Overview of Acceptance Tests
<table>
<thead>
<tr>
<th><strong>Document Title</strong></th>
<th>Overview of Acceptance Tests</th>
</tr>
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<tbody>
<tr>
<td><strong>Document Owner</strong></td>
<td>AUTOSAR</td>
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<tr>
<td><strong>Document Identification No</strong></td>
<td>643</td>
</tr>
<tr>
<td><strong>Document Classification</strong></td>
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</tr>
<tr>
<td><strong>Document Status</strong></td>
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<tr>
<td>1.0.0</td>
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- Introduction of AUTOSAR Acceptance Tests
- Deliverables
- Summary
Introduction to AUTOSAR Acceptance Tests: Scope

- AUTOSAR Acceptance Tests are system tests (ICC1) provided at specification level.
- Based on the SW specifications, the scope of acceptance testing has been refined to match the AUTOSAR functionalities visible at the application and bus level.

Application level
- RTE requirements with impact on applications (e.g. generation from artifacts, existence of APIs, behavior, …)
- BSW services (e.g. existence/compatibility of services, behavior, …)
- Libraries

Bus level
- Bus behavior (e.g. transmission behavior, bus off handling, network management)
- Bus protocols (e.g. transport protocol, network management, diagnostic communication)

AUTOSAR Acceptance Tests are optional. The release of standard acceptance tests does not mandate a specific business model.
**Objective**

- AUTOSAR Acceptance Tests main objective is to minimize the test effort and test costs

- The specification of standard acceptance tests for an ICC1 stacks can contribute to this objective in the following ways
  - Common test development and maintenance
    - Users do not have to specify and maintain test cases specification
  - Methodology and extensibility
    - A methodology is provided which can be used by users to extend further the standard test suite (e.g. for standard feature not covered in the standard set, or for user specific features)
  - Exchange of trustable test execution results
    - Test cases do not need to be executed by both supplier and customer
    - Test cases can be executed once for multiple customers
    - A test suite implementation can be used for multiple stack implementations

**Limitation**

- Coverage: test cases are only specified for commonly agreed features
- Tests are not intended to be executed on project specific configurations
Contents and limitations of the standard

- Standardization of test specification
  - AUTOSAR standardizes textual test specification
  - Limitations
    - Format: Test specifications are semi-formal
    - Implementation: The standard does not ensure a single implementation. Implementation designs are needed from implementers
    - Execution: Tests are not intended to be executed on series project specific configurations

- Test of tools
  - Test of tools is out of scope. But tools which participate in ECU code generation (e.g. RTE Generator) are implicitly tested
Acceptance Testing in the overall test activities

- Standard acceptance tests will not replace other testing activities
- Standard acceptance tests will not replace completely test suites for stack qualification

Diagram:

- Unit Tests
- Standard Acceptance Tests
- OEM Specific Qualification Tests
- Project Specific Tests

Code coverage

Test of configurable stack

Configuration Combination

Document ID 643: Overview of AUTOSAR Acceptance Tests

- AUTOSAR Confidential -
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- Introduction of AUTOSAR Acceptance Tests
- Deliverables
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Acceptance Tests is a separate work-product traceable to AUTOSAR SW specifications.
**Support for versions of the AUTOSAR SW specifications**

- Test cases are developed for released versions of the software specifications.

- At specification level, a test case can be valid for multiple versions (release or revision) of the AUTOSAR software specifications.
  - The applicability to versions is documented in each test case (*AUTOSAR Releases* field).

- In order to support users of other releases, test cases can provide hints how the test cases could be adapted, in their configuration requirements or test sequences, to support those release (*Needed Adaptation to other Releases* field).

- The tests specification in the first release of Acceptance Tests are applicable to the software specification of the AUTOSAR Release 4.1, Revision 1.

- Earlier releases are supported:
  - When test cases are known to be applicable to R4.0.3 or R3.2.2 (*AUTOSAR Releases* field).
  - When test cases are known to require adaptations in R4.0.3 or R3.2.2.
List of AUTOSAR Acceptance Tests deliverables

- Acceptance Test Specifications
  - AUTOSAR_ATS_CommunicationCan, AUTOSAR_ATS_CommunicationFlexRay, AUTOSAR_ATS_CommunicationLin, AUTOSAR_ATS_CommunicationManagement, AUTOSAR_ATS_CommunicationViaBus, AUTOSAR_ATS_DiagnosticServices, AUTOSAR_ATS_EcuModeManagement, AUTOSAR_ATS_MemoryStack, AUTOSAR_ATS_RTE

- AUTOSAR_ATR_Main
  - Refines the objective defined by AUTOSAR to specify AT
  - Defines high level requirements: “AT shall use only ICC1 interfaces”, ...

- AUTOSAR_ATR_Features
  - Defines what is to be tested by AT
    - “AT shall test RTE features”, “TC dedicated to bus compatibility shall be developed”, “AT shall reuse real production examples”, ...

- AUTOSAR_ATR_Requirements
  - Lists SRS (exceptionally SWS) that should be tested by AT
    - Chosen as most relevant through a selection process (OEMs’, Tier 1s’, … needs)
    - Regrouped by compatibility levels: application, bus, configuration
  - Used as traceability elements by AT specifications (test cases)
    - “AT shall support 1:n Sender-Receiver”, “AT shall support bus-off”, ...

- AUTOSAR_EXP_AcceptanceTestsOverview
  - The current document

- AUTOSAR_TR_ATSReleaseApplicability
  - Document the applicability of each test case on AUTOSAR software releases
## Content of Acceptance Tests Release R1.0.0

<table>
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<th># TC</th>
<th>Features</th>
<th>Short Description</th>
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<td>Data Transfer</td>
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<td></td>
<td>2</td>
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<td></td>
<td>6</td>
<td>RS_BRF_01707</td>
<td>Can Bus Off handling</td>
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<td>AUTOSAR_ATS_CommunicationLin</td>
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<td>AUTOSAR_ATS_CommunicationManagement</td>
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<td>RS_BRF_01448</td>
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<td>RS_BRF_01680</td>
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<td>4</td>
<td>RS_BRF_01680</td>
<td>Network management (Lin)</td>
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<td>10</td>
<td>RS_BRF_01688</td>
<td>ComM User Request</td>
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<td>4</td>
<td>RS_BRF_01696</td>
<td>Partial Networking</td>
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<td>AUTOSAR_ATS_CommunicationViaBus</td>
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<td>RS_BRF_01600</td>
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<td>22</td>
<td>RS_BRF_01616</td>
<td>Initial Values</td>
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<td>4</td>
<td>RS_BRF_01632</td>
<td>Data Consistency</td>
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<td>13</td>
<td>RS_BRF_01592</td>
<td>Data Transfer (Bus independent)</td>
</tr>
<tr>
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<td>6</td>
<td>RS_BRF_01648</td>
<td>Large Data Type</td>
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<tr>
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<td>RS_BRF_02184</td>
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<td>8</td>
<td>RS_BRF_02144</td>
<td>DataServies (DCM)</td>
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<td>RS_BRF_01488</td>
<td>EcuM Current Mode</td>
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<td>EcuM State Request</td>
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<td>2</td>
<td>RS_BRF_02152</td>
<td>EcuM Boot Target</td>
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<td>EcuM Shutdown Target</td>
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<td>Rte SWC scheduling and activation from events</td>
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<td>20</td>
<td>RS_BRF_01376</td>
<td>Rte Data Conversion Feature</td>
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<td>13</td>
<td>RS_BRF_01352</td>
<td>Rte Sender Receiver Communication</td>
</tr>
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**[ATR_Main_00001] Acceptance tests shall minimize test effort and test costs**

**Type:** Valid

**Description:**
In order to avoid redundant test cycles and ease the reuse of test results for users of AUTOSAR standard, acceptance tests shall focus on reduction of test effort and test costs.

Test concept shall address explicitly efficiency.

**Rationale:**
Users of acceptance tests will typically use these tests for checking that a BSW implementation is mature enough to enter the user’s ECU software development process. Within this development process, there are usually more in-depth release tests in place.

The acceptance tests are thus not required to test the BSW in full depth and with full coverage and can therefore not replace release tests at OEMs or Tier1s.

Standard test ease the reuse of test results because they are commonly understood by different market partners (who use the test results / who implement the tests and who execute the tests).

**Use Case:**
- BSW handover into Development process
- Selection of the standard tests needed for an application (where test results are required) / development of a test implementation (where test results are not required)

**Dependencies:**
- --

**Supporting Material:**
- --

**Tested Items:**
- (RS_PO_00007, RS_PO_00002)

Acceptance tests shall minimize test effort and test costs

Acceptance tests shall test interoperability of BSW implementations of one AUTOSAR release in one vehicle network

Acceptance tests shall test interoperability of BSW implementations in vehicle networks

Acceptance tests shall test interoperability of BSW implementations to applications

Acceptance tests shall provide means to measure quality of BSW implementation

Acceptance tests shall exist for mainstream releases

Execution of acceptance tests shall be feasible by any market partner

Acceptance tests shall cover a commonly agreed subset of AUTOSAR requirements

Acceptance test shall provide a commonly agreed test methodology

Acceptance tests shall use only ICC1 interfaces
### [ATR_ATF_00004] Application and bus compatibility test cases shall specify the required configurations

**Type:** valid  
**Description:** Application and bus compatibility test cases shall specify requirements on the configuration files needed when test suites are implemented or executed.

**Rationale:**
- The AUTOSAR basic software and RTE is heavily dependent on the configuration for its interface to applications and behavior toward applications or buses.
- The usage of acceptance tests in different contexts (e.g. implementation and execution by a stack vendor, implementation dedicated to one OEM, or implementation required to support multiple basic software implementation) needs flexibility in the actual configuration files used to generate the ECU where tests are executed.

### [ATR_ATF_00008] Acceptance Tests shall test BSW services

**Type:** valid  
**Description:** AUTOSAR Acceptance Tests shall test all BSW services.

**Rationale:** Software reuse is one of the major aims of AUTOSAR. The reuse of Software Components requires that the services of the BSW implementation are compatible

**Use Case:** Reuse of a Software Component on different platforms

**Dependencies:**
- RS_BRF_01408 AUTOSAR shall provide a service layer that is accessible from each basic software layer
- RS_BRF_01424 AUTOSAR services shall support communication services
- RS_BRF_01440AUTOSAR services shall support system diagnostic functionality
- RS_BRF_01448 AUTOSAR services shall support mode and state management

**Supporting Material:**

**Tested Items:**

- (ATR_Main_00004, ATR_Main_00010)
[ATR_ATR_00001] AUTOSAR Acceptance Tests shall support Client Server Asynchronous communication

<table>
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</tr>
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<tbody>
<tr>
<td>Description:</td>
<td>AUTOSAR shall provide acceptance tests for checking that Client Server Asynchronous communication (client not blocked after the service request is initiated until the response of the server is received) is supported according to the RTE specification.</td>
</tr>
<tr>
<td>Rationale:</td>
<td>Software Components with AUTOSAR interfaces shall have the possibility to use different communication schemes. Client Server Asynchronous communication is needed whenever the client needs to continue its operations after requesting a service from a server and collect a response later on.</td>
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<tr>
<td>Use Case:</td>
<td>--</td>
</tr>
<tr>
<td>Dependencies:</td>
<td>ATR_ATR_00022, ATR_ATR_00023</td>
</tr>
<tr>
<td>Tested Items:</td>
<td>SRS_Rte_00029, SRS_Rte_00072, SRS_Rte_00079, SRS_Rte_00110, SRS_Rte_00111</td>
</tr>
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</table>

(ATR_ATF_00004, ATR_ATF_00027, ATR_ATF_00007, ATR_ATF_00011)
ATS documents

- ATS documents are organized as a set of test suites.
- Each test suite is documented by
  - General Test Objective and Approach
    - Test System
      - Overview on Architecture
      - Specific Requirements
      - Test Coordination Requirements
  - Test Configuration
    - Required ECU Extract of System Description Files
    - Required ECU Configuration Description Files
    - Required Software Component Description Files
    - Mandatory vs. Customizable Parts
  - Test Case Design
    - Explanations on the design of test cases
  - Re-usable Test Steps
    - Complex set of test steps that can be later reused in test cases
  - Test Cases
    - Set of test cases, each described using the same template. See next slides.

Description or requirements on the test system architecture used to test the feature.

Requirements on how to configure the BSW stack in order to test the feature.
They can be completed or superseded by test case specific requirements.
ATS – Example of architecture

➢ In order to test the System Under Test (the basic software and RTE, seen as a black box ICC1 implementation), the test architecture is usually described using the ISO 9646 notation of a test harness
➢ The Test system is connected to a lower and upper tester which can both interact with the SUT
  - For example:
    ▪ Messages are sent or observer on the bus
    ▪ Applications on top of the RTE access services, RTE APIs, or receive notifications
### ATS – Example - Specification of test cases (1/4)

#### Test Objective
Test Intra-ECU C/S argument rescaling - ClientServerInterfaceMapping Linear Scaling

<table>
<thead>
<tr>
<th>ID</th>
<th>ATS_RTE_00145</th>
<th>AUTOSAR Releases</th>
</tr>
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<td>Affected Modules</td>
<td>RTE</td>
<td>State</td>
</tr>
<tr>
<td></td>
<td></td>
<td>reviewed</td>
</tr>
<tr>
<td>Trace to Requirement on Acceptance Test Document</td>
<td>ATR: ATR_ATR_00028</td>
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<tr>
<td>Trace to R4.1.1 Item</td>
<td>RTE: SWS_Rte_03818</td>
<td></td>
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<td></td>
<td>RTE: SWS_Rte_03819</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RTE: SWS_Rte_03829</td>
<td></td>
</tr>
</tbody>
</table>

- **Test case identifier.** It is unique over all test suites
- **Short description of the test objective.** This short description is also used as title of test case
- **Indication where the tested functionality is implemented (in case of ICC3 implementation)**
- **Traceability to SWS items relevant for the tested functionality**
- **List of SW releases for which this test case specification is applicable**
- **Test case state: proposed, accepted, reviewed**

*Traceability to acceptance tests requirement AUTOSAR_ATR_Requirements*
ATS – Example – Specification of test cases (2/4)

Reference to a test environment, described in earlier section of the test suite, or specific requirements for this test case

<table>
<thead>
<tr>
<th>Requirement / Reference to Test Environment</th>
<th>Use Case 03.01 : Intra-ECU C/S Communication</th>
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</thead>
<tbody>
<tr>
<td>Configuration Parameters</td>
<td></td>
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<tr>
<td>1 SWC Client</td>
<td></td>
</tr>
<tr>
<td>The Operation uses parameter with ClientType</td>
<td></td>
</tr>
<tr>
<td>LowerLimit = 0, UpperLimit = 100</td>
<td></td>
</tr>
<tr>
<td>ComputationMethod : PhytoInt : identical</td>
<td></td>
</tr>
<tr>
<td>1 SWC Server</td>
<td></td>
</tr>
<tr>
<td>The Operation uses parameter with ServerType</td>
<td></td>
</tr>
<tr>
<td>LowerLimit = 200, UpperLimit = 1200</td>
<td></td>
</tr>
<tr>
<td>ComputationMethod: PhyToUint : Linear (10*x+200)</td>
<td></td>
</tr>
<tr>
<td>Both are using uint32 types</td>
<td></td>
</tr>
<tr>
<td>1 ClientServerInterfaceMapping maps the</td>
<td></td>
</tr>
<tr>
<td>client to the server</td>
<td></td>
</tr>
</tbody>
</table>

Requirement on the configuration. Those requirements have to be taken into account when the BSW stack is configured. When possible, they are expressed using upstream template parameters.
ATS – Example – Specification of test cases (3/4)

Test Objective
Test Intra-ECU C/S argument rescaling

ClientServerInterfaceMapping Linear

Scaling

ID ATS_RTE_00145

AUTOSAR Releases
4.0.3 | 4.1.1

Affected Modules
RTE

Trace to Requirement
SRS_ATR: SRS_ATR_00028

Trace to R4.1.1
Item RTE: SWS_Rte_03818
RTE: SWS_Rte_03819
RTE: SWS_Rte_03829

Requirements/Reference to Test
Environment
Use Case 03.01: Intra-ECU C/S Communication

Configuration Parameters
1 SWC Client
The Operation uses parameter with ClientType
LowerLimit = 0, UpperLimit = 100
Computation Method: PhyToInt : identical

1 SWC Server
The Operation uses parameter with ServerType
LowerLimit = 200, UpperLimit = 1200
Computation Method: PhyToInt : Linear (10*x+200)
Both are using uint32 types

1 ClientServerInterfaceMapping maps the client to the server

Summary
The Test Manager starts the Client, which calls the server
The Test Manager checks that server was invoked with the converted values.

Needed Adaptation to other Releases

 Needed Adaptation for Release [3.2.2]

Configuration: [low]
Clinet-server argument rescaling does not exist in R3.2.2.

Test Steps: [n/a]
The test case shall be removed

Hints on the adaptations needed to apply the test case to other releases (for releases which are not listed in the field “AUTOSAR Releases”)
### ATS – Example – Specification of test cases (4/4)

#### Pre-conditions mandatory to execute the test case

#### Main Test Execution

- **Pre-conditions**: None
- **Main Test Execution**

<table>
<thead>
<tr>
<th>Test Steps</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>TCP: starts Tester_Client_1, Tester_Server</td>
</tr>
<tr>
<td>Step 2</td>
<td>Tester_Client_1: invokes the operation (Rte_call) with argument value 0</td>
</tr>
<tr>
<td>Step 3</td>
<td>Tester_Client_1: invokes the operation (Rte_call) with argument value 100</td>
</tr>
<tr>
<td>Step 5</td>
<td>TCP: terminates Tester_Client_1</td>
</tr>
</tbody>
</table>

#### Post-conditions mandatory to restore a working environment

None

---

**Sequence of test steps that shall be executed.**

Steps are organized as an action and a pass criteria.

When one of the pass criteria fails, the test case fails.

The actions and pass criteria can be preceded by an indication on where the action has to be performed (resp. where the pass criteria has to be observed).
Configuration

- AUTOSAR is highly configurable
  - Interfaces and behavior depends on configuration

- It is assumed that users of AUTOSAR Acceptance Tests use the AUTOSAR Methodology for configuring the System under Test (SUT) and integrating the SUT and test cases in the test environment.

- BSW stacks introduce vendor specific parameters, or have specific structure expectation
  - As a result, ECU configuration description cannot easily be exchanged from one stack vendor to another.

- For acceptance tests, at ICC1 level, the idea is to focus on upstream template which can be exchanged:
  - SWC description
  - System description

- Test specification include requirements on configuration for these upstream templates. Requirements on configuration are specified per test case.
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Summary

- AUTOSAR Acceptance Tests Specification
  - Black Box tests for an ICC1 configurable stack
  - Well-structured specifications
  - Test cases available for topics identified with high market needs
    - Communication (CAN, LIN, Flexray)
    - Diagnostics
    - NVRAM
    - Mode Management
    - RTE