Overview

Testing is a crucial and necessary step in the aircraft product development life cycle, ensuring the safety and reliability of mission and safety-critical aircraft systems. The real-time embedded control systems that drive the operation of the aircraft must be qualified and certified to highly regulated aerospace industry standards, such as DO-178 and DO-254 as regulated by the FAA and EASA, to ensure component and aircraft-level system functionality and design assurance.

Comparison of Testing Time

- Hours Using Automated Testing: 24

A customer was going through regression testing and had various manual procedures to run their tests. With the set-up of Aversan’s ATE and BES, Aversan utilized test automation to save the customer’s time and money.

Aversan’s core competency is testing, test automation and test program management. Aversan has lead the verification and validation efforts on major aircraft programs, such as:
- Lockheed Martin F-35
- Comac C-919
- Airbus A350WXB

As aircraft systems evolve and become more complex, our testing methodology must also evolve to address these new complexities and uncover defects and failure modes emerging from complex development projects.

Testing needs to be thorough and complete. One of the key testing methodologies Aversan employs to address the stringent DO-178 software testing requirements is Modified Criteria / Decision Coverage (MCDC). This test methodology tests all possible outcomes that a system can produce, ensuring complete test coverage.
With complete coverage comes the need for test automation. Automated regression testing based on MCDC test methodology will drastically reduce test cycle time and improve repeatability. Aversan has built an Automated Testing Framework (ATF) that is configurable to specific testing programs and can be reused for different applications. Aversan’s ATF has proven to be a valuable asset in large scale complex system testing projects.

**Aversan’s testing expertise for hardware, software and integrated systems includes:**

<table>
<thead>
<tr>
<th>Black Box Testing</th>
<th>White Box Testing</th>
<th>Unit Testing</th>
<th>Incremental Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration Testing</td>
<td>Functional Testing</td>
<td>System Testing</td>
<td>End-to-End Testing</td>
</tr>
<tr>
<td>Sanity Testing</td>
<td>Regression Testing</td>
<td>Acceptance Testing</td>
<td>Load Testing</td>
</tr>
<tr>
<td>Stress Testing</td>
<td>Security Testing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Building an Effective Test Program**

An effective test program has many factors to consider from test conception through to completion:

**Control Cost & Schedule Overruns by Planning Ahead**

**Test Program Planning and Risk Management**

It is important to consider testing right at the beginning of the project development lifecycle, from the requirements definition phase right through to project completion. Test plans need to trace back to the system-level requirements in order to assert full test coverage. Proper preparation for testing will help to ensure that the test program is executed with minimal unexpected issues and interruptions and will maximize the productivity of your test team. Accounting for anticipated risks as part of the test planning ensures that any issues encountered during test execution will be resolved in a timely manner with minimal impact to the scheduled delivery. Get ahead of the game and don’t wait to plan for testing until it’s too late.

**Requirements Testability**

System and component-level requirements must consider the ability to test the requirement. A poorly defined requirement that is not testable will lead to delays in the delivery of the final product. Often times, these un-testable requirements are found too late in the development cycle, which leads to cost and schedule overruns due to the changes required to remediate the issues. It is critical to include the test team during the requirements definition phase to ensure requirement testability. The system must be designed to test.
Contingencies to Deal with Scope and Requirement Changes

Requirements Testability

It is inevitable that changes to the requirements and scope of the project will happen at various points in the development life cycle. You must be prepared to accept these changes and analyze the impact the changes have on elements of the system. A system should be in place to link business, system, and component level requirements to the specifications, code and test artifacts. This traceability allows you to easily assess the impact a requirement change will have on the code and its associated test cases, making testing the change and associated risks manageable.

System and component-level requirements must consider the ability to test the requirement. A poorly defined requirement that is not testable will lead to delays in the delivery of the final product. Often times, these un-testable requirements are found too late in the development cycle, which leads to cost and schedule overruns due to the changes required to remediate the issues. It is critical to include the test team during the requirements definition phase to ensure requirement testability. The system must be designed to test.

Increased System Complexity means Increased Testing Complexity

Identification of Errors

Testing a highly complex system yields a greater potential for things to go wrong. It also becomes difficult to find where you went wrong (which part of the code) and how to fix it. Adding hooks in the code that trace back to the requirements allows you to identify a starting point to remediate a defect or resolve an issue, when a test fails.

Incremental Builds and Tests

It is important to reduce the complexity of the development by having incremental software builds and tests. Performing a reuse analysis and finding commonality between requirements and functionality allows for a hierarchical build structure to software development which reduces the complexity of the code. Test case development follows the same principle. This methodology minimizes the size of testable objects and allows for incremental testing that is easily manageable and enables continuous integration of software fixes. Testing needs to be done often and it needs to be repeatable.

Scalability and Automation

Testing requirements can often change in the middle of a development program or complexities and system integration issues arise. This can cause the testing effort to balloon out of proportion. It is important for the test architecture to be scalable to account for increased testing scope. Testing methodologies must evolve to handle higher levels of complexity and apply new methods and tools to increase productivity levels. Having a scalable, adaptable and configurable test automation framework, is a key factor in accounting for this risk.
Post-Test Analysis and Documentation

Analysis and Results Collection

Analyzing the test results and collecting the pertinent information is a key factor in determining the success of the testing effort. The results analysis must be thorough and complete in order to capture intermittent and infrequent events. Inserting hooks in the code allows for easy identification of errors and traceability to affected code and requirements. This simplifies the analysis and reduces the amount of manual analysis required during testing. Test results must be collected in a manner that is conducive to rapid and comprehensive documentation.

Aversan’s Automated Testing Framework features an automated results collection component that tabulates results in an XML format that is readily and easily documented.

Unbiased Third Party Testing

Independent Verification & Validation

The best way to ensure an unquestionable level of independence between design and testing personnel, as is required in Level A systems, is to use an unrelated and arm’s length testing specialist. Having a 3rd party responsible for the testing allows for an unbiased perspective on the test program and the assertion of pass/fail results. Test designs will be thorough, such that the system will be tested to fail, and uncover hidden bugs that may only surface in production. Validation ensures that you are building the right thing to meet the needs of your business. Verification ensures that it was built correctly in accordance to the requirements and specifications. Choosing Aversan as your independent verification & validation partner reduces the workload on your team and puts the risk on us ensure the quality and reliability of your system.

Collaboration and Communication is the Key to a Robust Test Program

Status Reporting and Earned Value Analysis

It is very important to monitor the progress of the testing program, and grant visibility to key stakeholders on the status of the testing effort, at any point in time during the project life cycle. Establishing project management tools and methodologies for calculating Earned Value on a test program allows you to visually track and forecast the progress of the test effort while managing budget and schedule. Having regular communication with involved parties helps resolve issues that have been encountered by team members and mitigate risks associated with cost and schedule overruns.
Automated Test Equipment (ATE)

Automated testing during the product development lifecycle is becoming an increasingly crucial element as embedded systems become more complex and require a higher sophistication in testing. Aversan’s test equipment performs automated test execution, logging and report generation for both closed-loop and open-loop testing applications.

All Aversan test stands are based on a proven modular and expandable platform so that they can quickly be tailored for a variety of systems.

Features

- Automated test capability – single or batch
- Test scripts are developed in XML using high level constructs
- HTML test report files showing start date/time, end date/time, expected, actual, individual pass/fail and overall pass/fail coloured in red/green
- Command line or GUI modes
- Hardware abstraction enables the addition or re-configuration of test hardware to be transparent to the higher level test script and test procedure
- Supports test interruption for user interaction
- Powerful signal definition (e.g. define individual Boolean signals within a CAN bus message)
- Supported interfaces:
  - NI DAQmx (digital I/O, analog I/O, counter, switch)
  - IVI over RS-232 (e.g. for Agilent power supply control)
  - RS-422
  - Deva quadrature generator
  - AIMS Client (Aversan Integrated Monitor Software)
  - ARINC 664
  - ARINC 825
  - 28 and 5 VDC discreet I/O
  - PWM

Benefits

- Designed for expandability (with data layer) and integration with simulation models, graphing and tabular interfaces, data logging, sharing, and analysis
- Configurable and scalable based on equipment requirements
- Regression testing made easy
- Test reports can be custom defined (e.g. XML for use in data analysis)
- Real time reporting of data for offline data analysis
- Versatile – Can be used in both engineering development and production level testing
- Cost savings due to reduced test cycle duration and manual labor

[Click here to download the Automated Test Equipment (ATE) Datasheet]
System Integration Labs (SIL)

There has been enormous growth in both the capability and complexity of aircraft embedded electronics as systems collect and share more data to obtain greater operational awareness. In order to meet the challenges in testing these complex systems, the System integration Lab (SIL) has become a key component in the development process.

The SIL is a risk-reduction facility where all systems of an aircraft can be integrated, tested and evaluated for both standalone functionality and interoperability prior to installation on the aircraft. As system integration on a highly complex aircraft is a very costly activity with great potential for schedule and cost overruns, the SIL provides a means to integrate one or many disparate aircraft systems into an environment that is representative of the actual aircraft by using both real and simulated aircraft components. This facilitates system integration testing early in the development process.

A350 XWB Systems Integration Lab

Honeywell Aerospace Canada was selected to develop several key environmental and power systems for the new A350 XWB aircraft. Aversan was selected by Honeywell to deliver a SIL to support their development activities for the project. The SIL is a development testing facility which allows systems and software engineers to test the Honeywell controllers and software along with the Integrated Modular Avionics (IMA) hardware provided by Airbus.

The SIL provides the ability to test multiple systems independently and concurrently whilst sharing hardware resources. The SIL is an integral part of the development for the Honeywell components as it provides the first opportunity for actual interaction between Honeywell and Airbus units and software.

The SIL is used to test various Honeywell systems including: ECS Systems, Power Systems, Avionics, and Vehicle Control Systems. The SIL provides a means for both open and closed loop testing. Closed loop testing involves the use of high-fidelity simulation and/or actual Airbus hardware to test against realistic (or unrealistic) conditions.

Batch Execution System (BES)

The BES is an Aversan product that is used to maximize the utilization of one or more test resources amongst a large team of users. The BES handles remote test submission as well as results collection, with configurable priority levels.

As Aversan's testing activities span different platforms and industries, the BES was developed with flexibility in mind so that it can be used effectively in virtually all software testing engagements. The BES can be purchased as a standalone product, or integrated within a test environment.

Click here to download the Batch Execution (BES) Datasheet
Testing Services

In the Aerospace and Defence industry, Aversan’s expertise is proven on a daily basis in an array of safety-critical embedded applications used on many of today’s commercial and military aircraft and land vehicles. We offer the following testing services both on and off site:

- **Test Assessment**: Resulting in Product Test Strategy
- **Test Planning**: Resulting in Test Plan, Test Procedures, and Finalized Requirements
- **Test Execution & Reporting**: Resulting in Automated Test Execution & Data Collection

Minimize your time-to-market by having a strong test program integrated into your product development life cycle. We provide independent verification and validation services to help you reach final qualification and certification of your aircraft products.

Aversan measures overall test quality by conducting coverage analysis from the functional and system-level testing perspectives which consists of requirements coverage and code coverage. These best practices produce test cases that demonstrate the requirements, find faults/failures in the design, and exercise the code.

Aversan’s quality management processes drive our test designs to ensure that your business requirements and objectives are satisfied. Being integrated with the client in the early phases of the product development cycle allows for the tests to be designed based on the overall big picture of what the business is trying to accomplish. Our testing methodology has been proven to be successful and highly valued by our customers, leading to repeat business and long-term relationships focused on quality of delivery and customer success.

Aversan’s SDLC methodology adheres to the strict development and testing processes defined by Aerospace industry standards, such as DO-178 and DO-254, to ensure system security and reliability.

**Aversan in Testing**

**Customized automated testing frameworks save time & money**

Aversan provides unique value to its customers through its proprietary IP in test automation. Aversan’s Automated Testing Framework (ATF) is a powerful and configurable testing tool capable of automating Test Execution, Test Reporting, and Message Generation. This tool gives Aversan a competitive edge in test automation by reducing test cycle time and the regression effort, while increasing test program efficiency and performance. Choosing Aversan as your independent verification and validation partner allows you to leverage Aversan’s IP in test automation. Over the years, Aversan has developed in-house test automation frameworks that can be customized to disparate applications. Test automation drastically reduces test cycle time and regression.
Advocates for continuous improvement

Aversan prides itself on its commitment to continuous improvement as it is integrated within the Quality Management System. We continually strive to improve existing methodologies and to apply new methodologies, in order to generate better outcomes.

Highly qualified pool of resources

Aversan has a highly qualified pool of resources experienced in the development and testing of real-time mission and safety-critical airborne electronics. With a well-balanced depth of engineering talent and continuous learning environment, Aversan's people are the key to its ability to stay on the leading edge of technology and differentiate us from the competition.

Focus on customer success

Aversan focuses on customer success. Our governance model supports an integrated team approach. Being involved in all stages of the product development life cycle enables us to work together with our client to provide a highly effective test program to supplement their needs. Although we are focused on designing tests to find failures, we will not let our customers fail.

Standards and Guidelines

- AS9100C
- SAE ARP 4761
- SAE ARP 4754
- DO-178 B/C
- DO-254
- DO-160G