
|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| There are bug reports for the SystemTest R2012b product. | Review the bug report descriptions and workarounds provided in the links listed in the ID column of the Model Advisor window. |

See Also

“SystemTest”

Display bug reports for Polyspace products for C/C++

Display bug reports for the Polyspace Client for C/C++ and Polyspace Server for C/C++ R2012b products.

Description

Run this check to display the bug reports for Polyspace Client for C/C++ and Polyspace Server for C/C++ R2012b that are available at www.mathworks.com/support/bugreports.

Note This check does not determine whether your model might be affected by these bugs.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

| Condition | Recommended Action |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| There are bug reports for the Polyspace Client for C/C++ R2012b product. | Review the bug report descriptions and workarounds provided in the links listed in the ID column of the Model Advisor window. |
| There are bug reports for the Polyspace Server for C/C++ R2012b product. | Review the bug report descriptions and workarounds provided in the links listed in the ID column of the Model Advisor window. |

See Also

“Polyspace Products for C/C++ Documentation”

Display bug reports for Embedded Coder

Display bug reports for the Embedded Coder R2012b product.

Description

Run this check to display the bug reports for Embedded Coder R2012b that are available at www.mathworks.com/support/bugreports.

Note This check does not determine whether your model might be affected by these bugs.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

| Condition | Recommended Action |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| There are bug reports for the Embedded Coder R2012b product. | Review the bug report descriptions and workarounds provided in the links listed in the ID column of the Model Advisor window. |

See Also

“Embedded Coder”

References

Normative References

DO-178C, *Software Considerations in Airborne Systems and Equipment Certification*. RTCA, Inc., 2011.

DO-330, *Software Tool Qualification Considerations*. RTCA, Inc., 2011.

DO-331, *Model-Based Development and Verification Supplement to DO-178C and DO-278A*. RTCA, Inc., 2011.

DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*. RTCA, Inc., 2000.

DO-278, *Guidelines for Communication, Navigation, Surveillance, and Air Traffic Management (CNA/ATM) Systems Software Integrity Assurance*. RTCA, Inc., 2002.

DO-278A, *Software Integrity Assurance Considerations for Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) Systems*. RTCA, Inc., 2011.

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