SYSTEM PILLAR – TRACKSIDE ASSETS CONTROL AND SUPERVISION

Conformance Testing for products compliant to SP TACS/EULYNX specifications

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1. Purpose and Objectives

Conformance testing provides formal evidence that a product correctly implements the relevant SP TACS/EULYNX specifications. The EULYNX consortium defined the EULYNX Conformance Test Plan, which outlines the process by which a supplier demonstrates conformity of a product. The conformance to interface specifications is essential for product applications in a standardised modular architecture.

The main objectives are:

- Ensure standardised testing process of compliant products
- Enable cross acceptance of test results and reuse of tested products across different markets
- Provide a common testing framework including:
    - Standardised test cases
    - Common processes
    - Qualifications for test laboratories

Conformance testing can be interpreted as a supporting step in acceptance of products but does not replace national authorisation or full system validation.

2. Scope of Conformance Testing

2.1 System Scope

The conformance testing process applies primarily to:

- SP TACS/EULYNX field element subsystems (object controllers)

The following are not in scope (only partially supported through generic interface tests):

- Subsystem – Electronic Interlocking
- Adjacent systems

Testing is limited to the SP TACS and/or EULYNX requirements, conformance testing does not in itself provide accreditation for form, fit or function of the product beyond the implementation of the specifications. National or infrastructure manager specific requirements are explicitly excluded.

2.2 Test Case Scope

Test cases are defined with the following principles:

- Focus on field elements

- Executed using a hardware-in-the-loop (HIL) setup
- Derived from requirement and interface specifications

Coverage rules:

- At least one test case per sequence diagram
- Additional coverage via white-box testing for linking to the state machines in the specifications

Not all requirements are explicitly listed in test cases. Preconditions and test case variations (alternative or parallel blocks) define the amount of possible test cases for a single sequence diagram. The prepared test cases currently include one variation per related sequence diagram.

EULYNX provides an open and standardised test case database that supports the conformance testing process. This database contains the formally defined test catalogue, including test cases, checks, and associated configuration data. It is accessible to all relevant stakeholders and ensures consistent application of testing across different laboratories and countries.

The test cases are also provided as complementary artefacts to the SP TACS/EULYNX specifications, enabling a direct link between requirements and their verification.

3. Specification Coverage

3.1 Referenced specifications

The following subsystems are included:

- Point (P)
- Level Crossing (LC)
- Generic IO (IO)
- Train Detection System (TDS)
- Light Signal (LS)

Test cases are based on the following specifications:

Generic Interface functionality:

- *Generic Interface and subsystem requirements for SCI: Document number: Eu.Doc.119*
- *Generic Interface and subsystem requirements for SMI: Document number: Eu.Doc.120*
- *Interface specification SCI Generic: Document number: Eu.Doc.93*
- *Interface specification SDI Generic: Document number: Eu.Doc.94*

Subsystem LS:

Signal aspect table: Document number: Eu.Doc.37

- *Requirements specification for subsystem Light Signal: Document number: Eu.Doc.32*
- *Interface specification SCI-LS: Document number: Eu.Doc.33*
- *Interface specification SDI-LS: Document number: Eu.Doc.78*

Subsystem Point:

- *Requirement specification for subsystem Point: Document number: Eu.Doc.36*
- *Interface specification SCI-P: Document number: Eu.Doc.38*
- *Interface specification SDI-P: Document number: Eu.Doc.80*

Subsystem LC:

- *Requirements specification for subsystem Level Crossing: Document number: Eu.Doc.108*
- *Interface specification SCI-LC: Document number: Eu.Doc.109*
- *Interface specification SDI-LC: Document number: Eu.Doc.110*

Subsystem IO:

- *Requirement specification for subsystem Generic IO: Document number: Eu.Doc.45*
- *Interface specification SCI-IO: Document number: Eu.Doc.46*
- *Interface specification SDI-IO: Document number: Eu.Doc.82*

Subsystem TDS:

- *Requirements specification for subsystem TDS: Document number: Eu.Doc.43*
- *Interface specification SCI-TDS: Document number: Eu.Doc.44*
- *Interface specification SDI-TDS: Document number: Eu.Doc.81*

3.2 Coverage Characteristics

- Test cases are linked to sequence diagrams
- Typically one variation per sequence diagram (extendable)
- Parameters:
    - Defined ranges and configurations
    - Some values fixed, others configured during execution

Representative configurations are used instead of exhaustive combinations, for example:

- Limited number of IO channels
- Simplified point machine configurations

- Single representative layouts for TDS

4. Conformance Test Process

The conformance test process is standardised and executed by qualified test laboratories. It is initiated by the supplier and results in a Laboratory Test Report.

The conformance testing process begins with the supplier initiating testing and defining the product version and scope. Testing is prepared using the standardised EULYNX test catalogue, where formally defined test cases specify preconditions, parameters, and expected behaviour.

The conformance testing is carried out by qualified test laboratories, which may be selected through two possible paths:

- independent external laboratories that meet the qualification criteria,
- laboratories that are part of the supplier's organisation, provided they fulfil the same requirements for competence, impartiality, and compliance (e.g. in line with ISO/IEC 17025).

In both cases, the laboratory must adhere to the defined EULYNX conformance testing process to ensure consistent and reliable results.

The test laboratory then executes the tests in a hardware-in-the-loop setup, performing functional conformance testing based on the exact catalogue test cases, optionally including cross-testing, as well as conformance checks through inspections and measurements.

Finally, results are logged and evaluated, mostly automatically, and documented in a Laboratory Test Report, which records outcomes and deviations and can support a declaration of conformity.

5. Handling of Deviations

All deviations found during testing must be documented in the report. Classification is agreed between laboratory and supplier.

Outcomes:

- Safety or vital deviations → test cannot be successful
- Minor deviations → report may be issued with limitations

It may happen that the qualified test laboratory and the supplier have conflicting opinions about the classification of a deviation, because of different interpretation of the specifications. In this case, the EULYNX Consortium and/or the client Infrastructure Manager shall be involved in order to resolve the conflict.

If deviations are found that require changes or improvements in the test catalogue and/or the specifications, the EULYNX Consortium must be formally informed by the test laboratory. In that way, the consistency of the specifications and the completeness of the test catalogue will be improved iteratively by any project and conformance test campaign.

6. Validity of Test Results

The Laboratory Test Report is valid for:

- A specific product version (hardware and software)
- A defined SP TACS/EULYNX specification scope
- A specific version of the test cases

Re-use of the Laboratory Test Report is allowed if:

- A supplier develops further products that differ from the previously tested product only in aspects that are clearly outside of the scope of the SP TACS and/or EULYNX specifications (e.g. national add-ons or additional capabilities), the unchanged scope of this new product may still be deemed covered by an issued Laboratory test report.

The report does not guarantee:

- Full system acceptance
- Compliance with national requirements

7. Evolution and Updates

The framework evolves continuously:

- Test cases are improved iteratively based on feedback from testing campaigns
- Specifications are improved iteratively due to developments

Updates to specifications or test cases do not automatically invalidate previous test results, but may require reassessment depending on the impact of the changes.

7.1 Changes to Test Cases and Test Catalogue

Updates to the test catalogue may occur due to identified gaps, improvements, or clarifications. All changes must be formally managed and incorporated into the official test catalogue.

- New conformance test campaigns shall use the updated test cases

- Existing test results remain valid for the product version and scope under which they were originally tested

7.2 Changes to Specifications

When SP TACS and/or EULYNX specifications are updated or new versions are released:

- Conformance testing shall be aligned with the updated specification version.
- The validity of an existing Laboratory Test Report remains limited to the specification version used during testing, the corresponding scope and version of the test cases.

Re-testing may be required if:

- New or modified requirements affect the behaviour of the system under test
- The scope of applicable specifications is extended

If changes are outside the scope of the tested requirements (e.g. optional packages), existing results may still be reused.

7.3 Error Corrections

Errors or inconsistencies of the test catalogue identified during testing may lead to updates in specifications or test cases.

- Such findings must be formally reported to the EULYNX Consortium
- Corrections are incorporated into future versions of specifications and test catalogues

8. Summary of Key Principles

Conformance testing is a standardised and repeatable process, relying on the use of standardised test cases, and ensuring the correct implementation of specifications. However, it does not replace integration testing or national authorisation processes, which remain necessary for full system validation and acceptance.

References

- EULYNX Conformance Test Plan (Eu.Proc.7 v3A)
- Scope and Coverage Justification for EULYNX Conformance Test Cases (v1C)