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First edition
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Telecontrol equipment and systems –

Part 5-6:
Guidelines for conformance testing for the IEC 60870-5 companion standards

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TELECONTROL EQUIPMENT AND SYSTEMS –

Part 5-6: Guidelines for conformance testing for the IEC 60870-5 companion standards

FOREWORD

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International Standard IEC 60870-5-6 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The text of this part of IEC 60870-5 is based on the following documents:

FDIS	Report on voting
57/792/FDIS	57/807/RVD

Full information on the voting for the approval of this part of IEC 60870-5 can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 60870-5 consists of the following parts, under the general title *Telecontrol equipment and systems – Part 5: Transmission protocols:*

Part 5-1: Transmission frame formats

Part 5-2: Link transmission procedures

Part 5-3: General structure of application data

Part 5-4: Definition and coding of application information elements

Part 5-5: Basic application functions

Part 5-6: Guidelines for conformance testing for the IEC 60870-5 companion standards

Part 5-101: Companion standard for basic telecontrol tasks

Part 5-102 Companion standard for the transmission of integrated totals in electric power systems

Part 5-103: Companion standard for the informative interface of protection equipment

Part 5-104: Network access for IEC 60870-5-101 using standard transport profiles

Part 5-601: Conformance test cases for the IEC 60870-5-101 companion standard

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

This part of IEC 60870-5 specifies methods and procedures for conformance testing of Telecontrol equipment or systems using IEC 60870-5 standard(s).

This part of IEC 60870-5 contains general subjects and guidelines for the test environment. Detailed test cases, mandatory and optional mandatory test cases for the companion standards will become available as technical specifications (IEC 60870-5-60x).

Tests according to EMC requirements or related to environmental and organisational conditions are beyond the scope of this part of IEC 60870-5. This part of IEC 60870-5 only focuses on the protocol implementation and the related system functionality necessary to validate the protocol implementation.

TELECONTROL EQUIPMENT AND SYSTEMS –

Part 5-6: Guidelines for conformance testing for the IEC 60870-5 companion standards

1 Scope

This part of the IEC 60870-5 series specifies methods for conformance testing of telecontrol equipment, amongst Substation Automation Systems (SAS) and telecontrol systems, including front-end functions of SCADA.

The use of this part of IEC 60870-5 facilitates interoperability by providing a standard method of testing protocol implementations, but it does not guarantee interoperability of devices. It is expected that using this part of IEC 60870-5 during testing will minimize the risk of non-interoperability.

The goal of this part of IEC 60870-5 is to enable unambiguous and standardised evaluation of IEC 60870-5 companion standard protocol implementations. The guidelines and conditions for the testing environment are described in this part of IEC 60870-5. The detailed test cases per companion standard, containing among others mandatory and optional mandatory test cases per Basic Application Function, ASDU and transmission procedure, will become available as technical specifications (IEC 60870-5-60x). Other functionalities may need test cases, but this is beyond the scope of this part of IEC 60870-5.

This part of IEC 60870-5 deals mainly with communication conformance testing; therefore other requirements, such as safety or EMC are not covered. These requirements are covered by other standards (if applicable) and the proof of compliance for these topics should be done according to those standards.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60870-5-1, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section One: Transmission frame formats*

IEC 60870-5-2, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 2: Link transmission procedures*

IEC 60870-5-3, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 3: General structure of application data*

IEC 60870-5-4, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 4: Definition and coding of application information elements*

IEC 60870-5-5, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 5: Basic application functions*

ISO/IEC 9646 (all parts), *Information technology – Open Systems Interconnection – Conformance testing methodology and framework*

3 Terms and definitions

For the purposes of this part of IEC 60870-5, the following terms and definitions apply.

3.1
configuration (of a system or device)
step in system design: selecting functional units, assigning their locations and defining their interconnections

3.2
configuration list
supplies an overview of all compatible hardware and software versions of components of controlled/controlling stations including the software versions of relevant supporting tools

3.3
address config
address config is the configuration file containing the ASDU-addressing including the information object addresses necessary to test all the functionality defined as in the PID

3.4
conformance test
verification process of the protocol implementation in a device by executing tests according to the applicable test plan, which contain mandatory and possibly mandatory optional test cases, so as to be able to answer the following question:

"Does the protocol implementation in device xxx of supplier yyy conform to the IEC 60870-5-10x standard and the applicable Protocol Implementation Document (PID)?"

NOTE A supplier-independent party that is allowed to issue a Conformance Statement can carry out a conformance test.

3.5
device
mechanism or piece of equipment designed to serve a purpose or perform a function

[IEEE STD 100-1996, IEEE Dictionary of Electrical and Electronic Terms]

3.6
direction
communication direction in which the device exchanges the data

NOTE IEC 60870-5 companion standards describe functions and ASDU's in the monitor direction (from the controlled to the controlling station) and control direction (from controlling to controlled station) as Normal direction (N). For some purposes, the functions or ASDU's can be used also in the Reverse direction (R) or in Both directions (B). The way they are used should be indicated in the PICS. If reversed direction is enabled, by using R or B, the functionality is used in the reverse direction, the applicable test cases in the normal direction are applicable for the reversed functionality.

3.7
error
behaviour, which does not conform to the standard and/or the applicable test cases as described in this part of IEC 60870-5

3.8
Factory Acceptance Test
FAT
customer agreed functional tests of the specifically manufactured telecontrol equipment or its parts using the parameter set for the planned application

NOTE The FAT should be carried out in the factory of the manufacturer by the use of process simulating test equipment.

3.9
function
tasks performed by the telecontrol equipment

NOTE Generally, functions will exchange data with each other.

3.10
hold point
H
point, defined in the appropriate document beyond which an activity should not proceed without the approval of the initiator of the conformance test. If necessary, the test facility could provide a written notice to the initiator at an agreed time prior to the hold point. The initiator or his representative is obliged to verify the hold point and approve the proceeding of the activity

3.11
quality program
quality program for the IEC 60870-5 series as described in Figure 3

3.12
initiator of conformance test
party initiating a conformance test that may be executed by a test facility

3.13
interface
shared boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics as appropriate

3.14
interoperability
ability of two or more telecontrol devices from the same vendor, or different vendors, to exchange information and use that information for correct co-operation

3.15
interoperability test
verification of the information exchange of two or more devices from the same vendor or different vendors.

In case of an open protocol, the test shall give an answer to the following question:

"Are the devices under test (DUT) able to communicate correctly according to the IEC 60870-5-10x standard and the Protocol Implementation Document (PID)?"

The interoperability test can be carried by a supplier-independent party that may result in an interoperability statement. A basic condition for this interoperability test is a passed conformance test of both devices

NOTE Interoperability does not necessarily mean that both systems are communicating according a specific protocol, but that both those devices are able to communicate and this might be an open protocol. Interoperability is not interchangability.

3.16
interchangability
ability to replace a device from the same vendor, or from different vendors, using the same communication interface and as a minimum, with the same functionality, and with no impact on the rest of the system

3.17
mandatory optional test case
test case initially marked as optional in the column “required”, indicated by “PICS, ….” or “PIXIT” which becomes a mandatory test case if this functionality is enabled and/or described in the PICS or the PIXIT. This optional test case then becomes a mandatory test case

3.18
negative test
test to verify the correct response of a device or a system on:

– IEC 60870-5 series conformant information and services, which are not implemented;
– non conformant communication traffic

3.19
open protocol
communication protocol of which the protocol specification is freely accessible for all market parties, for example an IEC protocol communication standard

3.20
Physical Connection
PC
communication link between physical devices

3.21
Physical Device
PD
independent physical entity capable of performing one or more specified device functions in a particular context and delimited by its interfaces. A physical device is equivalent to or is part of a controlling or controlled station

3.22
plausibility test
a plausibility test is passed if the corresponding time, value, status or other items have been shown to have the correct value (no tolerance) for time-stamp, values, status and for the other items regarding the requirements in 5.6.3.

NOTE Applicable tolerances may be part of the PIXIT.

3.23
Protocol Implementation eXtra Information for Testing
PIXIT
the PIXIT document contains system specific information regarding the capabilities of the system to be tested and specifies which items are optional, in the applicable Companion Standard or outside the scope of the 60870-5 series. The PIXIT is not subject to standardisation, but 5.5.1.4 describes guidelines and recommendations for setting up a PIXIT

NOTE It is recommended is to integrate the PIXIT and the PICS into one document, which is the PID.

3.24
positive test
test to ensure the correct implementation of the system capabilities as defined by the supplier. A positive test has a described and defined response

3.25
Protocol Implementation Conformance Statement
PICS
summary of the capabilities of the system to be tested. Every companion standard contains a PICS. The use of the interoperability sheets of the particular standard for the definition of the PICS is mandatory

NOTE It is recommended to integrate PIXIT and PICS into one document, which is the PID.

3.26
Protocol Implementation Document
PID
describes the way a specific area (country, company, functionality) uses and implements the protocol. The PID consists of the PICS and the PIXIT. The PID shall not be subject to standardisation and is system specific. The PID always contains the PICS and is mandatory for conformance testing

NOTE It is recommended to integrate the PIXIT and the PICS into one document, which is the PID.

3.27
Remote Terminal Unit
RTU
acts as an interface between the communication network and the substation equipment

NOTE An RTU is typically an outstation.

3.28
review
R
optional systematic examination, defined in the appropriate document, of the quality document(s) for an activity

NOTE The test facility can provide the documentation to be reviewed to the initiator of the conformance test at an agreed time prior to the associated hold or witness point. It is subject to agreement how the review will be conducted.

3.29
system
set of interrelated elements considered in a defined context as a whole and separated from its environment

3.30
logical system
union of all communicating functions performing some overall tasks such as “management of a substation”

3.31
physical system
composition of all devices and the interconnecting physical communication network

NOTE The boundary of a system is given by its logical or physical interfaces. Within the scope of IEC 60870-5, system always refers to Telecontrol equipment and systems, if not mentioned otherwise.

3.32
system test
check of correct behaviour of the controlled/controlling station under various application conditions

NOTE The system test marks the final stage of the development of a Telecontrol equipment or system.

3.33
test equipment
all tools and instruments, which simulate and verify the communication traffic, input or outputs of the system under test

3.34
test facility
supplier-independent organisations, which are able to provide appropriate test equipment and trained staff for conformance testing

NOTE The management of conformance tests and the resulting information should follow a quality system according to ISO 9001/ISO 9002 as far as applicable.

Test facilities should comply with the requirements as described in this part of IEC 60870-5.

3.35
test item
one single test step out of the sequence of tests defined to verify conformance

3.36
type test
verification of correct behaviour of the DUT by use of the system tested software under the environmental test conditions corresponding with the technical data

NOTE The type test marks the final stage of the hardware development and is the precondition for the start of the production. This test should be carried out with IED's, which have been manufactured through the normal production cycle.

3.37
witness point
W
point, defined in the appropriate document, at which an inspection should take place on an activity. The activity may proceed without the approval of the initiator of the conformance test. The test facility can provide a written notice to the initiator at an agreed time prior to the witness point. The initiator or his representative has the right, but is not obliged, to verify the witness point

3.38
receiving system
system that receives the message, either on physical, link or application layer level, and can be a controlling (Master) station or a controlled (Slave) station

4 Abbreviations

ASDU	Application Service Data Unit
BAF	Basic Application Function
CASDU	Common Address of ASDU
COT	Cause Of Transmission
DUT	Device Under Test
FAT	Factory Acceptance Test
HMI	Human Machine Interface
IED	Intelligent Electronic Device
IOA	Information Object Address
IP	Inter-Networking Protocol
MTTF	Mean Time To Failure
PICS	Protocol Implementation Conformance Statement
PID	Protocol Implementation Document (=PICS + PIXIT)
PIXIT	Protocol Implementation eXtra Information for Testing
RTU	Remote Terminal Unit
SAT	Site Acceptance Test
SCADA	Supervisory Control And Data Acquisition
SUT	System Under Test
TCP	Transport Control Protocol
TE	Telecommunication Environment

5 Conformance testing

5.1 General

There are many steps involved from the development and production of a device to the proper running of a complete system designed according the specific needs of a customer. Suitable test steps are incorporated in this process.

The quality system of the producer/supplier forms the basis of reliable testing in development and production activities.

Many internal tests during the development of a device (or a system kit) result in a type test (unit level test) performed at least by the provider and – if required by applicable standards – by an independent test authority. In the context of this document, the term type test is restricted to the functional behaviour of the device.

Continuing routine tests in the production chain are necessary to ensure a constant quality of delivered devices in accordance with the quality procedures of the producer.

A conformance test is the type test for communication and – since communication establishes a system – the system related test of the incorporated IED's. As a global communications standard, the IEC 60870-5 series includes standardised conformance tests to ensure that all suppliers comply with applicable requirements.

Type tests and conformance test do not completely guarantee that all functional and performance requirements are met. However, when properly performed, such tests significantly reduce the risk of costly problems occurring during system integration in the factory and on-site.

Conformance testing does not replace project-specific system related tests such as the FAT and SAT. The FAT and SAT are based on specific customer requirements for a dedicated substation automation system and are done by the system integrator and normally witnessed by the customer. These tests increase the confidence level that all potential problems in the system have been identified and solved. These tests establish that the delivered substation automation system is performing as specified.

5.2 Conformance test procedures

In general, conformance testing of the communication behaviour of devices shall address the functional requirements and performance requirements of typical applications supported by these devices in a system.

Conformance testing demonstrates the capability of the DUT to operate with other devices in a specified way according to the PID. The conformance test shall prove that the communication of the DUT works according to the PID.

The role of institutions and test bodies for conformance testing and certifying the results is described in this Subclause.

For conformance testing, the following points shall be considered:

– The problem of any testing is the completeness of the tests. The number of all possible situations could be very large. This part of IEC 60870-5 and the technical specifications (IEC 60870-5-60x) takes into consideration the normal operating cases, but not the failure cases. Only some failure cases are defined and it is recommended to add failure test cases in case of a critical function.

– A communication standard does not standardise the functions of the communicating equipment, including failure modes of the functions . But both the existence of distributed functions and the impact of function response in devices on the data flow create some interdependence.

– Depending on the definition range of the standard, some properties of the device may be proven not by the conformance test itself, but by information and documents to be provided with the DUT for the conformance testing.

For every companion standard, the PICS form the basis for the tests. As input, PICS defines the supported functions of a device. The output is the test plan for the applicable companion standard that contains the PICS and the marked check boxes (with N, R or B) that indicates that the applicable mandatory test cases are validated and approved by a test facility. Optional or additional test cases can be part of the test plan but will be marked separately, including their reference to the PIXIT. If test cases are applicable as indicated in the PICS and/or PIXIT, these test cases are mandatory optional test cases.

The test plan for each companion standard is the same for the controlling and/or controlled station. The check box at the beginning of the PICS indicates whether a controlling or controlled station is tested and approved.

5.3 Quality assurance and testing

In order to assure the quality during conformance testing, a quality assurance system shall be in place. This shall be clearly demonstrated by the test facility. This applies also to the quality systems of all sub-suppliers.

In general, quality surveillance is used to monitor and verify the status of components during all phases of the conformance tests. For this purpose, inspections can be carried out, based on hold and witness points that are indicated by the purchaser or its representative in the test and inspection book that is supplied by the test facility. These inspections are process related and will provide information on, and confidence in the quality of the tests. It will reduce the risks of failure during the Factory Acceptance Test (FAT) and Site Acceptance Test (SAT).

5.4 Quality plan

5.4.1 Conformance test quality plan

The test facility can supply, for evaluation, a quality plan for the conformance test.

This plan describes all measures for the scope of work and/or deliveries in the areas of budget, organisation, time, information and quality. There is only one plan for the test facility and its sub-suppliers.

The conformance test quality plan shall also contain the following:

– The complete and detailed description of the work methods which guarantees that all verifiable activities will fulfil all applicable requirements and conditions as stated in the scope of work during the total lead time.

– A detailed description of all tasks to be performed, including references to the schedule, an overview of the involved staff, materials and work methods as well as relevant methods and procedures.

– A detailed description of the organisation, including the assignments, tasks and responsibilities of mentioned staff for all tests, inspections, research and audits during the various stages of the tests and the dates at which they will take place. These programs will be part of the test and inspection book.

– A method for handling deviations, changes and modifications during all stages of the test.

– A sign off procedure and a description of the documentation to be supplied.

5.4.2 Test and inspection plan

The conformance test quality plan shall contain a test and optionally, an inspection plan. In this plan, the test facility specifies, for all phases of the tests:

– what will be inspected, tested and registered;

– the purpose of the inspections and tests;

– the procedures and standards to which inspections, tests and registrations will be performed;

– the expected results of the inspections and tests;

– who will perform the inspections, tests and registrations.

The test facility is responsible for performing all activities mentioned in the test and inspection plan.

The test facility may, optionally, include a proposal for so-called hold, witness and review points in the test and inspection plan.

There are several methods to perform a hold or witness point. The initiator of the conformance test or his representative can be present during the execution of a test or inspection. It is, however, also possible to review the associated quality documents, for example checklists, verification and validation documents. This review can take place at the test facility's site during the execution of a test or inspection or at the initiator's site.

All hold and witness points shall be announced by the test facility at least at a predefined time before they take place. A period of at least one week is recommended, depending on the time needed for making travel arrangements and the availability of the needed resources.

The initiator of a conformance test has the right to conduct audits on the quality system of the test facility and its sub-suppliers. The test facility shall co-operate and provide access to all locations applicable for the conformance test. The initiator's right to check the quality of the conformance test does not dismiss the test facility from its responsibilities.

Inspections and tests by the initiator of a conformance test shall be possible at mutually agreed times at the locations, offices and factories of the test facility and all applicable third parties and sub-suppliers.

5.5 Testing

5.5.1 General

5.5.1.1 Starting conditions

Conformance testing shall be customised for each DUT based on the capabilities identified in the PID provided by the vendor. When submitting devices for testing, the following shall be provided:

a) device ready for testing;

b) protocol Implementation Document (PID);

c) instruction manuals detailing the installation and operation of the device or assistance for operating the DUT during the test.

5.5.1.2 General requirements

The requirements for conformance testing fall into two categories:

1) static conformance requirements (defines the requirements the implementation shall fulfil);
2) dynamic conformance requirements (defines the requirements that arise from the protocol used for a certain implementation).

Additionally for each of these categories one of the following shall be indicated:

a) mandatory;
b) conditional;
c) optional.

The static conformance requirements define the requirements the protocol implementation shall fulfil, while the dynamic conformance requirements define the requirements that arise from the protocol used in a specific system with a specific functionality.

It is required to define a Protocol Implementation Document (PID), which contains the Protocol Implementation Conformance Statement (PICS) and the Protocol Implementation eXtra Information for Testing (PIXIT) document. The PID describes how the protocol is used and always contains the interoperability section of the applicable companion standard. The outcome from the testing of a device for a particular PID shall be either “conforms” (no discrepancies) or “fails to conform” with a list of discrepancies. The test outcomes for devices tested to the same PID shall indicate if the devices are able to interoperate. The format of the test report is specified in this part of IEC 60870-5. It is required to use this part of IEC 60870-5 and the technical specifications (this part) as the basis for testing the protocol implementation, and if additional test cases are required (based on the PID), these shall be added to the specific requirements in the PIXIT before the Factory Acceptance Test (FAT). It is recommended to execute the conformance test before the FAT.

5.5.1.3 PICS

The static conformance requirements are defined in a PICS. The PICS serves four purposes:

– The selection of the appropriate set of tests for the device or system.
– To ensure that the tests appropriate to a claim of conformance are performed.
– To provide the basis for the review of the static conformance.
– To determine the mandatory test cases for the required functionality as stated in the PICS. Test cases are mandatory if the test cases refer to the basic application function, ASDU or functionality in the PICS, ticked as applicable. For example, if ASDU 100 is used, this means that all the options in this ASDU are mandatory unless restricted in the PIXIT.

A standard PICS, also known as the PICS proforma, is supplied in the applicable companion standard.

In addition to the PICS, a PIXIT document should be provided.

5.5.1.4 PIXIT

In addition to the PICS, a PIXIT document is highly recommended. The standard PICS is supplied in the test plan for each companion standard and is the basis for the PID.

The PIXIT contain information directly related to the protocol implementation, but which is system/company/country specific and therefore not part of one of the Companion Standards or optional. The PIXIT is necessary to clarify the grey area between the protocol implementation and telecontrol system functionality. The PIXIT focuses on static and dynamic conformance requirements and may contain, but is not restricted to, the following aspects:

redundancy, performance requirements, configuration overview, command execution requirements, message priority mechanisms, etc. The additional test cases for the functionality in the PIXIT are created, preferably by a test facility, and shall be approved by the user/owner of the PIXIT before starting the testing process. The map of IOA is a mandatory part of the PIXIT.

5.5.1.5 Conceptual conformance assessment process

The process of assessing the conformance is shown in Figure 1.

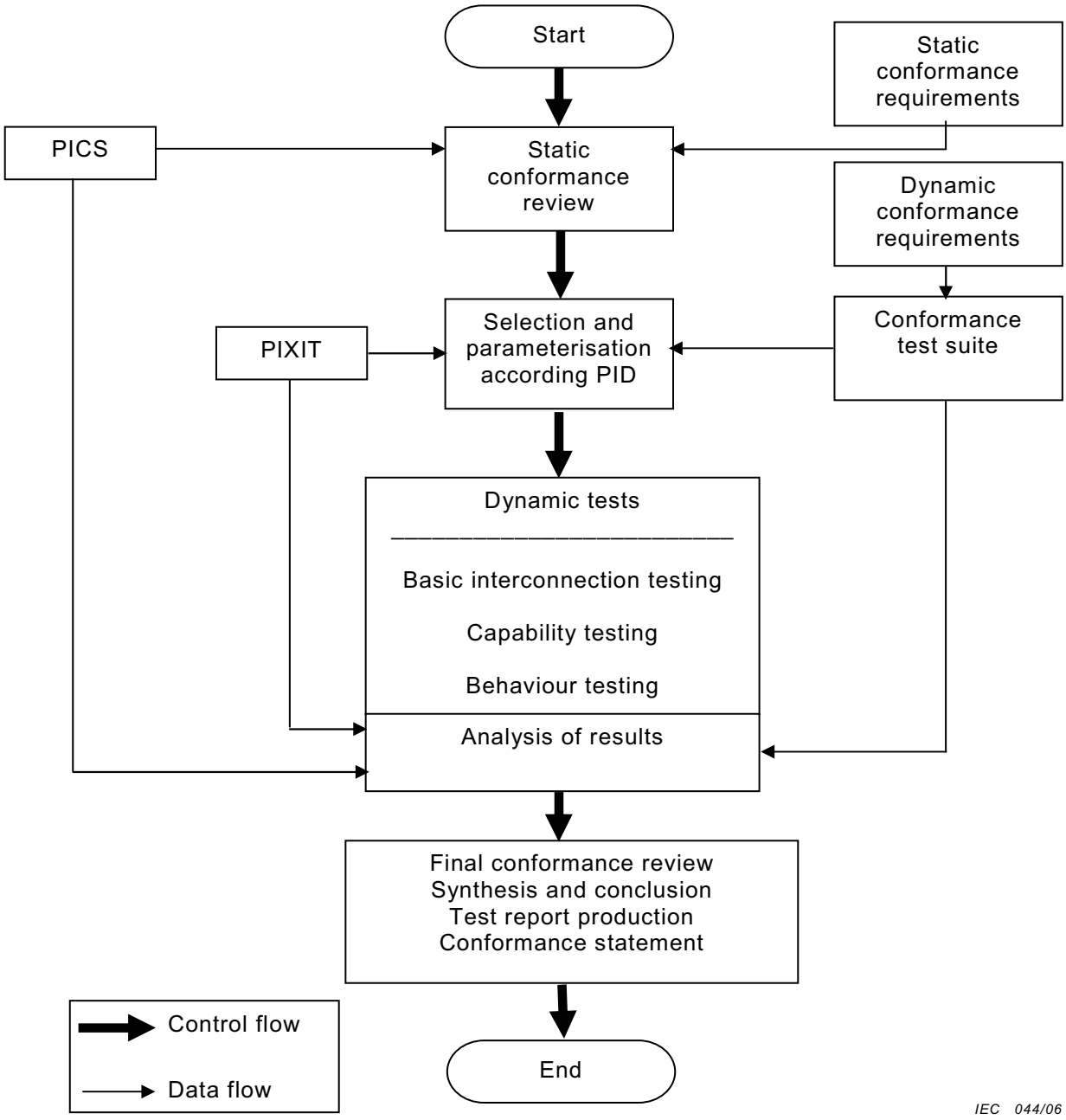

Figure 1 – Conceptual conformance assessment process

The final step to interoperability, with regard to conformance testing, is the verification of the interoperability of the DUT with other devices. Interoperability testing is beyond the scope of this part of IEC 60870-5, but recommended before the DUT goes into operation.

5.5.2 Device testing

5.5.2.1 General

A single device shall be conformance tested against a single test source by using a conformance test system or simulator, preferably executed by a test facility.

The PID is mandatory for conformance testing and does always include the PICS. The PIXIT is optional, but highly recommended. The device specific conformance tests contain the positive and negative testing of the mandatory test cases and optional system-specific test cases:

– Inspection of the documentation and version control of the device.
– Test of the requirements as in IEC 60870-5-1, IEC 60870-5-2 and IEC 60870-5-3 and the applicable companion standards.
– Test of implemented ASDU's/APDU's according to the definitions as in IEC 60870-5-4 and the applicable companion standard.
– Test of basic application functions as in IEC 60870-5-5 and the applicable companion standard.
– Verification of all the functionality in the protocol in a visible way by HMI or other means, for example verification of the measurand values and status points in the monitoring and control direction.
– Test of device-specific extensions according to rules given by all applicable IEC 60870-5 documents in general.

5.5.2.2 Requirements for the device under test

The supply of DUT specific test configuration hardware and software, to support a simulated target-operating environment, is to be negotiated between the initiator and test facility. The following are required:

– The DUT is able to operate as a controlling or controlled station in either standard or reversed direction according to the PID (depending of the type of DUT).
– The DUT must be fully configured according to the PID, and shall be able to execute all the functionality of the protocol implementation as described in the PID.
– The functionality described in the PID (for example basic application functions) related to data points such as parameter loading, read procedure, command transmission, etc. is implemented with a representative sub-set of data points.
– Verification of the data points shall be possible in a human readable way or format, and the verification of analogue and digital status changes is possible.
– The test focuses only on the protocol elements and functions as described in the PID; the test does not include the application logic and the operation of the tested system.

5.5.2.3 Requirements for the conformance test equipment

A protocol simulator is used to simulate the controlling or controlled station. The simulator is capable to perform, preferably automatically, the tests in this part of IEC 60870-5 and the applicable technical specification (IEC 60870-5-60x). The simulator is preferably flexible in adding or changing test cases in order to be adaptable to changes in the protocol standard and the PIXIT.

In all cases, the test shall be reproducible over time, test-engineer and test-facility (ISO/IEC 9646 series). A log-file in human-readable format shall be shown and available for all the mandatory tests.

In operational use, the device may show communication errors which forces the supplier to reproduce the complete conformance test (for example for verification afterwards) or for reproducing only the tests that were shown to have communication errors.

5.6 Testing process

5.6.1 Conformance testing process (informative)

The conformance testing process is described in Figure 2.

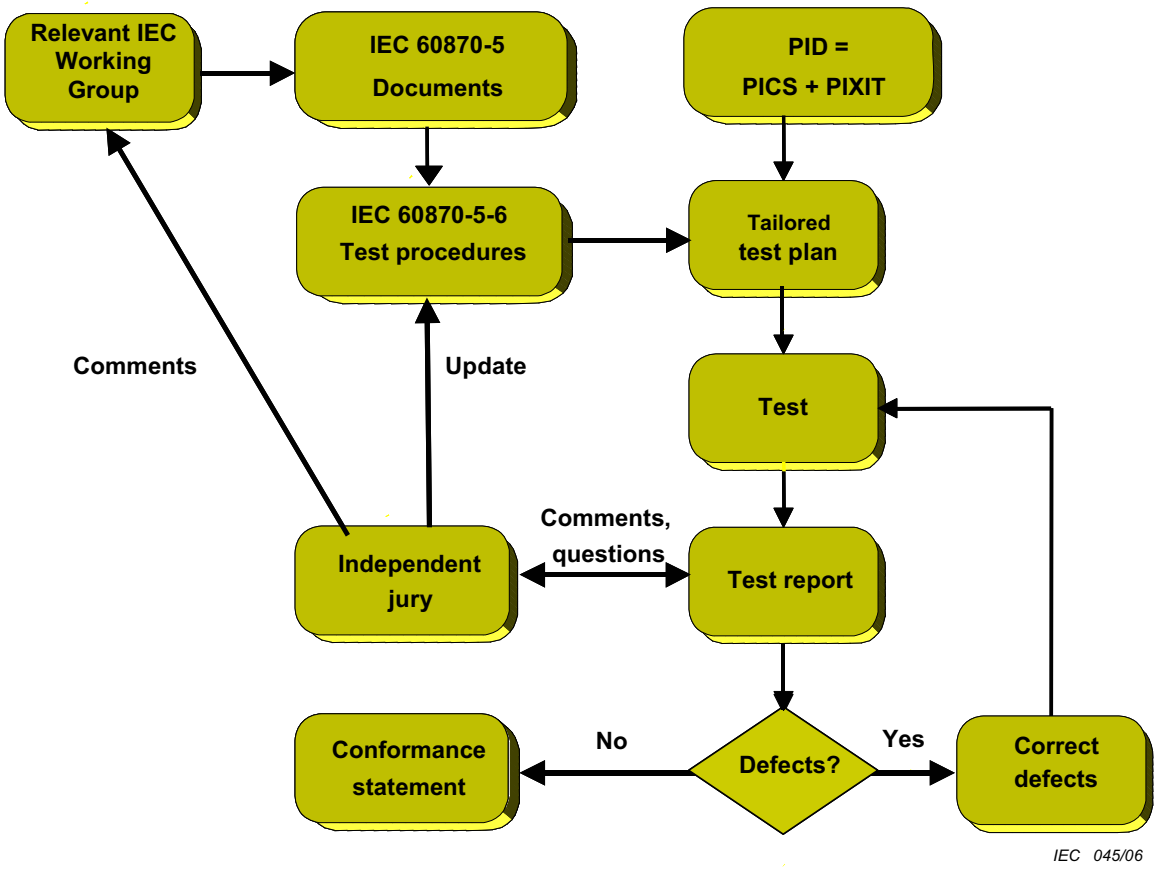

Figure 2 – Testing process

5.6.2 Quality program (informative)

In case of ambiguities during the testing, implementation process or elsewhere, the quality program of the relevant IEC Technical Committee 57 working group is publicly available (see http://www.trianglemicroworks.com/iec60870-5/). Figure 3 shows the procedure to follow in case of urgent and non-urgent issues.

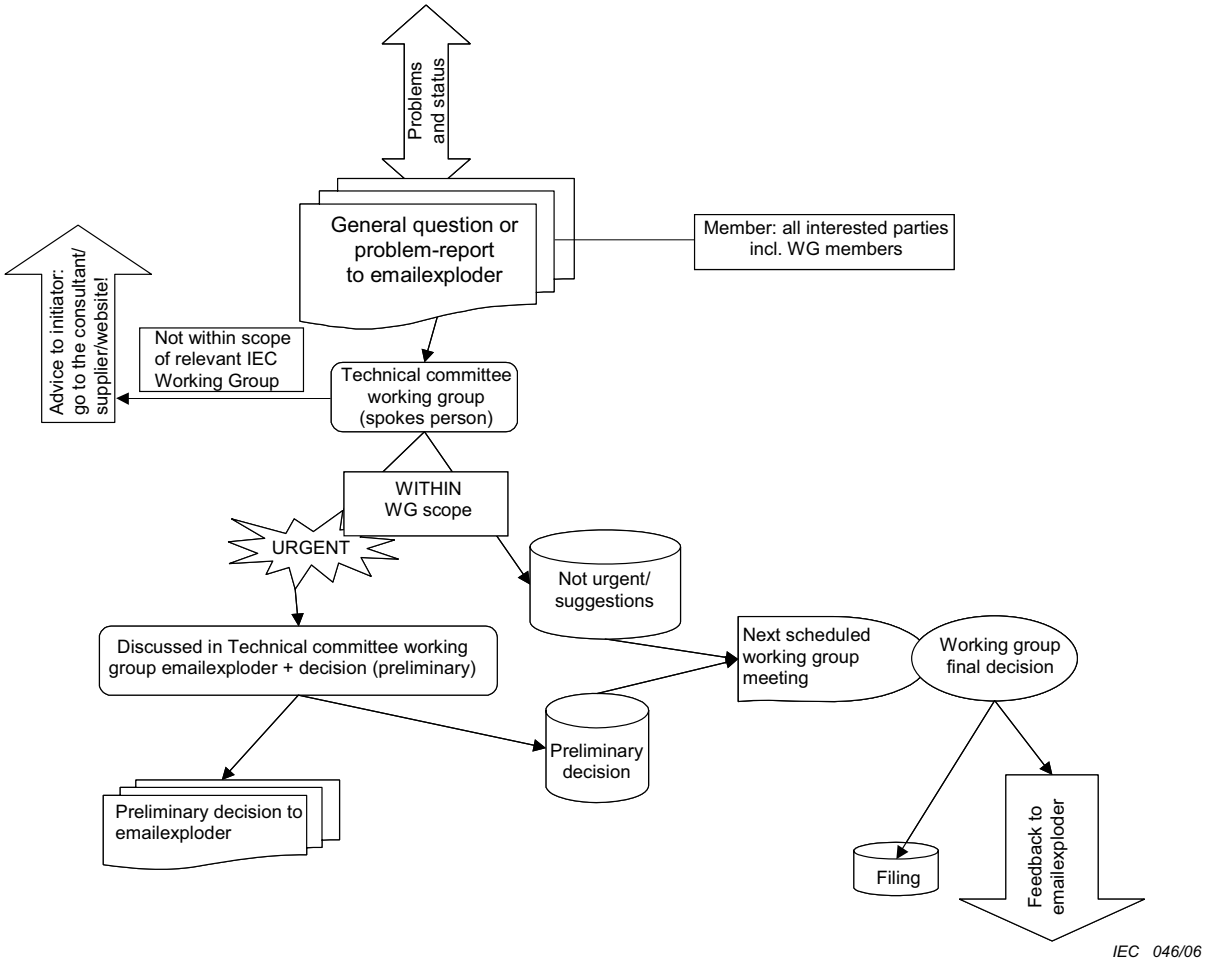

Figure 3 – Quality program

5.6.3 Verdict

The DUT has passed the conformance test if the question *"Does the IEC 60870-5-10x Protocol implementation in the DUT (name device) conform to the applicable Protocol Implementation Document (PID)?"* can be answered with a yes without any reservation, which means that:

a) all the mandatory functions and referring mandatory test cases are executed and passed correctly as described in the PICS;

b) the additional functionality and test cases as described in the PIXIT are executed and passed as described in the PIXIT;

c) if detected possible cause(s) of interoperability problems and risks (decided by the test facility and if necessary by the Quality program), will be reported in the recommendations of the conformance test report;

d) the observations during the test have not shown any cause for operational problems and/or risks;

e) behaviour of the DUT, which may be a cause for interoperable and/or operational risks, is approved within the quality program as described in 5.6.2;

f) the applicable test cases on physical and link level have not shown any non-conformant behaviour during the complete conformance test period, amongst others during testing the basic application functions and ASDU's.

5.7 Documentation

5.7.1 General

The documentation associated with conformance testing which are the deliverables of the conformance test consists of two parts:

– A conformance statement stating the conformance of a uniquely identifiable device (type, product range, version numbers) to specific parts of the applicable companion standard, the PICS and the PIXIT.

– A test report stating the details of the tests performed to verify conformance, which always contains the PICS as stated in 5.2.

5.7.2 Requirements for conformance statements

The test facility can provide a conformance statement, which states that a specific device or system has been tested for conformance to the applicable companion standard or a system/company/ country-specific PID.

A conformance statement shall include at least the following information:

– Unique ID of the conformance statement.

– Name and address of the vendor.

– Name and address of the initiator of the conformance test (if different from vendor name).

– Address details of the test location.

– Name of the tested device.

– Unique ID of the device type and version.

– All of the variants (for example software versions, product name, hardware, firmware, etc.) of tested device.

– Reference to whether the DUT operates as a controlling or controlled station during the tests.

– Related and applicable standards, including their date of issue.

– Related PID, with unique reference.

– Name and address of the test facility.

– Date of issue of the conformance statement.

– Legal signatures.

– Reference to underlying test reports.

– Approved basic application functions, marked with ‘limited’ if the complete function has not been tested and approved.

– Indication that the test is executed on one specimen of the product and that the test results may not be applicable to other specimens.

– The conformance statement produced after testing shall indicate any lack of conformance to either the test plan or the base standard.

A conformance statement remains valid as long as the vendor guarantees that no design or manufacturing changes in communication hard- and software with essential influence on the protocol implementation have been made to the certified device. If changes have been made, a retest is necessary to update the conformance statement and to assure conformity.

The conformance statement shows only the basic application functions, which are tested and approved. It is only allowed to put the basic application function on the statement if all mandatory test cases for the specific basic application functions have passed without any restriction as stated in other Subclauses of this part of IEC 60870-5. It is not allowed to approve and issue a conformance statement for a specific function without having passed all the mandatory test cases and, if applicable all the additional test case according to the PIXIT.

5.7.3 Requirements for conformance test reports

A conformance test report shall include the following:

– Reference list of all documents that describe or specify any qualifying tests that have been performed.
These documents may include the vendor's standard operating and testing procedures, and local, national and international standards. Document numbers, date, clause and sub-clauses shall cite international standards. References to other documents shall include complete source address and document identification. A complete and contextually accurate summary or extract of the document may be included for convenience.

– Description of purpose and contents of the document.

– A list of any specialised test equipment or computer programs used for performing the conformance tests.

– Name and address of the vendor.

– Name and address of the initiator of the conformance test (if different from vendor name).

– Name of the tested device.

– Exact description, configuration and addresses of the test configuration.

– All of the variants (hardware, firmware, etc.) of the tested device.

– Name and address of the test facility.

– Date of issue of test report.

– Name and signature of the tester.

– Unique reference number.

– A list of test items performed to verify conformance.

– The applicable PICS with only the check boxes marked, N, R and/or B, for the functionality that has passed the tests according to 5.6. With functionality, in this case it means Basic Application Function, ASDU, qualifier, etc.

– Detected possible cause(s) of interoperability problems and risks, including recommendations to minimize the risk.

– The following statement including the answer: "*Does the IEC 60870-5-10x Protocol implementation in the DUT (name device) conform to the applicable Protocol Implementation Document (PID)?* " The answer is only yes if all mandatory test cases with reference to the applicable Companion Standards and the additional test cases derived from the requirements in the PIXIT are passed without any reservation.

– For each test item, the following subjects shall be documented:

  a) Description of the test item with the objective of the test.

  b) Reference to the IEC 60870-5 part, Clause and Subclause.

  c) Unique identifier per test item.

  d) Test result as described in the legend.

– Overall conclusion per table with:

  a) Reference to the test cases that have failed or have remarks.

  b) Overall table conclusion indicating if all the test cases in this table are passed or that any test failed (table is failed if one or more mandatory test cases have failed).

– Observations during the test, which may be relevant for users of the equipment.

– Conformance test documentation shall be supplied to the initiator.

Bibliography

IEC 60870-5-101, *Telecontrol equipment and systems – Part 5-101: Transmission protocols – Companion standard for basic telecontrol tasks*

IEC 60870-5-103, *Telecontrol equipment and systems – Part 5-103: Transmission protocols – Companion standard for the informative interface of protection equipment*

IEC 60870-5-104, *Telecontrol equipment and systems – Part 5-104:, Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles*

ISO 9000:2005, *Quality management systems – Fundamentals and vocabulary*

ISO 9002:2000, *Quality systems – Model for quality assurance in production, installation and servicing*

ISO 9004:2000, *Quality management systems – Guidelines for performance improvement*s

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Q1 Please report on **ONE STANDARD** and **ONE STANDARD ONLY**. Enter the exact number of the standard: *(e.g. 60601-1-1)*

.....

Q2 Please tell us in what capacity(ies) you bought the standard *(tick all that apply).* I am the/a:

purchasing agent ❑
librarian ❑
researcher ❑
design engineer ❑
safety engineer ❑
testing engineer ❑
marketing specialist ❑
other.....

Q3 I work for/in/as a: *(tick all that apply)*

manufacturing ❑
consultant ❑
government ❑
test/certification facility ❑
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education ❑
military ❑
other.....

Q4 This standard will be used for: *(tick all that apply)*

general reference ❑
product research ❑
product design/development ❑
specifications ❑
tenders ❑
quality assessment ❑
certification ❑
technical documentation ❑
thesis ❑
manufacturing ❑
other.....

Q5 This standard meets my needs: *(tick one)*

not at all ❑
nearly ❑
fairly well ❑
exactly ❑

Q6 If you ticked NOT AT ALL in Question 5 the reason is: *(tick all that apply)*

standard is out of date ❑
standard is incomplete ❑
standard is too academic ❑
standard is too superficial ❑
title is misleading ❑
I made the wrong choice ❑
other .....

Q7 Please assess the standard in the following categories, using the numbers:
(1) unacceptable,
(2) below average,
(3) average,
(4) above average,
(5) exceptional,
(6) not applicable

timeliness.....
quality of writing.....
technical contents.....
logic of arrangement of contents .....
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other .....

Q8 I read/use the: *(tick one)*

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English text only ❑
both English and French texts ❑

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