

Qualification of RapiCover for MC/DC coverage of DO-178B level-A software

The M-346 is a leading transonic trainer aircraft from Alenia Aermacchi (a Finmeccanica company), an international supplier of aircraft and jet trainers to more than 40 countries. It is designed for training combat pilots for front-line fighter aircraft.



Alenia Aermacchi selected Rapi**Cover** to measure structural code coverage up to MC/DC, on the Flight Control System of the M-346. Rapi**Cover**, one of the tools in Rapita Verification Suite (RVS) was qualified for use as a DO-178B verification tool by Alenia Aermacchi.

Challenge

To meet the structural code coverage analysis objectives, Aermacchi selected Rapi**Cover** as their code coverage tool because of its support for C, Ada and for the low memory/execution time overheads it introduces when testing on-target.

In order to use the output of Rapi**Cover** as evidence in the certification of their system, Rapi**Cover** needed to be qualified as a verification tool using the guidance of DO-178B.

Aermacchi decided to qualify the tool using their own qualification process and adapt existing tests. This case study describes how they did it.

<i>DO-178B Objective</i>	<i>Description</i>	<i>Level of credit to achieve</i>
Table A7 - #5	"test coverage of software structure (modified condition/ decision) is achieved"	Full Certification Credit
Table A7 - #6	"test coverage of software structure (decision coverage) is achieved"	Full Certification Credit
Table A7 - #7	"test coverage of software structure (statement coverage) is achieved"	Full Certification Credit

Solution

Alenia Aermacchi created a Tool Qualification Plan (TQP), with a specific section for Rapi**Cover** qualification. The TQP lists the certification credits (with reference to the RTCA/DO-178B) that Alenia Aermacchi intended to take from this tool qualification. The TQP also provides a description of the hardware and software environments that were to be used in the tool qualification.

The operational requirements establish what is expected in terms of structural coverage from the tool. In the case of verification tools, this includes the requirement that they do not introduce semantic alterations/errors, for example, as a side effect of the instrumentation procedure.

Alenia Aermacchi developed a Tool Qualification Procedure document (TQPROC), to describe (for both languages used in the flight control system):

- the Ada and C language instruction subset on which

the tool qualification activity has to be performed;

- the tests that belong to the language instruction subsets;
- the way to run these tests and to check the relevant results;
- the purpose of each test (e.g. check statement coverage results or check that semantic is not altered by the instrumentation);
- the expected results of each test.

These tests are based on the pool of Ada/C statements that are described in the Alenia Aermacchi coding standard, which has been written and provided to the certification authority for level A application software.

Alenia Aermacchi generated the Tool Qualification Result document (TQR), which collects all the results of the tests identified as part of the TQPROC to demonstrate that the tool satisfies the operational requirements established inside the TQP. Test results were all positive, giving assurance that the tool was working correctly.

The qualification documents (i.e. TQP, TQPROC and TQR) were submitted to the certification authority as part of the M-346 certification documentation. The certification authority for the M-346 is the Italian Directorate of Air Armaments and Airworthiness.

Certification was successfully obtained.

Benefits

By using Rapi**Cover**, Alenia Aermacchi was able to produce structural code coverage of their level-A software quickly, accurately and efficiently. Taking certification credit from Rapi**Cover** is essential in this process, and this case study demonstrates the ability of a customer to perform their own qualification of Rapi**Cover** by exploiting internal knowledge, test cases and experience.

Next steps

As the M-346 flight control system evolves, with new features and variants, certification of future variants will be achieved in the same way. The same version of Rapi**Cover** and the same documents listed in this case study will be used, no modifications to the tools or qualification documentation are anticipated.



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