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REDLINE VERSION

TECHNICAL SPECIFICATION

colour inside

Telecontrol equipment and systems –
Part 5-604: Conformance test cases for the IEC 60870-5-104 companion standard

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TELECONTROL EQUIPMENT AND SYSTEMS –

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FOREWORD

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The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 60870-5-604, which is a technical specification, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Resolution of ambiguities between IEC 60870-5-104:2006 and IEC TS 60870-5-604:2016 (together with IEC 60870-5-104/AMD1);
b) Refinement of some test cases to enhance operability between tested devices;
c) Additional test cases (mainly negative test cases) added.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
57/1614/DTS	57/1683/RVC

Full information on the voting for the approval of this technical specification 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.

A list of all parts of IEC 60870 series, published under the general title *Telecontrol equipment and systems,* can be found on the IEC website.

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 60870, which is a technical specification, describes test cases for conformance testing of telecontrol equipment or systems using ~~the IEC 60870-5 companion standard 104 based on~~ the IEC 60870-5-104 companion standard and IEC 60870-5-6, *Guidelines for conformance testing for the IEC 60870-5 companion standards*.

TELECONTROL EQUIPMENT AND SYSTEMS –

Part 5-604: Conformance test cases for the IEC 60870-5-104 companion standard

1 Scope

This part of IEC 60870, which is a technical specification ~~which is part of the IEC 60870-5 series~~, describes test cases for conformance testing of telecontrol equipment, Substation Automation Systems (SAS) and telecontrol systems, including front-end functions of SCADA, using the IEC 60870-5-104 companion standard and IEC 60870-5-6, *Guidelines for conformance testing for the IEC 60870-5 companion standards*.

The use of this part of IEC 60870 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 specification during testing will minimize the risk of non-interoperability.

The goal of this part of IEC 60870 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 IEC 60870-5-6. 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 a technical specification. Other functionality may need additional test cases but this is outside the scope of this part of IEC 60870. For proper testing, it is recommended to define these additional test cases. This document is such a Technical Specification for the mentioned companion standard.

This part of IEC 60870 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 is done according to these standards.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.[1]

IEC 60870-5-4:1993, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 4: Definition and coding of application information elements*

IEC 60870-5-5:1995, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 5: Basic application functions*

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[1] The base standard always takes precedence. In case of ambiguity between this technical specification and the base standards (IEC 60870-5-1 to IEC 60870-5-5, IEC 60870-5-104), this part of IEC 60870 needs to be clarified or amended.

When testing, negative behaviour is not described in the base standard, the behaviour described in this document prevails and should be observed.

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

IEC 60870-5-6:2006, *Telecontrol equipment and systems – Part 5-6: Guidelines for conformance testing for the IEC 60870-5 companion standards*

IEC 60870-5-101:2003, *Telecontrol equipment and systems – Part 5-101: Transmission protocols – Companion standard for basic telecontrol tasks*

IEC 60870-5-104:2006, *Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles*

IETF RFC2200, *Internet Official Protocol Standards*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60870-5-6 apply.

4 Abbreviated terms

For the purposes of this document, the abbreviations given in IEC 60870-5-6 apply.

5 Conformance testing for IEC 60870-5-104

5.1 Overview and legend

An overview of tests is given in Tables 1 to 26. Procedural and functional testing ~~must~~ shall always start with the Station Initialisation function and proceeds with the next Basic Application Functions. The procedure in each test case ~~must~~ shall be followed, which means that the DUT is able to function as described in the specific test case.

The test procedures in Tables 1 through 11 ~~must~~ shall be carried out with no errors detected during testing of all the Basic Application Functions in Tables 12 through 26. These tests are preferably automatically performed by the used test platform.

In addition to the performance criteria listed in the test procedures, 5.3 lists the protocol specifications that ~~must~~ shall be verified automatically by the testing software or verified manually by review of the test history log after execution of the test procedures. The verification ~~must~~ shall result in no errors detected during the complete test procedure.

This test plan has a direct reference to the PICS and possibly a PIXIT. Without a reference to a PICS or PIXIT this test plan is obsolete.

Test case numbering syntax is subclause number + table number + test case number.

Test cases are mandatory depending on the description in the column ‘Required’. The following situations are possible:

M = Mandatory test case regardless if enabled in the PICS/PIXIT, not only in one situation but during execution of all the tests as in the PICS and/or PIXIT

PICS, x.x = Mandatory test case if the functionality is enabled in the PICS (by marking the applicable check box), with a reference to the section number of the PICS (x.x);

NOTE PICS 9.x always refers to 60870-5-104:2006, Clause 9.

PIXIT = Mandatory test case if the functionality is enabled/described in the PIXIT. Verification of these test cases by the user/owner of the PIXIT is required before the test is started.

For each test case the test results ~~need to~~ shall be marked in the appropriate column of the test result chart in 5.5 and 5.6. Each test case can either pass the test (Passed), fail the test (Failed), not applicable, when the configuration value is not supported by the device (N.A.), or the test case was not performed (Empty). Ideally, there should be no empty boxes when testing is complete.

For testing reverse direction, the same test procedures apply in the opposite direction (replace "Controlling" with "Controlled" and vice versa), except for COT44-47 which are only defined in Monitor direction (only a controlled station is allowed to send these COT).

The test tables are divided into 5 subclauses:

- Subclause 5.2 Configuration parameters IEC 60870-5-104
- Subclause 5.3 Verification of IEC 60870-5-104 communication
- Subclause 5.4 Conformance test procedures
- Subclause 5.5 Test result chart
- Subclause 5.6 Test results of command transmission

The procedure to perform all the mandatory test cases, according to the PID, is shown in Figure 1.

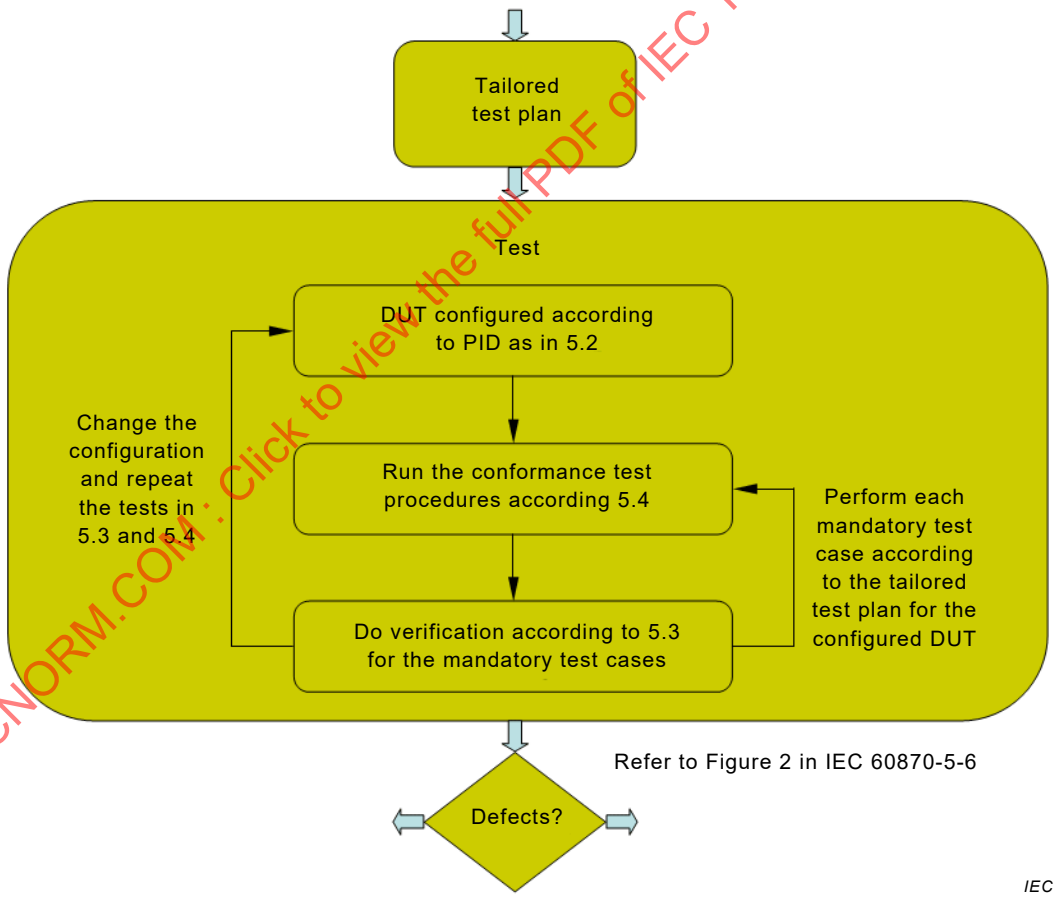

Figure 1 – Test procedure

5.2 Configuration parameters IEC 60870-5-104

Since IEC 60870-5-104 contains a number of configuration parameters affecting protocol behaviour, the conformance test procedures in 5.4 and verification in 5.3 ~~must~~ shall be performed at least once for each supported value of the parameters listed in Table 1. Basically the DUT ~~must~~ shall be tested if the functionality in 5.3 and 5.4 behaviour is correct for the configuration(s) in Table 1.

Table 1 – Run the Conformance Test Procedures for each of the following supported configuration parameter values

No.	Test	Description	Reference	Required
5.2.1.1	System definition	Controlling station test (Master)		PICS, 9.1
5.2.1.2		Controlled station test (Slave)		PICS, 9.1
5.2.1.50	Frame length	Maximum length L (control direction)	IEC 60870-5-101:2003, 6.2	PICS, 9.4
5.2.1.51		Maximum length L (monitor direction)	IEC 60870-5-101:2003, 6.2	PICS, 9.4
5.2.1.70	COMMON ADDRESS of ASDU	Two (2) octets for Common Address of ASDU (CASDU)	IEC 60870-5-101:2003, 7.2.4	PICS, 9.5
5.2.1.80	INFORMATION OBJECT ADDRESS	Three (3) octets for Information Object Address (structured or unstructured)	IEC 60870-5-101:2003, 7.2.5	PICS, 9.5
5.2.1.90	CAUSE OF TRANSMISSION	Two (2) octets for COT field (2nd octet is Originator address)	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5

5.3 Verification of IEC 60870-5-104 communication

This subclause lists the protocol specifications that ~~must~~ shall be verified automatically by the testing software or verified manually by review of the test history log after execution of the test procedures. Every test case describes functionality that has passed the test if the functionality as in the the description column was shown to be correct. Correct means: the functionality ~~must~~ shall be checked either automatically or manually, and also be checked by the test engineer in a human readable format log-file. For example to test the IV qualifier of some information elements, the ASDU containing this element ~~must~~ shall be sent with the IV=1. Every test case marked “Passed”, has to be verifiable during testing and archived in log-files for post assessment.

To identify if a test case is mandatory, it is necessary to read 5.1 carefully.

Table 2 – Tests on transport provider level *(1 of 5)*

No.	Test	Description	Reference	Required
5.3.2.1	IP FRAME	IP Header, IP Fragment Re-assembling	IETF RFC2200	M
5.3.2.2		Source Address, Destination address	IETF RFC2200	M
5.3.2.3	TCP FRAME	TCP Header, TCP Control field (specifically ACK, RST, SYN, FIN), TCP Sequencing	IETF RFC2200	M
5.3.2.4		[The server (controlled station) uses the] port number 2404 [(confirmed by IANA) in all cases, both for the listening port and established connections. The client (controlling station) is free to use ephemeral port number, e.g. as allocated by the client's TCP/IP implementation]	IEC 60870-5-104:2006, 5.4 ~~[MOM WG03 15 June 2001 4.2.2.4] (Especially marked because it is not yet in the standard!)~~	M
5.3.2.5		Actively *opening* a new TCP connection starts with a TCP frame containing (SYN) from the node that takes the initiative to establish the TCP connection. This is answered by the other node with (SYN, ACK), which in turn is answered by the initiating node with (ACK). Thereinafter the TCP connection is established	IETF RFC2200 IEC 60870-5-104:2006, 7.1	M
5.3.2.6		Actively *closing* an established TCP connection starts with a TCP frame containing (FIN) from the node that takes the initiative to close the TCP connection. This is answered by the other node (ACK) followed by a TCP frame from this same other node containing also (FIN). This in turn is answered by the initiating node with (ACK). Thereinafter the TCP connection is closed. It can be accepted if a node combines an (ACK) and a (FIN) in a single TCP frame in reply to a TCP frame with a (FIN).	IETF RFC2200 IEC 60870-5-104:2006, 7.1, Figure 19	M
5.3.2.7		~~TCP Data stream on an established TCP connection contains APDU's. APDU's are correctly assembled when divided over multiple TCP frames~~ During the test no problems should be detected on TCP/IP level	~~IEC 60870-5-104, Clause 5~~ IETF RFC2200	M
5.3.2.10	CS104 APDU FRAME LAYOUT	Start character of APDU: 68_H	IEC 60870-5-104:2006, Clause 5	M
5.3.2.11		Configured number of octets L as the maximum number of Data octets (ASDU + Control field) in APDU: The maximum length of APDU for both directions is 253. It is a fixed system parameter.	IEC 60870-5-104:2006, Clause 5	~~PICS, 9.4~~ M
5.3.2.12		4-octet Control field	IEC 60870-5-104:2006, Clause 5	M

Table 2 *(2 of 5)*

No.	Test	Description	Reference	Required
5.3.2.20	CS104 I-FORMAT APDU Information transfer frame	Control field octet 1 bit 1 (LSB) = 0	IEC 60870-5-104:2006, Clause 5	M
5.3.2.21		Control field octets 1-2, bit 2..16 contain end sequence number N(S) range 0..Maximum value 32767	IEC 60870-5-104:2006, Clause 5	M
5.3.2.22		Control field octet 3 bit 1 (bit 17) = 0	IEC 60870-5-104:2006, Clause 5	M
5.3.2.23		Control field octets 3-4, bit 18..32 contain Receive sequence number N(R) range 0..maximum value 32767	IEC 60870-5-104:2006, Clause 5	M
5.3.2.24		I-format frame contains exactly one ASDU	IEC 60870-5-104:2006, Clause 5	M
5.3.2.25	CS104 S-FORMAT APDU Numbered Supervisory function frame	Control field octet 1, bit 1-2 have value 01_B	IEC 60870-5-104:2006, Clause 5	M
5.3.2.26		Control field octets 1-2, bit 3..16 all contain value 0	IEC 60870-5-104:2006, Clause 5	M
5.3.2.27		Control field octet 3 bit 1 (bit 17) = 0	IEC 60870-5-104:2006, Clause 5	M
5.3.2.28		Control field octets 3-4, bit 18..32 contain Receive sequence number N(R) range 0..maximum value 32767	IEC 60870-5-104:2006, Clause 5	M
5.3.2.29		S-frame APDU only contains a single APCI field	IEC 60870-5-104:2006, Clause 5	M
5.3.2.30	CS104 U-FORMAT APDU Unnumbered Control function frame	Control field octet 1, bit 1-2 have value 11_B	IEC 60870-5-104:2006, Clause 5	M
5.3.2.31		Control field octet 1, bit 3 used for control function STARTDT Activation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.32		Control field octet 1, bit 4 used for control function STARTDT Confirmation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.33		Control field octet 1, bit 5 used for control function STOPDT Activation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.34		Control field octet 1, bit 6 used for control function STOPDT Confirmation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.35		Control field octet 1, bit 7 used for control function TESTFR Activation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.36		Control field octet 1, bit 8 used for control function TESTFR Confirmation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.37		Control field bit 3..8 contains exactly one active (bit with value 1) Control function (TESTFR, STARTDT, STOPDT, either Activation or Confirmation) per U-frame	IEC 60870-5-104:2006, Clause 5	M
5.3.2.38		Control field octets 2-4, bit 9..32 all contain value 0	IEC 60870-5-104:2006, Clause 5	M
5.3.2.39		U-frame APDU only contains a single APCI field	IEC 60870-5-104:2006, Clause 5	M

Table 2 *(3 of 5)*

No.	Test	Description	Reference	Required
5.3.2.50	TRANSMISSION PROCEDURE	Balanced transmission (after TCP connection has been established)	IEC 60870-5-104:2006, Introduction	M
		The initial values of the Send sequence number N(S) and the Receive sequence number N(R) are set to 0 (zero) after a new TCP connection is successfully established which is then a Stopped connection	IEC 60870-5-104:2006, 5.1	M
		An I-frame contains the current values of the Send sequence number N(S) and the Receive sequence number N(R)	IEC 60870-5-104:2006, 5.1	M
		After *sending* an I-frame, the Send sequence number N(S) in the Primary station is incremented with 1	IEC 60870-5-104:2006, 5.1	M
		After *receiving* a valid I-frame, the Receive sequence number N(R) in the Secondary station is incremented with 1	IEC 60870-5-104:2006, 5.1	M
		Yet unacknowledged I-frames from the Primary station are acknowledged by either an I-frame or an S-frame from the Secondary station	IEC 60870-5-104:2006, 5.1	M
		The Receive sequence number N(R) acknowledges all yet unacknowledged I-frames with N(S) < N(R)	IEC 60870-5-104:2006, 5.1	M
		A Primary station **sends at most the configured amount of K unacknowledged I-frames** before it stops and waits for an acknowledgement	IEC 60870-5-104:2006, 5.5	M
		A Secondary station sends an acknowledgement after **receiving at most the configured amount of W I-frames**	IEC 60870-5-104:2006, 5.5	M
		An APDU with a Send sequence number N(S) that is *higher or lower (called "out of sequence")* than the current Receive sequence number N(R), results in [sending an S-frame to confirm the I-frames that it has received (if applicable) after which] a TCP Active close (TCP Control field FIN) is given by the Secondary Station (because one or more previous APDUs may have been lost along the way to their destination due to connection failures)	IEC 60870-5-104:2006, 5.1 ~~[MOM WG03 15 June 2001 4.2.1/4.2.2.3]~~	M
		U-Frame Control function STARTDT_ACT answered with STARTDT_CON	IEC 60870-5-104:2006, 5.3	M
		U-Frame Control function STOPDT_ACT answered with STOPDT_CON	IEC 60870-5-104:2006, 5.3	M
		U-Frame Control function TESTFR_ACT answered with TESTFR_CON	IEC 60870-5-104:2006, 5.2	M

Table 2 *(4 of 5)*

No.	Test	Description	Reference	Required
5.3.2.70	TRANSMISSION CONTROL USING START/STOP	After a TCP connection has been established, initially a *Stopped connection* is created (a Stopped connection is an open ("established") TCP connection that is in confirmed STOPDT state) and allows the exchange of U-frames in controlling and controlled direction	IEC 60870-5-104:2006, 5.3	M
		~~Both the Controlling and Controlled station explicitly disable the transfer and do not answer~~ The receipt of I- and S-frames in a *Stopped connection* results in a TCP Active close (TCP Control field FIN).	IEC 60870-5-104:2006, 5.3 ~~[MOM WG03 15 June 2001 4.2.2.5]~~	M
		The controlling station sends a STARTDT_ACT after which a *Pending Started connection* is created. If no redundant links are configured, the controlling station may send U-, I-, and S- frames immediately after the STARTDT_ACT which will be accepted by the controlled station	IEC 60870-5-104:2006, 5.3 ~~[MOM WG03 15 June 2001 4.2.2.5]~~	M
		The controlled station explicitly disables the transfer of I- and S-frames and the controlling station does not accept I- or S-frames in a *Pending Started connection,* but only U-frames	IEC 60870-5-104:2006, 5.3 ~~[MOM WG03 15 June 2001 4.2.2.5]~~	M
		After the controlling station has received STARTDT_CON, the *Started connection* is created and the controlled station may sent U-, I-, and S- frames immediately after the STARTDT_CON. Controlled and controlling stations are allowed to send U-, I-, and S- frames	IEC 60870-5-104:2006, 5.3 ~~[MOM WG03 15 June 2001 4.2.2.5]~~	M
		The Controlling station explicitly disables the transfer of I-frames in monitoring direction by sending a STOPDT_ACT to the Controlled station, after which a *Pending Stopped connection* is created	IEC 60870-5-104:2006, 5.3 ~~[MOM WG03 15 June 2001 4.2.2.5]~~	M
		The controlled station disables the transfer of I-frames after the STOPDT_ACT is received. The controlling station may receive I-frames, which are transferred before the receipt of the STOPDT_ACT	IEC 60870-5-104:2006, 5.3 ~~[MOM WG03 15 June 2001 4.2.2.5]~~	M
		If unconfirmed I-frames are in the controlled station, the *Pending Stopped connection* is called the *Pending Unconfirmed Stopped connection*. If the controlled station receives the S-frame to confirm the I-frames (immediately or after time-out t2 of the controlling station expires) the controlled station sends the STOPDT_CON after the *Stopped connection* is created	IEC 60870-5-104:2006, 5.3 ~~[MOM WG03 15 June 2001 4.2.2.5]~~	M
		If NO unconfirmed I-frames are in the controlled station the controlled station sends a STOPDT_CON to the controlling station after which the *Stopped connection* is created	IEC 60870-5-104:2006, 5.3 ~~[MOM WG03 15 June 2001 4.2.2.5]~~	M
		Send sequence number N(S) and Receive Sequence number N(R) remain unchanged during the use of U-frames with STARTDT / STOPDT indications	IEC 60870-5-104:2006, 5.3	M

Table 2 *(5 of 5)*

No.	Test	Description	Reference	Required
5.3.2.90	TIME OUT INTERVALS	An unanswered TCP Active open by the (fixed) Controlling Station (TCP Control field SYN: CONNECTION REQUEST) is actually cancelled after the configured **time out** t_0 (range 1..255 s) and subsequently restarted. It is highly recommended to cancel the current timed out TCP Active open, to prevent against an increasing number of "not cancelled" TCP connections because of the limited number of available open connections in a system	IEC 60870-5-104:2006, 7.1, Figure 19	~~M~~ PIXIT
		A TCP Passive open by the Controlled Station (LISTEN) remains active infinitely until a CONNECT is received	IEC 60870-5-104:2006, 7.1	M
		An I-frame from the Primary Station that is not acknowledged within the configured **time out** t_1 (range 1..255 s) results in a TCP Active close (TCP Control field FIN) by the Primary Station. [The **time out** t_1 runs for every I-frame individually and is cancelled if that particular I-frame has been confirmed.]	IEC 60870-5-104:2006, 5.1, Figure 12 IEC 60870-5-104:2006, 5.2 IEC 60870-5-104:2006, 5.3 ~~[MOM WG03 15 June 2001 4.2.1/4.2.2.3]~~	M
		A U-frame from the Primary Station that is not confirmed within the configured **time out** t_1 (range 1..255 s) results in a TCP Active close (TCP Control field FIN) by the Primary Station	IEC 60870-5-104:2006, 5.1 IEC 60870-5-104:2006, 5.2	M
		After the configured **time period** t_2 (range 1..254 s) of transmitting I-frames, [which starts after the first unconfirmed frame is received], from the Primary Station in one direction only, an S-frame is sent by the Secondary Station to acknowledge the last I-frame	IEC 60870-5-104:2006, 5.1, Figure 10 ~~[MOM WG03 15 June 2001 4.2.1/4.2.2.3]~~	M
		$t_2 < t_1$	IEC 60870-5-104:2006, 9.6	M
		After the configured **time period** t_3 (range ~~1..255 s~~ 1..s 48 h, resolution 1 s) of inactivity (no ~~transmission~~ reception of I-, S- or U-frames on the connection by either Primary or Secondary station), a U-frame with TESTFR_ACT is sent. The reception of every frame – I frame, S frame or U frame – retriggers timer t3 and all time out interval rules apply	IEC 60870-5-104:2006, 5.2	M
		$t_3 > t_1$	IEC 60870-5-104:2006, 9.6	M

Table 3 – Tests on data unit identifier

No.	Test	Description	Reference	Required
5.3.3.1	TYPE IDENTIFICATION	Compatible ASDU type used/accepted for all ASDUs as in the PICS	IEC 60870-5-101:2003, 7.2.1.1 IEC 60870-5-101:2003, 7.3.1 IEC 60870-5-104:2006, Clause 8 PID	PICS, 9.5
5.3.3.2	VARIABLE STRUCTURE QUALIFIER	Variable structure qualifier SQ (Sequence or Set) as defined for each ASDU	IEC 60870-5-101:2003, 7.2.2 IEC 60870-5-101:2003, 7.3.1	M
5.3.3.3		SQ:=1 only for COT Spontaneous (3), Cyclic/Periodic (1), ~~Requested (5)~~ Background Scan (2) or Interrogation (20..36). Check the PICS for the supported COT values	IEC 60870-5-101:2003, 7.2.2	PIXIT
5.3.3.4		Variable structure qualifier i (Number of elements) according to transmitted number of information elements	IEC 60870-5-101:2003, 7.2.2	M
5.3.3.5		Defined number of octets for ASDU	IEC 60870-5-101:2003, 7.2	M
5.3.3.10	CAUSE OF TRANSMISSION	Originator address identifies source application of Primary station or 0 if present but not used	IEC 60870-5-101:2003, 7.2.3 IEC 60870-5-104:2006, 9.5	PIXIT
5.3.3.11		Compatible Cause Of Transmission (COT) used/accepted. Check the PICS for the supported COT values	IEC 60870-5-101:2003, 7.2.3 IEC 60870-5-101:2003, 7.2.3	PICS, 9.5
5.3.3.12		P/N bit = 0: positive confirmation of activation	IEC 60870-5-101:2003, 7.2.3	M
5.3.3.13		P/N bit = 1: negative confirmation of activation	IEC 60870-5-101:2003, 7.2.3	M
5.3.3.14		Test bit = 0: ASDU generated during normal conditions	IEC 60870-5-101:2003, 7.2.3	M
5.3.3.15		Test bit = 1: ASDU generated during test conditions	IEC 60870-5-101:2003, 7.2.3	PIXIT

Table 4 – Verification of ASDUs for process information in monitor (normal) direction *(1 of 18)*

No.	Test	Description	Reference	Required
5.3.4.10	M_SP_NA_1 ASDU 1 Single-point information	SIQ with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.1	PICS, 9.5
5.3.4.11		SIQ with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.1	PIXIT
5.3.4.12		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.1	PICS, 9.5
5.3.4.13	SIQ	SPI = 0 (OFF), 1 (ON)	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.14		RES = 0	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.15		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.16		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.17		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.18		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.30	M_DP_NA_1 ASDU 3 Double-point information	DIQ with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.3	PICS, 9.5
5.3.4.31		DIQ with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.3	PIXIT
5.3.4.32		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.3	PICS, 9.5
5.3.4.33	DIQ	DPI = 0 (indeterminate or intermediate state), 1 (OFF), 2 (ON), 3 (indeterminate state)	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5
5.3.4.34		RES = 0	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5
5.3.4.35		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.36		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.37		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.38		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5

Table 4 *(2 of 18)*

No.	Test	Description	Reference	Required
5.3.4.50	M_ST_NA_1 ASDU 5 Step-position information	VTI with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.5	PICS, 9.5
5.3.4.51		VTI with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.5	PIXIT
5.3.4.52		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.5	PICS, 9.5
5.3.4.53	VTI	Value valid range −64..+63	IEC 60870-5-101:2003, 7.2.6.5	PICS, 9.5
5.3.4.54		Transient = 0,1	IEC 60870-5-101:2003, 7.2.6.5	PICS, 9.5
5.3.4.55	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.56		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.57		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.58		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.59		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.60		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.70	M_BO_NA_1 ASDU 7 Bitstring of 32 bit	BSI with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.7	PICS, 9.5
5.3.4.71		BSI with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.7	PIXIT
5.3.4.72		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.7	PICS, 9.5
5.3.4.73	BSI	BSI = 0,1	IEC 60870-5-101:2003, 7.2.6.13	PICS, 9.5
5.3.4.74	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.75		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT

Table 4 *(3 of 18)*

No.	Test	Description	Reference	Required
5.3.4.76		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.77		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.78		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.79		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.90	M_ME_NA_1	NVA with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.9	PICS, 9.5
5.3.4.91	ASDU 9 Measured value, normalised value	NVA with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.9	PIXIT
5.3.4.92		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.9	PICS, 9.5
5.3.4.93	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.4.94		Range -1 to $+1-2^{-15}$	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5
5.3.4.95	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.96		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.97		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.98		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.99		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.100		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5

Table 4 *(4 of 18)*

No.	Test	Description	Reference	Required
5.3.4.110	M_ME_NB_1 ASDU 11 Measured value, scaled value	SVA with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.11	PICS, 9.5
5.3.4.111		SVA with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.11	PIXIT
5.3.4.112		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.11	PICS, 9.5
5.3.4.113	SVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5 PIXIT
5.3.4.114		Range -2^{15} to $2^{15} - 1$	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5
5.3.4.115	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.116		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.117		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.118		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.119		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.120		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.130	M_ME_NC_1 ASDU 13 Measured value, short floating point number	IEEE STD 754 with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.13	PICS, 9.5
5.3.4.131		IEEE STD 754 with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.13	PIXIT
5.3.4.132		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.13	PICS, 9.5

Table 4 *(5 of 18)*

No.	Test	Description	Reference	Required
5.3.4.133	IEEE STD 754	Fraction = 0.. $1-2^{-23}$	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.134		Exponent = 0.. 255	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.135		Sign = 0,1	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.136	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.137		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.138		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.139		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.140		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.141		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.150	M_IT_NA_1 ASDU 15 Integrated totals	BCR with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.15	PICS, 9.5
5.3.4.151		BCR with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.15	PIXIT
5.3.4.152		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.15	PICS, 9.5
5.3.4.153	BCR	Value range -2^{31} to $+2^{31}-1$	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.154		Sequence Number SQ range 0 to 31	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.155		CY = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.156		CA = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.157		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.170	M_PS_NA_1 ASDU 20 Packed single-point information with status change detection	SCD with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.20	PICS, 9.5
5.3.4.171		SCD with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.20	PIXIT
5.3.4.172		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.20	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.173	SCD	STi = 0,1	IEC 60870-5-101:2003, 7.2.6.40	PIXIT
5.3.4.174		CDi = 0,1	IEC 60870-5-101:2003, 7.2.6.40	PIXIT
5.3.4.175	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.176		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.177		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.178		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.179		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.180		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.190	M_ME_ND_1	NVA with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.21	PICS, 9.5
5.3.4.191	ASDU 21 Measured value, normalised value without quality descriptor	NVA with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.21	PIXIT
5.3.4.192		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.21	PICS, 9.5
5.3.4.193	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.4.194		Range −1 to +1−2^{-15}	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5
5.3.4.210	M_SP_TB_1	SIQ with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.22	PICS, 9.5
5.3.4.211	ASDU 30 Single-point information with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.22	PICS, 9.5

Table 4 *(7 of 18)*

No.	Test	Description	Reference	Required
5.3.4.212	SIQ	SPI = 0 (OFF), 1 (ON)	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.213		RES = 0	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.214		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.215		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.216		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.217		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.218	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.219		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.220		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.221		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.222		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.223		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.224		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.225		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.226		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.227		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.228		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.230	M_DP_TB_1	DIQ with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.23	PICS, 9.5
5.3.4.231	ASDU 31 Double-point information with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.23	PICS, 9.5

Table 4 *(8 of 18)*

No.	Test	Description	Reference	Required
5.3.4.232	DIQ	DIQ = 0 (indeterminate or intermediate state), 1 (OFF), 2 (ON), 3 (indeterminate state)	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5
5.3.4.233		RES = 0	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5
5.3.4.234		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.235		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.236		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.237		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5
5.3.4.238	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.239		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.240		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.241		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.242		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.243		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.244		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.245		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.246		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.247		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.248		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.250	M_ST_TB_1	VTI with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.24	PICS, 9.5
5.3.4.251	ASDU 32 Step-position information with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.24	PICS, 9.5
5.3.4.252	VTI	Value valid range –64..+63	IEC 60870-5-101:2003, 7.2.6.5	PICS, 9.5
5.3.4.253		Transient = 0,1	IEC 60870-5-101:2003, 7.2.6.5	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.254	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.255		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.256		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.257		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.258		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.259		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.260	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.261		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.262		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.263		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.264		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.265		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.266		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.267		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.268		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.269		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.270		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.280	M_BO_TB_1	BSI with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.25	PICS, 9.5
5.3.4.281	ASDU 33 Bitstring of 32 bit with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.25	PICS, 9.5
5.3.4.282	BSI	BSI = 0,1	IEC 60870-5-101:2003, 7.2.6.13	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.283	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.284		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.285		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.286		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.287		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.288		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.289	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.290		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.291		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.292		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.293		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.294		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.295		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.296		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.297		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.298		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.299		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.310	M_ME_TD_1	NVA with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.26	PICS, 9.5
5.3.4.311	ASDU 34 Measured value, normalised value with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.26	PICS, 9.5
5.3.4.312	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.4.313		Range –1 to $+1–2^{-15}$	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.314	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.315		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.316		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.317		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.318		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.319		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.320	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.321		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.322		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.323		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.324		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.325		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.326		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.327		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.328		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.329		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.330		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.340	M_ME_TE_1	SVA with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.27	PICS, 9.5
5.3.4.341	ASDU 35 Measured value, scaled value with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.27	PICS, 9.5
5.3.4.342	SVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5 PIXIT
5.3.4.343		Range -2^{15} to $2^{15} - 1$	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.344	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.345		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.346		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.347		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.348		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.349		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.350	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.351		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.352		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.353		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.354		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.355		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.356		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.357		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.358		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.359		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.360		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.370	M_ME_TF_1	IEEE STD 754 with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.28	PICS, 9.5
5.3.4.371	ASDU 36 Measured value, short floating point number with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.28	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.372	IEEE STD 754	Fraction = 0.. $1–2^{-23}$	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.373		Exponent = 0.. 255	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.374		Sign = 0,1	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.375	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.376		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.377		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.378		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.379		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.380		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.381	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.382		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.383		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.384		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.385		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.386		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.387		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.388		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.389		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.390		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.391		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.400	M_IT_TB_1	BCR with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.29	PICS, 9.5
5.3.4.401	ASDU 37 Integrated totals with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.29	PICS, 9.5
5.3.4.402	BCR	range -2^{31} to $+2^{31}-1$	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.403		Sequence Number SQ range 0 to 31	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.404		CY = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.405		CA = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.406		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.407	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.408		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.409		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.410		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.411		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.412		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.413		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.414		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.415		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.416		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.417		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.430	M_EP_TD_1	SEP with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.30	PICS, 9.5
5.3.4.431	ASDU 38 Event of protection equipment with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.30	PICS, 9.5
5.3.4.432	SEP	ES = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PIXIT
5.3.4.433		RES = 0	IEC 60870-5-101:2003, 7.2.6.10	PICS, 9.5
5.3.4.434		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PIXIT
5.3.4.435		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PIXIT
5.3.4.436		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PIXIT
5.3.4.437		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PICS, 9.5
5.3.4.438		EI = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PIXIT
5.3.4.439	CP16Time2a	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.20	PICS, 9.5
5.3.4.440	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.441		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.442		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.443		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.444		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.445		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.446		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.447		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.448		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.449		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.450		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.460	M_EP_TE_1	SPE with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.31	PICS, 9.5
5.3.4.461	ASDU 39 Packed start events of protection equipment with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.31	PICS, 9.5
5.3.4.462	SPE	GS = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.463		SL1 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.464		SL2 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.465		SL3 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.466		SIE = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.467		SRD = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.468		RES = 0	IEC 60870-5-101:2003, 7.2.6.11	PICS, 9.5
5.3.4.469	QDP	RES = 0	IEC 60870-5-101:2003, 7.2.6.4	PICS, 9.5
5.3.4.470		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.471		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.472		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.473		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PICS, 9.5
5.3.4.474		EI = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT

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No.	Test	Description	Reference	Required
~~5.3.3.475~~	**CP16Time2a**	**milliseconds = 0..59999**	**IEC 60870-5-101:2003, 7.2.6.20**	**PICS, 9.5**
5.3.4.475	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.476		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.477		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.478		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.479		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.480		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.481		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.482		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.483		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.484		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.485		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.490	M_EP_TF_1	OCI with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.32	PICS, 9.5
5.3.4.491	ASDU 40 Packet output circuit information of protection equipment with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.32	PICS, 9.5
5.3.4.492	OCI	GC = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.493		CL1 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.494		CL2 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.495		CL3 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.496		RES = 0	IEC 60870-5-101:2003, 7.2.6.11	PICS, 9.5

Table 4 *(18 of 18)*

No.	Test	Description	Reference	Required
5.3.4.497	QDP	RES = 0	IEC 60870-5-101:2003, 7.2.6.4	PICS, 9.5
5.3.4.498		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.499		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.500		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.501		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PICS, 9.5
5.3.4.502		EI = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PICS, 9.5
5.3.4.503	CP16Time2a	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.20	PICS, 9.5
5.3.4.504	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.505		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.506		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.507		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.508		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.509		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.510		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.511		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.512		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.513		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.514		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

Table 5 – Verification of ASDUs for process information in control (normal) direction *(1 of 8)*

No.	Test	Description	Reference	Required
5.3.5.1	C_SC_NA_1 ASDU 45 Single command	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.1	PICS, 9.5
5.3.5.2	SCO	SCS = 0 (OFF), 1 (ON)	IEC 60870-5-101:2003, 7.2.6.15	PICS, 9.5
5.3.5.3		RES = 0	IEC 60870-5-101:2003, 7.2.6.15	PICS, 9.5
5.3.5.4		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.5		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.6		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT
5.3.5.10	C_DC_NA_1 ASDU 46 Double command	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.2	PICS, 9.5
5.3.5.11	DCO	DCS = 1 (OFF), 2 (ON)	IEC 60870-5-101:2003, 7.2.6.16	PICS, 9.5
5.3.5.12		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.13		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.14		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT
5.3.5.20	C_RC_NA_1 ASDU 47 Regulating step command	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.3	PICS, 9.5
5.3.5.21	RCO	RCS = 1 (next step LOWER), 2 (next step HIGHER)	IEC 60870-5-101:2003, 7.2.6.17	PICS, 9.5
5.3.5.22		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.23		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.24		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT

Table 5 *(2 of 8)*

No.	Test	Description	Reference	Required
5.3.5.30	C_SE_NA_1 ASDU 48 Set point command, normalised value	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.4	PICS, 9.5
5.3.5.31	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.5.32		Range –1 to +1–2^{-15}	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5
5.3.5.33	QOS	QL = 0, 1…63 or 64…127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.34		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT
5.3.5.40	C_SE_NB_1 ASDU 49 Set point command, scaled value	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.5	PICS, 9.5
5.3.5.41	SVA	Value (with scaling factor)	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5 PIXIT
5.3.5.42		Range –2^{15} to 2^{15} – 1	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5
5.3.5.43	QOS	QL = 0, 1…63 or 64…127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.44		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT
5.3.5.50	C_SE_NC_1 ASDU 50 Set point command, short floating point value	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.6	PICS, 9.5
5.3.5.51	IEEE STD 754	Fraction = 0.. 1–2^{-23}	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4, 6.5	PICS, 9.5
5.3.5.52		Exponent = 0..255	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4, 6.5	PICS, 9.5
5.3.5.53		Sign = 0,1	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4, 6.5	PICS, 9.5
5.3.5.54	QOS	QL = 0, 1…63 or 64…127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.55		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT

Table 5 *(3 of 8)*

No.	Test	Description	Reference	Required
5.3.5.60	C_BO_NA_1 ASDU 51 Bitstring of 32 bits	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.7	PICS, 9.5
5.3.5.61	BSI	BSI = 0,1	IEC 60870-5-101:2003, 7.2.6.13	PICS, 9.5
5.3.5.70	C_SC_TA_1 ASDU 58 Single command with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.1	PICS, 9.5
5.3.5.71	SCO	SCS = 0 (OFF), 1 (ON)	IEC 60870-5-101:2003, 7.2.6.15	PICS, 9.5
5.3.5.72		RES = 0	IEC 60870-5-101:2003, 7.2.6.15	PICS, 9.5
5.3.5.73		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.74		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.75		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT
5.3.5.76	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.77		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.78		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.79		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.80		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.81		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.82		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.83		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.84		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.85		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.86		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.90	C_DC_TA_1 ASDU 59 Double command with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.2	PICS, 9.5

Table 5 *(4 of 8)*

No.	Test	Description	Reference	Required
5.3.5.91	DCO	DCS = 1 (OFF), 2 (ON)	IEC 60870-5-101:2003, 7.2.6.16	PICS, 9.5
5.3.5.92		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.93		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.94		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT
5.3.5.95	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.96		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.97		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.98		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.99		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.100		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.101		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.102		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.103		day of month = 1..31	IEC 60870-5-10:2003, 7.2.6.18	PICS, 9.5
5.3.5.104		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.105		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.110	C_RC_TA_1 ASDU 60 Regulating step command with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.3	PICS, 9.5

Table 5 *(5 of 8)*

No.	Test	Description	Reference	Required
5.3.5.111	RCO	RCS = 1 (next step LOWER), 2 (next step HIGHER)	IEC 60870-5-101:2003, 7.2.6.17	PICS, 9.5
5.3.5.112		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.113		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.114		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT
5.3.5.115	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.116		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.117		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.118		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.119		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.120		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.121		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.122		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.123		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.124		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.125		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.130	C_SE_TA_1 ASDU 61 Set point command, normalised value with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.4	PICS, 9.5
5.3.5.131	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.5.132		Range -1 to $+1-2^{-15}$	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5

Table 5 *(6 of 8)*

No.	Test	Description	Reference	Required
5.3.5.133	QOS	QL = 0, 1…63 or 64…127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.134		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT
5.3.5.135	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.136		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.137		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.138		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.139		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.140		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.141		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.142		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.143		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.144		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.145		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.150	C_SE_TB_1 ASDU 62 Set point command, scaled value with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.5	PICS, 9.5
5.3.5.151	SVA	Value (with scaling factor)	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5 PIXIT
5.3.5.152		Range -2^{15} to $2^{15} - 1$	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5
5.3.5.153	QOS	QL = 0, 1…63 or 64…127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.154		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT

Table 5 *(7 of 8)*

No.	Test	Description	Reference	Required
5.3.5.155	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.156		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.157		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.158		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.159		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.160		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.161		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.162		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.163		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.164		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.165		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.170	C_SE_TC_1 ASDU 63 Set point command, short floating point value with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.6	PICS, 9.5
5.3.5.171	IEEE STD 754	Fraction = 0.. $1–2^{-23}$	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.5.172		Exponent = 0.. 255	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.5.173		Sign = 0,1	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.5.174	QOS	QL = 0, 1...63 or 64...127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.175		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT

Table 5 *(8 of 8)*

No.	Test	Description	Reference	Required
5.3.5.176	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.177		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.178		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.179		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.180		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.181		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.182		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.183		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.184		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.185		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.186		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.190	C_BO_TA_1 ASDU 64 Bitstring of 32 bits with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.7	PICS, 9.5
5.3.5.191	BSI	BSI = 0,1	IEC 60870-5-101:2003, 7.2.6.13	PICS, 9.5
5.3.5.192	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.193		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.194		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.195		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.196		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.197		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.198		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.199		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.200		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.201		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.202		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.220	PROCESS CONTROL TIME TAGS	Either the set of Process Control ASDUs without time tag or the set of Process Control ASDUs with CP56Time2a is used	IEC 60870-5-104:2006, 9.5	PICS, 9.5

Table 6 – Verification of ASDUs for system information in monitor (normal) direction

No.	Test	Description	Reference	Required
5.3.6.1	M_EI_NA_1	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.3.1	PICS, 9.5
5.3.6.2	ASDU 70 End of initialisation	Information Object Address = 0	IEC 60870-5-101:2003, 7.3.3.1	PICS, 9.5
5.3.6.3	COI	UI =0, 1, 2, 3-31 or 32-127	IEC 60870-5-101:2003, 7.2.6.21	PIXIT
5.3.6.4		BS = 0,1	IEC 60870-5-101:2003, 7.2.6.21	PIXIT

Table 7 – Verification of ASDUs for system information in control (normal) direction *(1 of 3)*

No.	Test	Description	Reference	Required
5.3.7.1	C_IC_NA_1	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.4.1	PICS, 9.5
5.3.7.2	ASDU 100 Interrogation command	Information Object Address = 0	IEC 60870-5-101:2003, 7.3.4.1	PICS, 9.5
5.3.7.3	QOI	QOI = 1.. 19 or 20…36 or 37…63 or 64…255	IEC 60870-5-101:2003, 7.2.6.22	PIXIT
5.3.7.10	C_CI_NA_1	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.4.2	PICS, 9.5
5.3.7.11	ASDU 101 Counter interrogation command	Information Object Address = 0	IEC 60870-5-101:2003, 7.3.4.2	PICS, 9.5
5.3.7.12	QCC	RQT Counter request = 0…5	IEC 60870-5-101:2003, 7.2.6.23	PICS, 9.6
5.3.7.13		FRZ Counter freeze = 0…3	IEC 60870-5-101:2003, 7.2.6.23	PICS, 9.6
5.3.7.20	C_RD_NA_1 ASDU 102 Read command	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.4.3	PICS, 9.5
5.3.7.30	C_CS_NA_1	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.4.4	PICS, 9.5
5.3.7.31	ASDU 103 Clock synchronisation command	Information Object Address = 0	IEC 60870-5-101:2003, 7.3.4.4	PICS, 9.5

Table 7 *(2 of 3)*

No.	Test	Description	Reference	Required
5.3.7.32	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.33		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.34		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.35		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.36		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.37		res1 = <0> genuine time or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.6
5.3.7.38		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.39		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5 PICS, 9.6
5.3.7.40		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.41		day of week = <1..7>	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.6
5.3.7.42		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.43		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.44		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.60	C_RP_NA_1	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.4.6	PICS, 9.5
5.3.7.61	ASDU 105 Reset process command	Information Object Address = 0	IEC 60870-5-101:2003, 7.3.4.6	PICS, 9.5
5.3.7.62	QRP	QRP = 1, 2 (zero is not permitted)	IEC 60870-5-101:2003, 7.2.6.27	PIXIT
5.3.7.70	C_CD_NA_1 ASDU 107 Test command with time tag CP56Time2a	COT as defined in the attached PICS	IEC ~~60870-5-101, 7.3.4.7~~ 60870-5-104:2006, 8.8	PICS, 9.5
5.3.7.71	TSC	Test sequence counter, 16 bit = UI16[1..16]<0..65535> ~~TCS is a binary counter which gives the number of the test command. After a reset, the counter restarts with an initial value of 0~~	IEC 60870-5-104:2006, 8.8	PICS, 9.5

Table 7 *(3 of 3)*

No.	Test	Description	Reference	Required
5.3.7.72	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.73		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.74		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.75		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.76		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.77		res1 = <0> genuine time or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.6
5.3.7.78		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.79		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5 PICS, 9.6
5.3.7.80		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.81		day of week = <1..7>	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.6
5.3.7.82		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.83		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.84		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

Table 8 – Verification of ASDUs for parameters in control (normal) direction *(1 of 2)*

No.	Test	Description	Reference	Required
5.3.8.1	P_ME_NA_1 ASDU 110 Parameter of measured value, normalised value	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.5.1	PICS, 9.5
5.3.8.2	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.8.3		Range -1 to $+1-2^{-15}$	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5
5.3.8.4	QPM	KPA = 0-4	IEC 60870-5-101:2003, 7.2.6.24	PICS, 9.6 PIXIT
5.3.8.5		LPC = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.6		POP = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.10	P_ME_NB_1 ASDU 111 Parameter of measured values, scaled value	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.5.2	PICS, 9.5
5.3.8.11	SVA	Value (with scaling factor)	IEC 60870-5-101:2003, 7.2.6.7 PID	PICS, 9.5 PIXIT
5.3.8.12		Range -2^{15} to $2^{15} - 1$	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5
5.3.8.13	QPM	KPA = 0-4	IEC 60870-5-101:2003, 7.2.6.24	PICS, 9.6 PIXIT
5.3.8.14		LPC = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.15		POP = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.20	P_ME_NC_1 ASDU 112 Parameter of measured values, short floating point number	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.5.3	PICS, 9.5

Table 8 *(2 of 2)*

No.	Test	Description	Reference	Required
5.3.8.21	IEEE STD 754	Fraction = 0.. $1-2^{-23}$	IEC 60870-5-10:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.8.22		Exponent = 0.. 255	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.8.23		Sign = 0,1	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.8.24	QPM	KPA = 0-4	IEC 60870-5-101:2003, 7.2.6.24	PICS, 9.6 PIXIT
5.3.8.25		LPC = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.26		POP = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.30	P_AC_NA_1 ASDU 113 Parameter activation	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.5.4	PICS, 9.5
5.3.8.31	QPA	QPA = 3 (other values not permitted)	IEC 60870-5-101:2003, 7.2.6.25	PIXIT

Table 9 – Verification of ASDUs for file transfer (in monitor (normal) and control direction) *(1 of 4)*

No.	Test	Description	Reference	Required
5.3.9.1	F_FR_NA_1 ASDU 120 File ready	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.1	PICS, 9.5
5.3.9.2	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.3		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.4	LOF	LOF = 0	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.5		LOF = 1..16777215	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.6	FRQ	UI = 0	IEC 60870-5-101:2003, 7.2.6.28	PIXIT
5.3.9.7		BS = 0,1	IEC 60870-5-101:2003, 7.2.6.28	PIXIT
5.3.9.10	F_SR_NA_1 ASDU 121 Section ready	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.2	PICS, 9.5
5.3.9.11	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.12		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.13	NOS	NOS = 0	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.14		NOS = 1..255	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.15	LOS	LOS = 0	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.16		LOS = 1..16777215	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.17	SRQ	UI = 0	IEC 60870-5-101:2003, 7.2.6.29	PIXIT
5.3.9.18		BS = 0,1	IEC 60870-5-101:2003, 7.2.6.29	PIXIT
5.3.9.30	F_SC_NA_1 ASDU 122 Call directory, select file, call file, call section	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.3	PICS, 9.5
5.3.9.31	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.32		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5

Table 9 *(2 of 4)*

No.	Test	Description	Reference	Required
5.3.9.33	NOS	NOS = 0	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.34		NOS = 1..255	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.35	SCQ	UI1 = 0..7	IEC 60870-5-101:2003, 7.2.6.30	PICS, 9.5
5.3.9.36		UI2 = 0..5	IEC 60870-5-101:2003, 7.2.6.30	PICS, 9.5
5.3.9.40	F_LS_NA_1 ASDU 123 Last section, last segment	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.3	PICS, 9.5
5.3.9.41	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.42		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.43	NOS	NOS = 0	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.44		NOS = 1..255	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.45	LSQ	LSQ = 0..4	IEC 60870-5-101:2003, 7.2.6.36	PICS, 9.5
5.3.9.46	CHS	CHS = 0..255	IEC 60870-5-101:2003, 7.2.6.37	PICS, 9.5
5.3.9.50	F_AF_NA_1 ASDU 124 ACK file, ACK section	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.5	PICS, 9.5
5.3.9.51	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.52		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.53	NOS	NOS = 0	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.54		NOS = 1..255	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.55	AFQ	UI1 = 0..4	IEC 60870-5-101:2003, 7.2.6.32	PIXIT
5.3.9.56		UI2 = 0..5	IEC 60870-5-101:2003, 7.2.6.32	PIXIT
5.3.9.60	F_SG_NA_1 ASDU 125 Segment	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.5	PICS, 9.5

Table 9 *(3 of 4)*

No.	Test	Description	Reference	Required
5.3.9.61	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.62		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.63	NOS	NOS = 0	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.64		NOS = 1..255	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.65	LOS	LOS = 0	IEC 60870-5-101:2003, 7.2.6.36	PICS, 9.5
5.3.9.66		LOS = 1..234 (1..240)	IEC 60870-5-101:2003, 7.2.6.36	PICS, 9.5
5.3.9.67	Segment	Segment data	IEC 60870-5-101:2003, 7.3.6.6	PICS, 9.5
5.3.9.70	F_DR_TA_1 ASDU 126 Directory	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.7	PICS, 9.5
5.3.9.71	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.72		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.73	LOF	LOF = 0	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.74		LOF = 1..16777215	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.75	SOF	STATUS = 0	IEC 60870-5-101:2003, 7.2.6.38	PICS, 9.5
5.3.9.76		RES1 = 0,1	IEC 60870-5-101:2003, 7.2.6.38	PICS, 9.5
5.3.9.77		FOR = 0,1	IEC 60870-5-101:2003, 7.2.6.38	PICS, 9.5
5.3.9.78		FA = 0,1	IEC 60870-5-101:2003, 7.2.6.38	PICS, 9.5

Table 9 *(4 of 4)*

No.	Test	Description	Reference	Required
5.3.9.79	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.80		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.81		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.82		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.83		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.84		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.85		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.86		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.87		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.88		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.89		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

5.4 Conformance test procedures

The conformance test procedures ~~have to~~ shall be tested for all the mandatory test cases in 5.3 and for every configuration as in 5.2. See 5.1 for the procedure to execute all mandatory test cases.

A test is passed if the described behaviour has been automatically verified by the test software or shown to the test engineer in a human readable format. A specific Function has passed completely if all mandatory test cases in that group have passed.

To identify if a test case is mandatory, it is necessary to read 5.1 carefully.

Table 10 – Data unit identifier conformance test procedures *(1 of 2)*

No.	Test	Description	Reference	Required
5.4.10.1	TYPE IDENTIFICATION	If COT=44 is NOT supported, any undefined or not supported ASDU received by the controlled station should be mirrored with P/N=1 negative	IEC 60870-5-101:2003, 7.3	PICS, 9.5 ~~PIXIT~~ *Type id and cot assignments: COT 44*
		~~If COT=44 is~~ Any undefined or not supported ~~any undefined~~ ASDU received by the controlling station is ignored (or discarded)	IEC 60870-5-101:2003, 7.3	PICS, 9.5 PIXIT
		If COT = 44 is supported, any undefined or not supported ASDU is mirrored by the controlled station with P/N = 1: negative confirmation of activation using COT = 44 (unknown type identification)	IEC 60870-5-101:2003, 7.3	PICS, 9.5 *Type id and cot assignments: COT 44*
		These tests are performed correctly for at least three undefined or not supported ASDUs. The test should include at least one undefined ASDU. If possible, the test should include at least one ASDU defined in the standard, but not supported by the DUT. Undefined ASDU = ASDU which is not defined by the standard. Unsupported ASDU = ASDU which is defined by the standard, but not supported by the DUT		M
5.4.10.5	CAUSE OF TRANSMISSION	Test bit = 0: ASDU generated during normal conditions	IEC 60870-5-101:2003, 7.2.3	M
		Test bit = 1: ASDU generated during test conditions	IEC 60870-5-101:2003, 7.2.3	PIXIT
		If COT=45 is NOT supported, any message received by the controlled station containing an undefined or not supported COT should be mirrored with P/N=1 negative	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5 ~~PIXIT~~ *Type id and cot assignments: COT 45*
		~~If COT=45 is NOT supported,~~ Any message received by the controlling station containing an undefined or not supported COT is ignored (or discarded)	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5 ~~PIXIT~~
		If COT=45 is supported, any undefined or not supported ASDU is mirrored by the controlled station with P/N = 1: negative confirmation of activation using COT = 45 (unknown cause of transmission)	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5 *Type id and cot assignments: COT 45*
		Originator address is zero or the applicable Originator address ~~(if COT = 2 octets)~~	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5
		These tests are performed correctly for at least three undefined or not supported COTs. The test should include at least one undefined COT. If possible, the test should include at least one COT defined in the standard, but not supported by the DUT. Undefined COT = COT which is not defined by the standard. Unsupported COT = COT which is defined by the standard, but not supported by the DUT.		M

Table 10 *(2 of 2)*

No.	Test	Description	Reference	Required
5.4.10.10	COMMON ADDRESS of ASDU	If COT=46 is NOT supported, any message received by the controlled station containing an undefined CASDU should be mirrored with P/N=1 negative	IEC 60870-5-101:2003, 7.2.4	PICS, 9.5 ~~PIXIT~~ *Type id and cot assignments: COT 46*
		~~If COT=46 is NOT supported,~~ Any message received by the controlling station containing an undefined CASDU is ignored (or discarded)	IEC 60870-5-101:2003, 7.2.4	PICS, 9.5 ~~PIXIT~~
		If COT=46 is supported, any ASDU with undefined CASDU is mirrored by the controlled station with P/N = 1: negative confirmation of activation using COT = 46 (unknown CASDU)	IEC 60870-5-101:2003, 7.2.4	PICS, 9.5 *Type id and cot assignments: COT 46*
		Broadcast CASDU value (0xFF<FF>) only used in control direction with ASDU Types 100 (Interrogation), 101 (Counter interrogation), 103 (Clock Sync) or 105 (Reset Process).	IEC 60870-5-101:2003, 7.2.4	PIXIT
		The Controlled station rejects all other ASDU Types with a Broadcast CASDU value by mirroring the ASDU with P/N = 1 negative (and with COT = 46, if supported)	IEC 60870-5-101:2003, 7.2.4	M
		The Controlling station handles any received ASDU with a Broadcast CASDU as an ASDU with an undefined CASDU	IEC 60870-5-101:2003, 7.2.4	M

Table 11 – Information object address conformance test procedures

No.	Test	Description	Reference	Required
5.4.11.1	OBJECT ADDRESS	If COT=47 is NOT supported, any message received by the controlled station containing an undefined IOA should be mirrored with P/N=1 negative	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5 ~~PIXIT~~ *Type id and cot assignments: COT 47*
		~~If COT=47 is NOT supported,~~ Any message received by the controlling station containing an undefined IOA is ignored (or discarded)	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5 ~~PIXIT~~
		If COT=47 is supported, any ASDU with undefined IOA in control direction is mirrored by the controlled station with P/N = 1: negative confirmation of activation using COT = 47 (unknown IOA)	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5 *Type id and cot assignments: COT 47*
		These tests are performed correctly for each supported ASDU.		M

Table 12 – Station initialisation function ~~(unbalanced systems)~~ conformance test procedures *(1 of 3)*

No.	Test	Description	Reference	Required
5.4.12.1	Local Initialisation of the Controlling station: (re-)boot	After its power on, hardware reset or warm boot, the Controlling station (which may be configured as a fixed selection in case of two equivalent Controlling stations) starts to create the number of configured Stopped connections (a TCP connection in STOPDT state) to each configured Controlled station	IEC 60870-5-104:2006, 7.1	M
		During or after the creation of one or more *new* Stopped connections, the Controlling station initiates the creation of exactly one Started connection to each configured Controlled station by sending a STARTDT_ACT. This STARTDT_ACT is sent over the Stopped connection that is configured as the preferred Started connection (if multiple Stopped connections to the same Controlled station are available) to that Controlled station	IEC 60870-5-104:2006, 5.3	M
		The Controlling station finishes the Station initialisation by starting the update of its internal process representation by issuing a General Interrogation command C_IC_ACT to each Controlled station	IEC 60870-5-104:2006, 7.1	M
		Each Controlled station enables the Stopped connection over which the STARTDT_ACT was received by sending a STARTDT_CON over that same connection to the Controlling station	IEC 60870-5-104:2006, 5.3	M
		Each Controlled station updates the Controlling station with the requested actual process information in the General interrogation cycle. The normal telecontrol operations may begin	IEC 60870-5-104:2006, 7.1	M
5.4.12.10	Local initialisation of the Controlled station: (re-)boot	After power on, hardware reset or warm boot the Controlled station waits for the establishment of one or (optional) more TCP connections from the Controlling station(s) after its transport provider (the TCP stack) and internal application components are initialised	IEC 60870-5-104:2006, 7.1	M
		The Controlled station only allows Active TCP connections from configured Controlling stations (optional, for security reasons)		~~M~~ PIXIT
		The Controlled station finishes the creation of exactly one Started connection by sending a STARTDT_CON after receiving a STARTDT_ACT from the Controlling station	IEC 60870-5-104:2006, 7.1	M
		The Controlled station finishes its local initialisation by sending the M_EI (End of initialisation) to the Controlling station (this is optional, but recommended, because it allows the Controlled station to distinguish between this initiated local initialisation and other connection establishment procedures like lost connections)	IEC 60870-5-104:2006, 7.1 ~~[MOM WG03 15 June 2001 6.2]~~	~~M~~ PICS, 9.5 *System info in monitor direction*
		The Controlled station starts the General interrogation procedure to update the Controlling station with the actual process information after receipt of the General Interrogation command C_IC_ACT. The normal telecontrol operations may begin	IEC 60870-5-104:2006, 7.1	M

Table 12 *(2 of 3)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Remote initialization. If 'M' is mentioned, the test case is mandatory for systems with the relevant Remote initialization options marked in the PICS: - PICS, 9.5, "System information in control direction", "Reset process command". - PICS, 9.6, "Station initialization", "Remote initialization".				
5.4.12.20	Remote initialisation of the Controlled station	The Controlling station forces the Controlled station to do a restart of the Application processes by issuing a "Reset process" C_RP_ACT with QRP=1 over the Started connection	IEC 60870-5-104:2006, 7.1	~~PICS,9.6~~ M
		The Controlled station confirms the forced restart by sending a C_RP_ACTCON to the Controlling station ("Reset process" procedure means reset of layer 7 and User processes.)	IEC 60870-5-104:2006, 7.1 IEC 60870-5-101:2003, 6.2.3	~~PICS,9.6~~ M
		The Controlled station sends a TCP Active close (TCP Control field FIN) over the Started connection and all Stopped connections to the Controlling station to close all Started and Stopped connections between the two communication partners. The TCP Active close may be sent before, during or after the "Reset process" procedure, which is system dependent	IEC 60870-5-104:2006, 7.1	~~PICS,9.6~~ M
		The Controlling station continues to try to create the number of configured Stopped connections to the Controlled station	IEC 60870-5-104:2006, 7.1	~~PICS,9.6~~ M
		The Controlled station waits with the establishment of one or (optional) more Stopped connection(s), till its transport provider (the TCP stack) and internal application components are initialised	IEC 60870-5-104:2006, 7.1	~~PICS,9.6~~ M
		The Controlled station only allows Stopped connections from configured Controlling stations (optional, for security reasons)		~~PICS,9.6~~ M
		The Controlled station finishes the creation of exactly one Started connection by sending a STARTDT_CON after receiving a STARTDT_ACT from the Controlling station	IEC 60870-5-104:2006, 7.1	~~PICS,9.6~~ M
		The Controlled station finishes its local initialisation by sending the M_EI (End of initialisation) to the Controlling station (this is optional, but recommended, because it allows the Controlled station to distinguish between this initiated local initialisation and other connection establishment procedures like lost connections)	IEC 60870-5-104:2006, 7.1	~~PICS,9.5~~ PIXIT
		The Controlled station starts the General interrogation procedure to update the Controlling station with the actual process information after receipt of the General Interrogation command C_IC_ACT. The normal telecontrol operations may begin	IEC 60870-5-104:2006, 7.1	~~PICS,9.6~~ M
5.4.12.21	Reset of pending information with time tag of the event buffer	The Controlling station forces one LRU (using a specific CASDU address in the C_RP_ECT) or all LRUs (using broadcast CASDU address in the C_RP_ACT) in the Controlled station to do a restart of the Application processes. QRP is set to 2 in the C_RP_ACT. Run this test while the Controlled station has pending events in the buffer.	IEC 60870-5-5:1995, 6.1 IEC 60870-5-101:2003, 7.2.6.27	PIXIT
		The Controlled station confirms the Reset of pending information with time tag of the event buffer by sending a C_RP_ACTCON to the Controlling station from each addressed LRU (with the LRUs specific CASDU address) and resets its pending information with time tag in the event buffer. The Controlled station does not send any events anymore (until new events are generated).	IEC 60870-5-5:1995, 6.1 IEC 60870-5-101:2003, 7.2.6.27	PIXIT

Table 12 *(3 of 3)*

No.	Test	Description	Reference	Required
5.4.12.30	Re-establishing a lost Started connection between the Controlling and the Controlled station when no other connections are available	After the Started connection is inoperable for a longer period than time-out (t_1) allows, the **Primary** station (whether Controlling or Controlled) initiates a TCP active close on the Started connection (which may never arrive)	IEC 60870-5-104:2006, 5.3	M
		After detecting that the Started connection is inoperable and not yet closed, the **Secondary** station initiates a TCP active close on the Started connection (which may never arrive). Both sides of the inoperable Started connection have been closed now and the Started connection is no longer present	IEC 60870-5-104:2006, 5.3	M
		After detecting that the Started connection is no longer present, the Controlling station (which may be configured as a fixed selection in case of two equivalent Controlling stations) tries to create a new Stopped connection to the Controlled station at regular intervals	IEC 60870-5-104:2006, 5.3	M
		After the creation of the *new* Stopped connection, the Controlling station initiates the creation of the *new* Started connection to the Controlled station by sending a STARTDT_ACT over the new established Stopped connection	IEC 60870-5-104:2006, 5.3	M
		The Controlled station finishes the creation of the new Started connection by sending a STARTDT_CON over that same connection over which the STARTDT_ACT was received to the Controlling station	IEC 60870-5-104:2006, 5.3	M
		After re-establishment of the connection between Controlling and Controlled station, **no** M_EI (End of initialisation) is sent (nor needed) to the Controlling station. Normal operation continues with the application messages that have not yet been acknowledged (if supported and if available) and begins the General Interrogation procedure		M
5.4.12.40	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 “Verification of IEC 60870-5-104 communication” have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		~~PICS, 9~~ M

Table 13 – Redundant link conformance test procedures *(1 of 3)*

Remark: these test cases are describing the redundancy mechanism (with multiple connections to a single Controlled station, of which exactly one is the Started connection and the other connections are Stopped connections), but not how this mechanism will be used in operational redundant systems. The diversity of operational systems requires additional testing.

~~Variant A: multiple connections to a single Controlled station, of which exactly one is the Started connection and the other connections are Hot standby Stopped connections~~

No.	Test	Description	Reference	Required
NOTE: The tests in this Table are only required for systems supporting Redundant connections. If 'M' is mentioned, the test case is mandatory for systems with the relevant Redundant connections options marked in the PICS: - PICS, 9.6, "Redundant connections"				
5.4.13.1	Periodic check of *ALL* redundant connections	Both Controlling and Controlled station guard the configured inactivity **time period t_3 on the Started connection and start a TESTFR procedure when t_3 expires.** All time out interval rules apply	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		The Controlling and Controlled station guards the configured inactivity **time period t_3 on *all* the Stopped connections and starts a TESTFR procedure when t_3 expires.** All time out interval rules apply	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
5.4.13.10	Re-establishing a lost Started connection between the Controlling and the Controlled station when redundant connections are available: (automatic switch-over)	After the Started connection is inoperable for a longer period than time-out (t_1) allows, the Primary station (whether Controlling or Controlled) initiates a TCP active close on the Started connection (which may never arrive)	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		After detection that the Started connection is no longer present, the Controlling station (which may be configured as a fixed selection in case of two equivalent Controlling stations) initiates the creation of a *new* Started connection by sending a STARTDT_ACT over one of the redundant, until now still Stopped connections to the same Controlled station	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		The Controlled station finishes the creation of the new Started connection by sending a STARTDT_CON over that same connection over which the STARTDT_ACT was received to the Controlling station. The Controlled station sends an active close on the old Started connection.	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		After re-establishment of the Started connection between Controlling and Controlled station, **no** M_EI (End of initialisation) is sent (nor needed) to the Controlling station. Normal operation continues with the application messages that have not yet been acknowledged (if supported and if available) and begins the General Interrogation procedure	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		The send- and receive counters are not reset to "0" as long as the TCP connection is established. Each TCP connection, not affected by STARTDT and STOPDT procedures or switch-over procedures, maintains its send- and receive counter	IEC 60870-5-104:2006, 5.3 IEC 60870-5-104:2006, 10	~~PIXIT~~ M

Table 13 *(2 of 3)*

No.	Test	Description	Reference	Required
5.4.13.20	Re-establishing a lost redundant connection between the Controlling and the Controlled station	After detecting that one of the redundant (Started or Stopped) connections is inoperable and not yet closed, the **Controlling** station (which may be configured as a fixed selection in case of two equivalent Controlling stations) initiates a TCP active close on the inoperable connection (which may never arrive)	IEC 60870-5-104:2006, 10	~~PIXI~~ M
		After detecting that one of the redundant (Started or Stopped) connections is inoperable and not yet closed, the **Controlled** station initiates a TCP active close on the inoperable connection (which may never arrive)	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		The Controlling station tries at regular intervals to create a new Stopped connection for the now closed inoperable connection to the Controlled station	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
5.4.13.30	Manual switching over the Started connection to another redundant Stopped connection: (manual switch-over)	The **Controlling** station (which may be configured as a fixed selection in case of two equivalent Controlling stations) issues a STOPDT_ACT on the current Started connection to the Controlled station	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		After sending the STOPDT_ACT, the Controlling station (optionally, but recommended) stops the transfer of I-frames on the Started connection that is then in pending STOPDT state	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		The Controlled station also stops the transfer of I-frames on the Started connection after receipt of the STOPDT_ACT, which then is in pending STOPDT state, even before the STOPDT_CON is sent. NOTE Due to timing effects, it is allowed that (which cannot be prevented) one I-frame will be sent after the controlled station has received the STOPDT_ACT because it is already handed over to the TCP socket	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		The Controlled station acknowledges all yet unacknowledged I-frames from the Controlling station with one or more S-frames	IEC 60870-5-104:2006, 5.3 IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		The Controlling station also acknowledges all yet unacknowledged I-frames from the Controlled station with one or more S-frames within or according to time out t_2	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		The Controlled station finishes the pending STOPDT state for the Started connection by sending a STOPDT_CON to the Controlling station which transforms the previously Started connection to a Stopped connection	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		The Controlling station initiates the creation of a *new* Started connection by sending a STARTDT_ACT over the selected Stopped connection to the same Controlled station	IEC 60870-5-104:2006, 10	~~PIXIT~~ M

Table 13 *(3 of 3)*

No.	Test	Description	Reference	Required
		The Controlled station finishes the creation of the new Started connection by sending a STARTDT_CON over that same connection over which the STARTDT_ACT was received to the Controlling station	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		After establishing a new Started connection between Controlling and Controlled station, **no** M_EI (End of initialisation) is sent (nor needed) to the Controlling station. Normal operation continues	IEC 60870-5-104:2006, 10	~~PIXIT~~ M
		The send- and receive counters are not reset to "0" as long as the TCP connection is established. Each TCP connection, not affected by STARTDT and STOPDT procedures or switch-over procedures, maintains its send- and receive counter	IEC 60870-5-104:2006, 5.3 IEC 60870-5-104:2006, 10	~~PIXIT~~ M

Table 14 – Cyclic data transmission function conformance test procedures

~~No.~~	~~Test~~	~~Description~~	~~Reference~~	~~Required~~
~~5.4.13.1~~	~~Cyclic data transmission and Background Scan - sequential procedure~~	~~The Controlled station transfers the configured Periodic /Cyclic process information data in ASDUs (look at PICS for the supported ASDU's) with COT=1 to the Controlling station~~	~~IEC 60870-5-101, 7.4.3~~ ~~IEC 60870-5-5, 6.3.1~~ ~~IEC 60870-5-101, 7.4.3~~	~~PICS, 9.6~~
		~~The Controlled station uses the configured period for process information transferred in ASDUs with COT=1 (PER/CYC)~~	~~IEC 60870-5-101, 7.4.3~~ ~~IEC 60870-5-5, 6.3.1~~	~~PICS, 9.6~~
		~~The Controlled station uses the configured period for process information transferred in ASDUs with COT=1~~	~~IEC 60870-5-101, 7.4.3~~ ~~IEC 60870-5-5, 6.3.1~~	
		~~The Controlled station transfers the configured Background Scan process information data in ASDUs with COT=2 (BACK) to the Controlling station~~	~~IEC 60870-5-101, 7.4.13~~ ~~IEC 60870-5-5, 6.3.1~~	~~PICS, 9.6~~
		~~Process information data consisting of (the Information Object Addresses of) measured values that are sent in ASDUs with COT=1 should not appear in ASDUs with COT=2 (Background Scan), COT=3 (Spontaneous) or Interrogation (COT=20 to 36)~~	~~IEC 60870-5-101, 7.4.13~~ ~~IEC 60870-5-101, 7.4.5~~	~~PICS, 9.6~~
		~~The Controlled station transfers the configured Background Scan process information data in ASDUs with COT=2 to the Controlling station~~	~~IEC 60870-5-101, 7.4.13~~ ~~IEC 60870-5-5, 6.3.1~~	~~PICS, 9.6~~
		~~The Controlled station uses the configured period for process information transferred in ASDUs with COT=2~~	~~IEC 60870-5-5, 6.3.1~~ ~~PID~~	~~PICS, 9.6~~
~~5.4.13.10~~	~~COMPATIBILITY WITH OTHER TEST CASES~~	~~All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation~~		~~PICS, 9~~

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Cyclic data transmission and/or Background Scan. If 'M' is mentioned, the test case is mandatory for systems with the relevant Cyclic and/or Background Scan options marked in the PICS: – PICS, 9.5, "Process information in monitor direction". At least one of the types should be selected. – PICS, 9.5, "Type identification and cause of transmission assignments", column COT 1 and COT 2. – PICS, 9.6, sections "Cyclic data transmission" and "Background scan".				
5.4.14.1	Cyclic data transmission and Background Scan – sequential procedure	The Controlled station transfers the configured Periodic / Cyclic process information data in ASDUs (look at PICS for the supported ASDU's), with COT=1 to the Controlling station	IEC 60870-5-101:2003, 7.4.3 IEC 60870-5-5:1995, 6.3.1 IEC 60870-5-101:2003, 7.4.3	PICS, 9.6 *Cyclic data transmission*
		The Controlled station uses the configured period for process information transferred in ASDUs with COT=1 (PER/CYC)	IEC 60870-5-101:2003, 7.4.3 IEC 60870-5-5:1995, 6.3.1	PICS, 9.6 *Cyclic data transmission*
		The Controlled station transfers the configured Background Scan process information data in ASDUs with COT=2 (BACK) to the Controlling station	IEC 60870-5-101:2003, 7.4.13 IEC 60870-5-5:1995, 6.3.1	PICS, 9.6 *Background Scan*
		The Controlled station transmits Periodic, Cyclic, Background Scan process information data of the same Type, COT and priority but with gaps in their addresses as a Set of Information elements (SQ:=0) in one single ASDU, filled up to but not exceeding the maximum configured ASDU or APDU length as in the PICS	IEC 60870-5-3:1992, 5.1.5 IEC 60870-5-101:2003, 7.2.2.2	M
		The Controlled station transmits Periodic, Cyclic, Background Scan process information data of the same type, COT and priority and with sequential addresses as a Sequence of Information elements (SQ:=1) in one single ASDU, filled up to but not exceeding the maximum configured ASDU or APDU length as in the PICS	IEC 60870-5-3:1992, 5.1.5 IEC 60870-5-101:2003, 7.2.2.2	PIXIT
		Process information data consisting of (the Information Object Addresses of) measured values that are sent in ASDUs with COT=1 should not appear in ASDUs with COT=2 (Background Scan), COT=3 (Spontaneous) or Interrogation (COT=20 to 36)	IEC 60870-5-101:2003, 7.4.13 IEC 60870-5-101:2003, 7.4.5	PIXIT
		The Controlled station uses the configured period for process information transferred in ASDUs with COT=2	IEC 60870-5-5:1995, 6.3.1 PID	PICS, 9.6 *Background Scan*
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		M
		The Controlling station activates or deactivates cyclic or periodic transmission of the addressed object by using P_AC_NA_1 (ASDU 113). The Controlled station acknowledges the activation or deactivation by mirroring the command with COT=7 (ACTCON)	IEC 60870-5-101:2003, 7.3.5.4	PICS, 9.6 *Parameter activation*
		The tests in this Table are performed correctly by each ASDU in the PICS that supports COT=1 (PER/CYC) and/or 2 (BACK)	IEC 60870-5-104:2006, 9.5, 9.6	M
		All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		M
5.4.14.10	COMPATIBILITY WITH OTHER TEST CASES			

Table 15 – Data acquisition through read function conformance test procedures

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Data acquisition through Read. If 'M' is mentioned, the test case is mandatory for systems with the relevant Acquisition of events options marked in the PICS: – PICS, 9.5, "Process information in control direction", "Read command". – PICS, 9.5, "Type identification and cause of transmission assignments", column COT 5. – PICS, 9.6, "Read procedure".				
5.4.15.1	Data acquisition through Read – sequential procedure:	The Controlling station send a Read command (C_RD, ASDU 102) with COT = 5 to the Controlled station (look at PICS for the supported ASDU's)	IEC 60870-5-101:2003, 7.3.4.3 IEC 60870-5-5:1995, 6.2.1	~~PICS, 9.6~~ M
		The Controlled station sends the requested Information Object in the correct ASDU that is configured for the requested Information Object (look at PICS 9.5, "Type identification and cause of transmission assignments" for the supported ASDUs) to the Controlling station	IEC 60870-5-101:2003, 7.3.1 IEC 60870-5-101:2003, 7.4.2 IEC 60870-5-5:1995, 6.2.1	~~PICS, 9.6~~ M
		~~The Controlled station sends the requested Information Object in the correct ASDU that is configured for the requested Information Object (look at PICS for the supported ASDU's) to the Controlling station~~ The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station.	~~IEC 60870-5-101, 7.3.1~~ ~~IEC 60870-5-101, 7.4.2~~ ~~IEC 60870-5-5, 6.2.1~~	~~PICS, 9.6~~ M
		The tests in this table are performed correctly by every ASDU in the PICS that supports COT=5 (REQ)	IEC 60870-5-104:2006, 9.5, 9.6 ~~IEC 60870-5-101, 8.5, 8.6~~ IEC 60870-5-101:2003, 7.3.4.3	~~PICS, 9.6~~ M
		All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		~~PICS, 9~~ M
5.4.15.10	COMPATIBILITY WITH OTHER TEST CASES			

Table 16 – Acquisition of events function conformance test procedures

No.	Test	Description	Reference	Required
NOTE: The following tests are only required for systems supporting Acquisition of events. If 'M' is mentioned, the test case is mandatory for systems with the relevant Acquisition of events options marked in the PICS: – PICS, 9.5, "Process information in monitor direction". At least one of the types should be selected. – PICS, 9.5, "Type identification and cause of transmission assignments", column COT 3. – PICS, 9.6, section "Spontaneous transmission".				
5.4.16.1	Acquisition of events - sequential procedure	When an event occurs in the Controlled station, The Controlled station transfers the configured process information data in ASDUs (look at PICS for the supported ASDUs)with COT=3 to the Controlling station	IEC 60870-5-101:2003, 7.4.4 IEC 60870-5-5:1995, 6.4.1	~~PICS, 9.6~~ M
		Local buffer function to collect events that may appear faster than it is possible to transmit them to the Controlling station to prevent the loss of events	IEC 60870-5-101:2003, 7.4.4 IEC 60870-5-5:1995, 6.4	~~PICS, 9.6~~ M
		Events *without* a time tag are transmitted in chronological order of occurrence to the Controlling station Note: This test is only required for systems supporting events without time tag. (See PICS 9.5, "Type identification and cause of transmission assignments": COT 3 should be marked for at least one type without time tag)	IEC 60870-5-101:2003, 7.2.2.2	~~PIXIT~~ PICS, 9.5 *Type id and COT assignment*
		The Controlled station transmits events of the same Type, COT and priority but with gaps in their addresses as a *Set of Information elements* (SQ:=0) in one single ASDU, filled until the maximum configured ASDU or ADPU length as in the PICS	IEC 60870-5-3:1992, 5.1.5 IEC 60870-5-101:2003, 7.2.2.2	~~PICS, 9.6~~ M
		The Controlled station transmits events of the same type, COT and priority and with sequential addresses as a *Sequence of Information elements* (SQ:=1) in one single ASDU, filled until the maximum configured ASDU or ADPU length as in the PICS. Using SQ=1 is optional for a controlled station and a mandatory requirement for a controlling station	IEC 60870-5-3:1992, 5.1.5 IEC 60870-5-101:2003, 7.2.2.2	~~PICS, 9.6~~ PIXIT
		The time label in ASDUs with a time tag represents the time of occurrence (plausibility test)		~~PICS, 9.6~~ M
		The Controlled station sends a spontaneous clock synchronisation message with COT=3 to indicate its internal date and hour shift immediately after the hour shift or before sending subsequent ASDUs with short time tag	IEC 60870-5-101:2003, 7.3.4.4. IEC 60870-5-101:2003, 7.4.3	PICS, 9.5 *Type id and COT assignment: COT 3 / ASDU 103*
		The time label in the clock synchronization message from the Controlled station represents the time of occurrence (plausibility test)		PICS, 9.5 *Type id and COT assignment: COT 3 / ASDU 103*
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station.		M
		The tests in this Table are performed correctly by each ASDU in the PICS that supports COT=3, spontaneous	IEC 60870-5-101:2003, 9.5, 9.6	M
5.4.16.10	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		~~PICS, 9~~ M

Table 17 – General interrogation function conformance test procedures *(1 of 5)*

No.	Test	Description	Reference	Required
5.4.16.1	General interrogation – Outstation interrogation – one Logical Remote Unit (LRU) available in the controlled station	The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=20 (station) or 21..36 (group 1..16) if: – the controlling station receives an ENDINIT message; – the controlling station observes a loss of link and the link is available again; – an interrogation procedure is initiated manually (e.g. by the operator)	IEC 60870-5-101, 7.4.5 IEC 60870-5-101, 7.2.6.22 IEC 60870-5-5, 6.6.1	M
		The Controlled station mirrors the Interrogation Command with COT = 7, C_IC_ACTCON to the Controlling station if the Controlled station is ready to return the interrogation information	IEC 60870-5-101, 7.4.5 IEC 60870-5-5, 6.6.1	M
		The Controlled station mirrors the Interrogation Command with COT = 7, C_IC_ACTCONneg to the Controlling station if the Controlled station is NOT ready to return the interrogation information. In this case, the Controlling station may repeat the command	IEC 60870-5-101, 7.4.5 IEC 60870-5-5, 6.6.1	M
		All Information Objects that are part of the initiated GI with that QOI are sent with the corresponding COT (20-36) to the Controlling station	IEC 60870-5-101, 7.4.5 IEC 60870-5-5, 6.6.1	M
		The Controlled station sends GI data in ASDUs without time stamp	IEC 60870-5-101, 7.4.5	M
		The Controlled station transmits Interrogated process information data of the same Type, COT and priority but with gaps in their addresses as a *Set of Information elements* (SQ:=0) in one single ASDU, filled up to but not exceeding the maximum configured ASDU or APDU length as in the PICS. The controlling station must be able to handle SQ=0 and SQ=1	IEC 60870-5-3, 5.1.5 IEC 60870-5-101, 7.2.2.2	M
		The Controlled station transmits Interrogated process information data of the same type, COT and priority and with sequential addresses as a *Sequence of Information elements* (SQ:=1) in one single ASDU, filled up to but not exceeding the maximum configured ASDU or APDU length as in the PICS. The controlling station must be able to handle SQ=0 and SQ=1	IEC 60870-5-3, 5.1.5 IEC 60870-5-101, 7.2.2.2	M
		The Controlled station sends an Interrogation Command with COT = 10, C_IC_ACTTERM, to the Controlling station after *all configured* GI data is sent	IEC 60870-5-101, 7.4.5 IEC 60870-5-5, 6.6.1	M
		GI messages contain actual status information (an event before the corresponding GI message does not state the status in the Controlling station). With single transfer, buffered time tagged events are transmitted from the Controlled station before GI data	IEC 60870-5-101, 7.4.5 IEC 60870-5-101, 7.2.2.2 IEC 60870-5-5, 6.6	M
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station. The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		M
		The tests in this table are performed correctly by every ASDU in the PICS that supports the applicable COT=20-36	IEC 60870-5-101, 8.5, 8.6	M

No.	Test	Description	Reference	Required
5.4.16.10	General interrogation – Outstation interrogation – more than one Logical Remote Unit (LRU) available in the controlled station –	The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=20 (station) or 21..36 (group 1..16) with CASDU broadcast address (FF or FFFF) if: – the controlling station receives an ENDINIT message; – the controlling station observes a loss of link and the link is available again; – an interrogation procedure is initiated manually (e.g. by the operator	IEC 60870-5-101, 7.4.5 IEC 60870-5-101, 7.2.6.22 IEC 60870-5-5, 6.6.1 IEC 60870-5-101, 7.4.5	PICS, 9.6 PIXIT
		Every LRU mirrors the Interrogation Command with COT = 7, C_IC_ACTCON to the Controlling station, containing its configured CASDU address	IEC 60870-5-101, 7.4.5 IEC 60870-5-5, 6.6.1 IEC 60870-5-101, 7.4.5	PICS, 9.6 PIXIT
		It may be possible that one or more LRU(s) mirrors the Interrogation Command with COT = 7, C_IC_ACTCONneg to the Controlling station (e.g. if the LRU(s) is not ready to return the interrogated information), containing its configured CASDU address. Then, the controlling station starts the normal GI procedure (for one LRU available) containing the CASDU address of that/those LRU(s) and finishes correctly the GI for every LRU as described	IEC 60870-5-101, 7.4.5 IEC 60870-5-5, 6.6.1 IEC 60870-5-101, 7.4.5	PICS, 9.6 PIXIT
		It may be possible that one or more LRU(s) sends an ENDINIT to the Controlling station during or after the completion of the first initiated interrogation procedure (if the LRU(s) is restarted), containing the LRUs configured CASDU address. Then the controlling station starts the normal GI procedure (for one LRU available) containing the CASDU address of that/those LRU(s) and finishes correctly the GI for every LRU as described		PIXIT
		All Information Objects that are part of the initiated GI with that QOI are sent with the corresponding COT (20-36) to the Controlling station for every LRU, containing its configured CASDU address	IEC 60870-5-101, 7.4.5 IEC 60870-5-5, 6.6.1 IEC 60870-5-101, 7.4.5	PICS, 9.6 PIXIT
		The Controlled station sends GI data in ASDUs without time stamp	IEC 60870-5-101, 7.4.5	PICS, 9.6 PIXIT
		The Controlled station transmits Interrogated process information data of the same Type, COT and priority but with gaps in their addresses as a *Set of Information elements* (SQ:=0) in one single ASDU, filled up to but not exceeding the maximum configured ASDU or APDU length as in the PICS. The controlling station must be able to handle SQ=0 and SQ=1	IEC 60870-5-3, 5.1.5 IEC 60870-5-101, 7.2.2.2	PICS, 9.6 PIXIT
		The Controlled station transmits Interrogated process information data of the same type, COT and priority and with sequential addresses as a *Sequence of Information elements* (SQ:=1) in one single ASDU, filled up to but not exceeding the maximum configured ASDU or APDU length as in the PICS. The controlling station must be able to handle SQ=0 and SQ=1	IEC 60870-5-3, 5.1.5 IEC 60870-5-101, 7.2.2.2	PIXIT
		The Controlled station sends an Interrogation Command with COT = 10, C_IC_ACTTERM, for every LRU to the Controlling station after *all configured* GI data of that LRU is sent, containing its configured CASDU address	IEC 60870-5-101, 7.4.5 IEC 60870-5-5, 6.6.1 IEC 60870-5-101, 7.4.5	PICS, 9.6 PIXIT

No.	Test	Description	Reference	Required
		GI messages contain actual status information (an event before the corresponding GI message can stale the status in the GI)	IEC 60870-5-101, 7.4.5 IEC 60870-5-5, 8.6	PICS, 9.6 PIXIT
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station. The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		PICS, 9.6 PIXIT
		The tests in this table are performed correctly by every ASDU in the PICS that supports the applicable COT=20-36	IEC 60870-5-101, 8.5, 8.6	PICS, 9.6 PIXIT
5.4.16.20	General interrogation – Re-activate a running Outstation interrogation Option 1: the running GI continues	The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=20 (station) or 21..36 (group 1..16) when a General Interrogation is already running. A running GI means that the controlling station has not received the C_IC_TERM after it has sent a C_IC_ACT	IEC 60870-5-101, 7.3.4.1	PICS, 9.6
		The Controlled station mirrors the Interrogation Command with COT = 7, C_IC_ACTCONNeg, to the Controlling station	IEC 60870-5-101, 7.3.4.1 IEC 60870-5-101, 7.4.5	PICS, 9.6
		The Controlled station continues the already running General Interrogation	IEC 60870-5-101, 7.4.5	PICS, 9.6
5.4.16.30	General interrogation – Re-activate a running Outstation interrogation Option 2: the running GI is stopped and the second GI is started	The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=20 (station) or 21..36 (group 1..16) when a General Interrogation is already running. A running GI means that the controlling station has not received the C_IC_ACTTERM after it has sent a C_IC_ACT	IEC 60870-5-101, 7.3.4.1 PICS, PID	PICS, 9.6
		The Controlled station stops the running General Interrogation (this may be indicated by the Controlled station by sending a C_IC_ACTTERM or a C_IC_ACTCONNeg) and mirrors the Interrogation Command with COT = 7 C_IC_ACTCON to the Controlling station	IEC 60870-5-101, 7.3.4.1 IEC 60870-5-101, 7.4.5	PICS, 9.6
		The Controlled station continues the normal General Interrogation procedure as in test case 5.21.1	IEC 60870-5-101, 7.4.5 PICS, PID	PICS, 9.6
5.4.16.40	General interrogation – Re-activate a running Outstation interrogation Option 3: the running GI continues and after activation termination (COT=10) the second GI is started. (Option 3 can be described as undesirable behaviour!!)	The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=20 (station) or 21..36 (group 1..16) when a General Interrogation is already running. A running GI means that the controlling station has not received the C_IC_TERM after it has sent a C_IC_ACT	IEC 60870-5-101, 7.3.4.1 PICS, PID	PICS, 9.6
		The Controlled station continues the running General Interrogation and mirrors the second Interrogation Command with COT = 7, C_IC_ACTCON to the Controlling station.	IEC 60870-5-101, 7.3.4.1 IEC 60870-5-101, 7.4.5	PICS, 9.6
		The Controlled station continues with the first General Interrogation procedure. After activation termination (COT=10) the Information Objects that are part of the second initiated GI are sent with the correct COT (20..36) to the Controlling station	IEC 60870-5-101, 7.4.5 PICS, PID	PICS, 9.6

No.	Test	Description	Reference	Required
5.4.16.50	General interrogation – Deactivate a running Outstation interrogation	The Controlling station sends an Interrogation Command with COT = 8, C_IC_DEACT to the Controlled station with QOI=20 (station) or 21..36 (group 1..16)	IEC 60870-5-101, 7.3.4.1 PICS, PID	PICS, 9.6
		The Controlled station sends an Interrogation Command with COT = 9, C_IC_DEACTCON to the Controlling station	IEC 60870-5-101, 7.3.4.1 PICS, PID	PICS, 9.6
		No further Information Objects that are part of the GI for that QOI are sent to the Controlling station. No Interrogation Command with COT = 10 (ACTTERM) to the Controlling station	IEC 60870-5-101, 7.3.4.1 PICS, PID	PICS, 9.6
5.4.16.60	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		PICS, 9

No.	Test	Description	Reference	Required
5.4.17.1	General interrogation – Outstation interrogation - one Logical Remote Unit (LRU) available in the controlled station -	The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=20 (station) if: – the controlling station receives an ENDINIT message; – the controlling station observes a loss of link and the link is available again; – an interrogation procedure is initiated manually (e.g. by the operator)	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-101:2003, 7.2.6.22 IEC 60870-5-5:1995, 6.6.1	M
		The Controlled station mirrors the Interrogation Command with COT = 7, C_IC_ACTCON to the Controlling station if the Controlled station is ready to return the interrogation information	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-5:1995, 6.6.1	M
		The Controlled station mirrors the Interrogation Command with COT = 7, C_IC_ACTCONneg to the Controlling station if the Controlled station is NOT ready to return the interrogation information. In this case, the Controlling station may repeat the command	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-5:1995, 6.6.1	M
		All Information Objects that are part of the initiated GI with that QOI are sent with the corresponding COT (20-36) to the Controlling station	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-5:1995, 6.6.1	M
		The Controlled station sends GI data in ASDUs without time stamp	IEC 60870-5-101:2003, 7.4.5	M
		The Controlled station transmits Interrogated process information data of the same Type, COT and priority but with gaps in their addresses as a *Set of Information elements* (SQ:=0) in one single ASDU, filled up to but not exceeding the maximum configured ASDU or APDU length as in the PICS.	IEC 60870-5-3:1992, 5.1.5 IEC 60870-5-101:2003, 7.2.2.2	M
		The Controlled station transmits Interrogated process information data of the same type, COT and priority and with sequential addresses as a *Sequence of Information elements* (SQ:=1) in one single ASDU, filled up to but not exceeding the maximum configured ASDU or APDU length as in the PICS.	IEC 60870-5-3:1992, 5.1.5 IEC 60870-5-101:2003, 7.2.2.2	PIXIT
		The controlling station shall be able to handle both SQ=0 and SQ=1	IEC 60870-5-3:1992, 5.1.5 IEC 60870-5-101:2003, 7.2.2.2	M
		The Controlled station sends an Interrogation Command with COT = 10, C_IC_ACTTERM, to the Controlling station after *all configured* GI data is sent	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-5:1995, 6.6.1	M
		GI messages contain actual status information. Test by sending an event during the GI before the corresponding GI message. The value in the GI should be updated. With single transfer buffered time tagged events are transmitted from the Controlled station before GI data	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-101:2003, 7.2.2.2 IEC 60870-5-5:1995, 6.6	M
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station.		M
		The tests in this table are performed correctly by every ASDU in the PICS that supports the applicable COT=20-36	IEC 60870-5-101:2003, 8.5, 8.6	M
		The tests in this Table are performed correctly for supported General Interrogation groups: The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=21…36 (group 1…16). At least 3 groups need to be tested (unless only 1 or 2 groups are supported).	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-101:2003, 7.2.6.22	PICS, 9.6 *Station interrogation*

Table 17 *(2 of 5)*

No.	Test	Description	Reference	Required
NOTE: The following tests are only required for - systems supporting more than one Logical Remote Unit - systems supporting the broadcast CASDU address while only supporting one Logical Remote Unit. If 'M' is mentioned, the test case is mandatory for systems with the functionality above described as supported in the PIXIT.				
5.4.17.10	General interrogation – Outstation interrogation - more than one Logical Remote Unit (LRU) available in the controlled station -	The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=20 (station) with CASDU broadcast address (FF or FFFF) if: – the controlling station receives an ENDINIT message; – the controlling station observes a loss of link and the link is available again; – an interrogation procedure is initiated manually (e.g. by the operator	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-101:2003, 7.2.6.22 IEC 60870-5-5:1995, 6.6.1	M
		Every LRU mirrors the Interrogation Command with COT = 7, C_IC_ACTCON to the Controlling station, containing its configured CASDU address	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-5:1995, 6.6.1	M
		It may be possible that one or more LRU(s) mirrors the Interrogation Command with COT = 7, C_IC_ACTCONneg to the Controlling station (e.g. if the LRU(s) is not ready to return the interrogated information), containing its configured CASDU address. Then, the controlling station starts the normal GI procedure (for one LRU available) containing the CASDU address of that/those LRU(s) and finishes correctly the GI for every LRU as described	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-5:1995, 6.6.1	M
		It may be possible that one or more LRU(s) sends an ENDINIT to the Controlling station during or after the completion of the first initiated interrogation procedure (if the LRU(s) is restarted), containing the LRUs configured CASDU address. Then the controlling station starts the normal GI procedure (for one LRU available) containing the CASDU address of that/those LRU(s) and finishes correctly the GI for every LRU as described		PIXIT
		All Information Objects that are part of the initiated GI with that QOI are sent with the corresponding COT (20-36) to the Controlling station for every LRU, containing its configured CASDU address	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-5:1995, 6.6.1	M
		The Controlled station sends GI data in ASDUs without time stamp	IEC 60870-5-101:2003, 7.4.5	M
		The Controlled station transmits Interrogated process information data of the same Type, COT and priority but with gaps in their addresses as a *Set of Information elements* (SQ:=0) in one single ASDU, filled up to but not exceeding the maximum configured ASDU or APDU length as in the PICS.	IEC 60870-5-3:1992, 5.1.5 IEC 60870-5-101:2003, 7.2.2.2	M
		The Controlled station transmits Interrogated process information data of the same type, COT and priority and with sequential addresses as a *Sequence of Information elements* (SQ:=1) in one single ASDU, filled up to but not exceeding the maximum configured ASDU or APDU length as in the PICS.	IEC 60870-5-3:1992, 5.1.5 IEC 60870-5-101:2003, 7.2.2.2	PIXIT
		The controlling station shall be able to handle SQ=0 and SQ=1	IEC 60870-5-3:1992, 5.1.5 IEC 60870-5-101:2003, 7.2.2.2	M
		The Controlled station sends an Interrogation Command with COT = 10, C_IC_ACTTERM, for every LRU to the Controlling station after *all configured* GI data of that LRU is sent, containing its configured CASDU address	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-5:1995, 6.6.1	M

Table 17 *(3 of 5)*

No.	Test	Description	Reference	Required
		GI messages contain actual status information (an event before the corresponding GI message can stale the status in the GI)	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-5:1995, 6.6	M
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station. The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		M
		The tests in this table are performed correctly by every ASDU in the PICS that supports the applicable COT=20-36	IEC 60870-5-101:2003, 8.5, 8.6	M
		The tests in this Table are performed correctly for supported General Interrogation groups: The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=21…36 (group 1…16) with CASDU broadcast address (FF or FFFF). At least 3 groups need to be tested (unless only 1 or 2 groups are supported).	IEC 60870-5-101:2003, 7.4.5 IEC 60870-5-101:2003, 7.2.6.22	PICS, 9.6 *Station interrogation*
NOTE The Controlled station shall fulfil one of the following 3 options. If the Controlling station supports activating a new interrogation while another interrogation is already running, then the Controlling station shall be able to handle each option.				
	General interrogation – Re-activate a running Outstation interrogation Option 1: the running GI continues	The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=20 (station) or 21..36 (group 1..16) when a General Interrogation is already running. A running GI means that the controlling station has not received the C_IC_TERM after it has sent a C_IC_ACT	IEC 60870-5-101:2003, 7.3.4.1	PIXIT
		The Controlled station mirrors the Interrogation Command with COT = 7, C_IC_ACTCONneg, to the Controlling station	IEC 60870-5-101:2003, 7.3.4.1 IEC 60870-5-101:2003, 7.4.5	PIXIT
		The Controlled station continues the already running General Interrogation	IEC 60870-5-101:2003, 7.4.5	PIXIT

Table 17 *(4 of 5)*

No.	Test	Description	Reference	Required
	General interrogation – Re-activate a running Outstation interrogation Option 2: the running GI is stopped and the second GI is started	The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=20 (station) or 21..36 (group 1..16) when a General Interrogation is already running. A running GI means that the controlling station has not received the C_IC_ACTTERM after it has sent a C_IC_ACT	IEC 60870-5-101:2003, 7.3.4.1 PICS, PID	PIXIT
		The Controlled station stops the running General Interrogation (this may be indicated by the Controlled station by sending a C_IC_ACTTERM or a C_IC_ACTCONneg) and mirrors the Interrogation Command with COT = 7, C_IC_ACTCON to the Controlling station	IEC 60870-5-101:2003, 7.3.4.1 IEC 60870-5-101, 7.4.5	PIXIT
		The Controlled station continues the normal General Interrogation procedure	IEC 60870-5-101:2003, 7.4.5 PICS, PID	PIXIT
	General interrogation – Re-activate a running Outstation interrogation Option 3: the running GI continues and after activation termination (COT=10) the second GI is started.	The Controlling station sends an Interrogation Command (ASDU 100) with COT = 6, C_IC_ACT, to the Controlled station with QOI=20 (station) or 21… 36 (group 1…16) when a General Interrogation is already running. A running GI means that the controlling station has not received the C_IC_TERM after it has sent a C_IC_ACT	IEC 60870-5-101:2003, 7.3.4.1 PICS, PID	PIXIT
		The Controlled station continues the running General Interrogation and mirrors the second Interrogation Command with COT = 7, C_IC_ACTCON to the Controlling station.	IEC 60870-5-101:2003, 7.3.4.1 IEC 60870-5-101:2003, 7.4.5	PIXIT
		The Controlled station continues with the first General Interrogation procedure. After activation termination (COT=10) the Information Objects that are part of the second initiated GI are sent with the correct COT (20-36) to the Controlling station	IEC 60870-5-101:2003, 7.4.5 PICS, PID	PIXIT

Table 17 *(5 of 5)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting General interrogation Deactivation. If 'M' is mentioned, the test case is mandatory for systems with the relevant General interrogation options marked in the PICS: – PICS, 9.5, "Type identification and cause of transmission assignments", column COT 8 and 9 for ASDU Type 100.				
5.4.17.50	General interrogation – Deactivate a running Outstation interrogation	The Controlling station sends an Interrogation Command with COT = 8, C_IC_DEACT to the Controlled station with QOI=20 (station) or 21..36 (group 1..16)	IEC 60870-5-101:2003, 7.3.4.1 PICS, PID	M
		The Controlled station sends an Interrogation Command with COT = 9, C_IC_DEACTCON to the Controlling station	IEC 60870-5-101:2003, 7.3.4.1 PICS, PID	M
		No further Information Objects that are part of the GI for that QOI are sent to the Controlling station. No Interrogation Command with COT = 10 (ACTTERM) to the Controlling station	IEC 60870-5-101:2003, 7.3.4.1 PICS, PID	M
5.4.17.60	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		M

Table 18 – Clock synchronisation function conformance test procedures

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Clock synchronization. If 'M' is mentioned, the test case is mandatory for systems with the relevant Clock synchronization options marked in the PICS: – PICS, 9.5, "Process information in control direction" – PICS, 9.6, section "Clock synchronization".				
5.4.18.1	Clock synchronisation - sequential procedure	The Controlling station sends a Clock Synchronisation message (ASDU 103) with COT = 6, C_CS_ACT, to the Controlled station	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		The time label in the clock synchronization message from the Controlling station represents the time of occurrence (plausibility test)		~~PICS, 9.6~~ M
		The Controlled station mirrors ASDU 103 with COT=7, C_CS_ACTCON, ~~and~~ containing the ~~*current*~~ *local time minus the value of time correction* in the Controlled station before it was adjusted back to the Controlling station	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		Any events waiting in the Controlled station BEFORE the Time Sync arrives still have their previous, unadjusted time tags	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		Events occurring AFTER the Time Sync has arrived in the Controlled station use the new, corrected time value	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		Events occurring before the FIRST Time Sync arrives in the Controlled station after a Reset Process or Local initialisation have the IV (Invalid) bit in the time label set	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		Events occurring after the configured clock accuracy interval in the Controlled station has passed without a Time Sync from the Controlling station have the IV (Invalid) bit in the time label set	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		The clock synchronisation is executed after station initialisation and at configured intervals	PID	~~PICS, 9.6~~ M
5.4.18.10	Clock synchronisation – Change the clock	The Controlling station increases its internal time one day and one hour ahead	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		Sequential Clock synchronisation procedure continues	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		Events occurring AFTER the Time Sync has arrived in the Controlled station use the new, corrected time value	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		The Controlling station increases its internal time one day and one hour back.	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		Sequential Clock synchronisation procedure continues	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M
		Events occurring AFTER the Time Sync has arrived in the Controlled station use the new, corrected time value	IEC ~~60870-5-101~~ 60870-5-104:2006, 7.6 IEC 60870-5-5:1995, 6.7	~~PICS, 9.6~~ M

5.4.18.15	Clock synchronisation – Broadcast	The Controlling station sends a Clock Synchronisation message (ASDU 103) with COT = 6, C_CS_ACT and with the Broadcast CASDU, to the Controlled station. The Controlled station replies with its own CASDU(s)	IEC 60870-5-104:2006, 7.6 IEC 60870-5-101, 7.2.4 IEC 60870-5-5:1995, 6.7	PIXIT ~~PICS, 9~~ M
5.4.18.20	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		

Table 19 – Command transmission function conformance test procedures *(1 of 9)*

These procedures are passed only if the mandatory procedures and test cases are passed for every supported ASDU according to the PICS. The detailed result ~~must~~ shall be reported as in 5.6.

~~No.~~	~~Test~~	~~Description~~	~~Reference~~	~~Required~~
~~5.4.18.1~~	~~Command transmission - sequential procedure:~~ ~~Select and Execute~~	~~The Controlling station sends a Single, Double, Regulating step or Setpoint Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT, and S/E=1 (SELECT) to the Controlled station~~	~~IEC 60870-5-101, 7.4.7~~ ~~IEC 60870-5-5, 6.8.1~~	~~PICS, 9.6~~
		~~The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCON, to the Controlling station~~	~~IEC 60870-5-101, 7.4.7~~ ~~IEC 60870-5-5, 6.8.1~~	~~PICS, 9.6~~
		~~The Controlling station sends the same Command message with COT=6, C_SC/DC/SE/RC_ACT, and S/E=0 (EXECUTE) to the Controlled station~~	~~IEC 60870-5-101, 7.4.7~~ ~~IEC 60870-5-5, 6.8.1~~	~~PICS, 9.6~~
		~~The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCON, to the Controlling station~~	~~IEC 60870-5-101, 7.4.7~~ ~~IEC 60870-5-5, 6.8.1~~	~~PICS, 9.6~~
		~~The Controlled station generates an event (RETURN_INF) with COT=11(RETURN_INF caused by a remote command) or COT=12 (RETURN_INF caused by a local command), when the status of the (Process) Information Object that is associated with the command object changes as a result of the command.~~ ~~The controlled station may send the RETURN_INF with COT=3, 11, or 12 *after* the ACTTERM. The Controlling station performs an overall check on the correct command procedure and corresponding status change, regardless of the order in which they occur. (change this also in other test cases!!)~~	~~IEC 60870-5-101, 7.4.7~~ ~~IEC 60870-5-101, 7.4.7~~ ~~IEC 60870-5-5, 6.8.1~~	~~PICS, 9.6~~
		~~The Controlled station mirrors the previous Command message with COT=10, C_SC/DC/SE/RC_ACTTERM (for SE if supported as in the PICS), to the Controlling station~~	~~IEC 60870-5-101, 7.4.7~~ ~~IEC 60870-5-5, 6.8.1~~	~~PICS, 9.6~~
		~~Command function during a running general interrogation is processed and executed without waiting for the GI to finish~~	~~IEC 60870-5-5, 5~~	~~PICS, 9.6~~
~~No.~~	~~Test~~	~~Description~~	~~Reference~~	~~Required~~
		~~Command function EXECUTE after SELECT must be received within the configured delay in the controlled station~~	~~IEC 60870-5-5, 6.8.1~~	~~PICS, 9.6~~
		~~Command execution in progress must be completed with status change and ACTTERM (for SE if supported as in the PICS) within the configured delay in the controlling station.~~ ~~The controlled station may send the RETURN_INF with COT=3, 11, or 12 *after* the ACTTERM if and only if the Controlling station performs an overall check on the correct command procedure and corresponding status change, regardless of the order in which they occur~~		~~PICS, 9.6~~

No.	Test	Description	Reference	Required
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		PICS, 9.6
5.4.18.10	Command transmission - sequential procedure: Select and Deactivation	The Controlling station sends a Single, Double, Regulating step or Setpoint Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT, and S/E=1 (SELECT) to the Controlled station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCON, to the Controlling station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlling station sends the same Command message with COT=8, C_SC/DC/SE/RC_DEACT, and S/E=1 (SELECT) to the Controlled station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlled station mirrors the same ASDU with COT=9, C_SC/DC/SE/RC_DEACTCON, to the Controlling station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		Both the Controlling and Controlled stations have deactivated the Command transmission procedure	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The value of the Object(s) does not change at all during this command procedure		PICS, 9.6
5.4.18.20	Command transmission - sequential procedure: Direct Execute	The Controlling station sends a Single, Double, Regulating step, Setpoint or Bitstring Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT and S/E=0 (EXECUTE) to the Controlled station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
No.	**Test**	**Description**	**Reference**	**Required**
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCON, to the Controlling station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlled station generates an event (RETURN_INF) with COT=11 (RETURN_INF caused by a remote command)or 12 (RETURN_INF caused by a local command), when the status of the (Process) Information Object that is associated with the command object changes as a result of the command. The controlled station may send the RETURN_INF with COT=3 (SPONT), 11 (RETURN_INF caused by a remote command), or 12 (RETURN_INF caused by a local command) *after* the ACTTERM if the Controlling station performs an overall check on the correct command procedure and corresponding status change, regardless of the order in which they occur	IEC 60870-5-101, 7.4.7 IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlled station mirrors the previous Command message with COT=10, C_SC/DC/SE/RC_ ACTTERM (for SE if supported as in the PICS), to the Controlling station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		Command function during a running general interrogation is processed and executed without waiting for the GI to finish	IEC 60870-5-5, Clause 5	PICS, 9.6

No.	Test	Description	Reference	Required
		Command execution in progress must be completed with status change and ACTTERM (for SE if supported as in the PICS) within the configured delay in the controlling station. The controlled station may send the RETURN_INF with COT=3 (SPONT), 11 (RETURN_INF caused by a remote command), or 12 (RETURN_INF caused by a local command) *after* the ACTTERM if the Controlling station performs an overall check on the correct command procedure and corresponding status change, regardless of the order in which they occur		PICS, 9.6
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		PICS, 9.6
No.	**Test**	**Description**	**Reference**	**Required**
5.4.18.30	Command transmission – sequential procedure: Select with Negative Confirmation by Controlled station (Abort)	The Controlling station sends a Single, Double, Regulating step or Setpoint Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT, and S/E=1 (SELECT) to the Controlled station for a non existing Information object	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCONneg (Negative ACTCON), or COT=47 (unknown Information Object Address) to the Controlling station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlling station stops the Command function with an indication at user level	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The value of the Object(s) does not change at all during this command procedure		PICS, 9.6
		The controlled station does not accept and responds with a P/N=1 if a not allowed command (e.g. DCO=0 or 3; RCO=0 or 3) is received	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
5.4.18.40	Command transmission – sequential procedure: Select with Negative Execute Confirmation by Controlled station if Execute is received after configured delay in the controlling station	The Controlling station sends a Single, Double, Regulating step or Setpoint Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT, and S/E=1 (SELECT) to the Controlled station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCON, to the Controlling station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlling station sends the same Command message with COT=6, C_SC/DC/SE/RC_ACT, and S/E=0 (EXECUTE) to the Controlled station AFTER the configured delay in the controlling station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCONneg (Negative ACTCON) to the Controlling station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlling station stops the Command function with an indication at user level	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The value of the Object(s) does not change at all during this command procedure		PICS, 9.6

No.	Test	Description	Reference	Required
5.4.18.50	Command transmission – sequential procedure: Direct Execute with Negative Confirmation by Controlled station	The Controlling station sends a Single, Double, Regulating step, Setpoint or Bitstring Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT, and S/E=0 (EXECUTE) to the Controlled station for a not controllable Information object	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1 PICS, PID	PICS, 9.6
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCONNneg (Negative ACTCON), to the Controlling station	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlling station stops the Command function with an indication at user level	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
		The Controlled station does NOT change the status of the (Process) Information Object that is associated with the command object		PICS, 9.6
		The value of the Object(s) does not change at all during this command procedure		PICS, 9.6
		The controlled station does not accept and responds with a P/N=1 if a not allowed command (e.g. DCO=0 or 3; RCO=0 or 3) is received	IEC 60870-5-101, 7.4.7 IEC 60870-5-5, 6.8.1	PICS, 9.6
5.4.18.60	Command transmission with network delay supervision – sequential procedure: Command received WITHIN configured delay	The Controlling station sends a Single, Double, Regulating step, Setpoint or Bitstring Command message with time tag (look at PICS for the supported ASDU's with time tag CP56Time2a) containing the time of command initiation to the Controlled station	IEC 60870-5-104, Clause 8	PICS, 9.6
		The time label in the Command message from the Controlling station represents the time of initiation (plausibility test)		PICS, 9.6
		The Controlled station accepts the Command message if the time difference between time tag in the Command message and the local time in the Controlled station is less than or equal to the configured maximum allowable delay of commands	IEC 60870-5-104, Clause 8 IEC 60870-5-104, 9.6	PICS, 9.6
		After accepting the command, normal command processing continues (see above)	IEC 60870-5-104, Clause 8	PICS, 9.6
No.	**Test**	**Description**	**Reference**	**Required**
5.4.18.70	Command transmission with network delay supervision – sequential procedure: Command received AFTER configured delay	The Controlling station sends a Single, Double, Regulating step, Setpoint or Bitstring Command message with time tag (look at PICS for the supported ASDU's with time tag CP56Time2a) containing the time of command initiation to the Controlled station	IEC 60870-5-104, Clause 8	PICS, 9.6
		The time label in the Command message from the Controlling station represents the time of initiation (plausibility test)		PICS, 9.6
		The Controlled station accepts the Command message if the time difference between time tag in the Command message and the local time in the Controlled station exceeds the configured maximum allowable delay of commands [and passes it to the controlled station application to identify that a command was received "too late"]	IEC 60870-5-104, Clause 8 IEC 60870-5-104, 9.6 [MOM WG03 15 June 2001 4.2.2.2]	PICS, 9.6
		[After accepting the command, NO protocol response is returned (the ASDU IS NOT MIRRORED with COT=7, C_SC/DC/SE/RC_ACTCON), to the Controlling station]	IEC 60870-5-104, Clause 8 [MOM WG03 15 June 2001 4.2.2.2]	PICS, 9.6

No.	Test	Description	Reference	Required
		[NO command process is activated in the Controlled station and therefore NO status change occurs]	IEC 60870-5-104, Clause 8 [MOM WG03 15 June 2001 4.2.2.2]	PICS, 9.6
5.4.18.80	Command transmission — Test for all supported ASDU's	The tests in this table are performed correctly by every supported ASDU according to the PICS. Results are shown in 5.6		PICS, 9
5.4.18.90	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		PICS, 9

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Command transmission with Select and Execute. If 'M' is mentioned, the test case is mandatory for systems with the relevant command options marked in the PICS: – PICS, 9.5, "Process information in control direction" – PICS, 9.6, "Select and execute command" and "Select and execute set point command".				
5.4.19.1	Command transmission – sequential procedure: Select and Execute	The Controlling station sends a Single, Double, Regulating step or Setpoint Command message (look at PICS 9.5 "Process information in control direction" for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT, and S/E=1 (SELECT) to the Controlled station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCON, to the Controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-101:2003, 7.2.1 IEC 60870-5-5:1995, 6.8.1	M
		The Controlling station sends the same Command message with COT=6, C_SC/DC/SE/RC_ACT, and S/E=0 (EXECUTE) to the Controlled station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCON, to the Controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-101:2003, 7.2.1 IEC 60870-5-5:1995, 6.8.1	M
		The Controlled station generates an event (RETURN_INF) with COT=11(RETURN_INF caused by a remote command) or COT=12 (RETURN_INF caused by a local command), when the status of the (Process) Information Object that is associated with the command object changes as a result of the command. The controlled station may send the RETURN_INF with COT=3, 11, or 12 *after* the ACTTERM. The Controlling station performs an overall check on the correct command procedure and corresponding status change, regardless of the order in which they occur.	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	PICS, 9.6 *Type id and COT assignment:* *COT 11/12*
		The Controlled station mirrors the previous Command message with COT=10, C_SC/DC/SE/RC_ACTTERM (for SE if supported as in the PICS), to the Controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	PICS, 9.6 *C_SE ACTTERM used*

Table 19 *(2 of 9)*

No.	Test	Description	Reference	Required
		Command function EXECUTE after SELECT shall be received within the configured delay in the controlled station	IEC 60870-5-5:1995, 6.8.1	M
		Command execution in progress shall be completed with status change and ACTTERM (for SE if supported as in the PICS) within the configured delay in the controlling station. The controlled station may send the RETURN_INF with COT=3, 11, or 12 *after* the ACTTERM if and only if the Controlling station performs an overall check on the correct command procedure and corresponding status change, regardless of the order in which they occur		PICS, 9.6 *Type id and COT assignment:* *COT 3/11/12*
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		M
		If the SELECT message from the Controlling station is not correctly mirrored by the Controlled station, then the Controlling station does not proceed with sending the EXECUTE message	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-101:2003, 7.2.1	M
		If the EXECUTE message from the Controlling does not contain exactly the same information as the SELECT message, then the Controlled mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCONNeg (Negative ACTCON), to the Controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-101:2003, 7.2.1	M

Table 19 *(3 of 9)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Command transmission with Select and Execute and with Deactivation. If 'M' is mentioned, the test case is mandatory for systems with the relevant command options marked in the PICS: – PICS, 9.5, "Process information in control direction" – PICS, 9.6 section Command transmission, "Select and execute command", "Select and execute set point command" and "Type id and COT assignments": column COT 8/9.				
5.4.19.10	Command transmission – sequential procedure: Select and Deactivation	The Controlling station sends a Single, Double, Regulating step or Setpoint Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT, and S/E=1 (SELECT) to the Controlled station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCON, to the Controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlling station sends the same Command message with COT=8, C_SC/DC/SE/RC_DEACT, and S/E=1 (SELECT) to the Controlled station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlled station mirrors the same ASDU with COT=9, C_SC/DC/SE/RC_DEACTCON, to the Controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		Both the Controlling and Controlled stations have deactivated the Command transmission procedure	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The value of the Object(s) does not change at all during this command procedure		M

Table 19 *(4 of 9)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Command transmission with Direct Execute. If 'M' is mentioned, the test case is mandatory for systems with the relevant command options marked in the PICS: – PICS, 9.5, "Process information in control direction" – PICS, 9.6 section Command transmission, "Direct command" and "Direct set point command".				
5.4.19.20	Command transmission – sequential procedure: Direct Execute	The Controlling station sends a Single, Double, Regulating step, Setpoint or Bitstring Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT and S/E=0 (EXECUTE) to the Controlled station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCON, to the Controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlled station generates an event (RETURN_INF) with COT=11 (RETURN_INF caused by a remote command) or 12 (RETURN_INF caused by a local command), when the status of the (Process) Information Object that is associated with the command object changes as a result of the command. The controlled station may send the RETURN_INF with COT=3 (SPONT), 11 (RETURN_INF caused by a remote command), or 12 (RETURN_INF caused by a local command) *after* the ACTTERM if the Controlling station performs an overall check on the correct command procedure and corresponding status change, regardless of the order in which they occur	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	PICS, 9.6 *Type id and COT assignment:* *COT 11/12*
		The Controlled station mirrors the previous Command message with COT=10, C_SC/DC/SE/RC_ ACTTERM (for SE if supported as in the PICS), to the Controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	PICS, 9.6 C_SE_ACTTERM used
		Command execution in progress shall be completed with status change and ACTTERM (for SE if supported as in the PICS) within the configured delay in the controlling station. The controlled station may send the RETURN_INF with COT=3 (SPONT), 11 (RETURN_INF caused by a remote command), or 12 (RETURN_INF caused by a local command) *after* the ACTTERM if the Controlling station performs an overall check on the correct command procedure and corresponding status change, regardless of the order in which they occur		PICS, 9.6 *Type id and COT assignment:* *COT 3/11/12*
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		M

Table 19 *(5 of 9)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Command transmission with Select and Execute. If 'M' is mentioned, the test case is mandatory for systems with the relevant command options marked in the PICS: – PICS, 9.5, "Process information in control direction" – PICS, 9.6 section Command transmission, "Select and execute command" and "Select and execute set point command".				
5.4.19.30	Command transmission – sequential procedure: Select with Negative Confirmation by Controlled station (Abort)	The Controlling station sends a Single, Double, Regulating step or Setpoint Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT, and S/E=1 (SELECT) to the Controlled station for a not controllable or not existing Information object	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCONneg (Negative ACTCON) to the controlling station. In case of a not existing Information object, the controlled station could instead mirror the same ASDU with COT=47 (unknown Information Object Address) to the Controlling station (if supported (see PICS clause 8.5)	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-101:2003, 7.2.3 IEC 60870-5-5:1995, 6.8.1 IEC 60870-5-104:2006, 6	M
		The Controlling station stops the Command function with an indication at user level	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	PIXIT
		The value of the Object(s) does not change at all during this command procedure		M
		The controlled station does not accept and responds with a P/N=1 if a not allowed command (e.g. DCO=0 or 3; RCO=0 or 3) is received	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-101:2003, 7.2.3 IEC 60870-5-5:1995, 6.8.1	M

Table 19 *(6 of 9)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Command transmission with Select and Execute. If 'M' is mentioned, the test case is mandatory for systems with the relevant command options marked in the PICS: – PICS, 9.5, "Process information in control direction" – PICS, 9.6 section Command transmission, "Select and execute command" and "Select and execute set point command".				
5.4.19.40	Command transmission – sequential procedure: Select with Negative Execute Confirmation by Controlled station if Execute is received after configured delay in the controlling station	The Controlling station sends a Single, Double, Regulating step or Setpoint Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT, and S/E=1 (SELECT) to the Controlled station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCON, to the Controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlling station sends the same Command message with COT=6, C_SC/DC/SE/RC_ACT, and S/E=0 (EXECUTE) to the Controlled station AFTER the configured delay in the controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	M
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCONneg (Negative ACTCON) to the Controlling station	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1 IEC 60870-5-101:2003, 7.2.3	M
		Alternatively, the Controlled station can first accept the command with a Positive ACTCON and then send a Negative Termination by mirroring the previous Command message with COT=10, C_SC/DC/SE/RC_ ACTTERM (for SE if supported as in the PICS) and P/N=1, to the Controlling station	IEC 60870-5-101:2003, 7.2.3	PIXIT PICS, 9.6 *C_SE ACTTERM used*
		The Controlling station stops the Command function with an indication at user level	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	PIXIT
		The value of the Object(s) does not change at all during this command procedure		M

Table 19 *(7 of 9)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Command transmission with Direct Execute. If 'M' is mentioned, the test case is mandatory for systems with the relevant command options marked in the PICS: – PICS, 9.5, "Process information in control direction" – PICS, 9.6 section Command transmission, "Direct command" and "Direct set point command".				
5.4.19.50	Command transmission – sequential procedure: Direct Execute with Negative Confirmation by Controlled station	The Controlling station sends a Single, Double, Regulating step, Setpoint or Bitstring Command message (look at PICS for the supported ASDUs) with COT = 6, C_SC/DC/SE/RC_ACT, and S/E=0 (EXECUTE) to the Controlled station for a not-controllable or not existing Information object	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1 PICS, PID	M
		The Controlled station mirrors the same ASDU with COT=7, C_SC/DC/SE/RC_ACTCONneg (Negative ACTCON), to the Controlling station. In case of a not existing Information object, the controlled station could instead mirror the same ASDU with COT=47 (unknown Information Object Address) to the Controlling station (if supported (see PICS clause 8.5)	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-101:2003, 7.2.3 IEC 60870-5-5:1995, 6.8.1 IEC 60870-5-104:2006, 6	M
		Alternatively, in case of a not-controllable Information object, the Controlled station can first accept the command with a Positive ACTCON and then send a Negative Termination by mirroring the previous Command message with COT=10, C_SC/DC/SE/RC_ ACTTERM (for SE if supported as in the PICS) and P/N=1, to the Controlling station	IEC 60870-5-101:2003, 7.2.3	PIXIT PICS, 9.6 *C_SE ACTTERM used*
		The Controlling station stops the Command function with an indication at user level	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-5:1995, 6.8.1	PIXIT
		The Controlled station does NOT change the status of the (Process) Information Object that is associated with the command object		M
		The value of the Object(s) does not change at all during this command procedure		M
		The controlled station does not accept and responds with a P/N=1 if a not allowed command (e.g. DCO=0 or 3; RCO=0 or 3) is received	IEC 60870-5-101:2003, 7.4.7 IEC 60870-5-101:2003, 7.2.3 IEC 60870-5-5:1995, 6.8.1	M

Table 19 *(8 of 9)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Command transmission with time tag. If 'M' is mentioned, the test case is mandatory for systems with the relevant command options marked in the PICS: – PICS, 9.5, "Process information in control direction".				
5.4.19.60	Command transmission with network delay supervision – sequential procedure: Command received WITHIN configured delay	The Controlling station sends a Single, Double, Regulating step, Setpoint or Bitstring Command message with time tag (look at PICS for the supported ASDU's with time tag CP56Time2a) containing the time of command initiation to the Controlled station	IEC 60870-5-104:2006, 8	M
		The time label in the Command message from the Controlling station represents the time of initiation (plausibility test)		M
		The Controlled station accepts the Command message if the time difference between time tag in the Command message and the local time in the Controlled station is less than or equal to the configured maximum allowable delay of commands	IEC 60870-5-104:2006, 8 IEC 60870-5-104:2006, 9.6	M
		After accepting the command, normal command processing continues (see above)	IEC 60870-5-104:2006, 8	M
5.4.19.70	Command transmission with network delay supervision – sequential procedure: Command received AFTER configured delay	The Controlling station sends a Single, Double, Regulating step, Setpoint or Bitstring Command message with time tag (look at PICS for the supported ASDU's with time tag CP56Time2a) containing the time of command initiation to the Controlled station	IEC 60870-5-104:2006, 8	M
		The time label in the Command message from the Controlling station represents the time of initiation (plausibility test)		M
		The Controlled station accepts the Command message if the time difference between time tag in the Command message and the local time in the Controlled station exceeds the configured maximum allowable delay of commands [and passes it to the controlled station application to identify that a command was received "too late"]	IEC 60870-5-104:2006, 8 IEC 60870-5-104:2006, 9.6	M
		[After accepting the command, NO protocol response is returned (the ASDU IS NOT MIRRORED with COT=7, C_SC/DC/SE/RC_ACTCON), to the Controlling station]	IEC 60870-5-104:2006, 8	M
		[NO command process is activated in the Controlled station and therefore NO status change occurs]	IEC 60870-5-104:2006, 8	M
5.4.19.75	Command transmission – Command received with time tag in the future	The Controlled station behaves in the same way as described in test case "Command received AFTER configured delay"	IEC 60870-5-104:2006, 8	M

Table 19 *(9 of 9)*

No.	Test	Description	Reference	Required
5.4.19.80	Command transmission – Test for all supported ASDU's	The tests in this table are performed correctly by every supported ASDU according to the PICS. Results are shown in 5.6		PICS, 9.5 *Process info for control dir.*
5.4.19.85	Command transmission – Commands with or without time tag	Either the ASDUs of the set <45> – <51> or of the set <58> – <64> are used or configured at the same time	IEC 60870-5-104:2006, 9.5	PICS, 9.5 *Process info for control dir.*
5.4.19.86	Command transmission – Command received during GI	Command function during a running general interrogation is processed and executed without waiting for the GI to finish. This is performed correctly by every supported ASDU according to the PICS. If ASDUs are configurable to use Select and Execute or Direct Execute, then test each ASDU at once (with Select and Execute *or* Direct Execute) and one ASDU with both Select and Execute *and* Direct Execute.	IEC 60870-5-5:1995, 5 IEC 60870-5-101:2003, 7.4	PICS, 9.5 *Process info for control dir.*
5.4.19.90	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		PICS, 9.5 *Process info for control dir.*

Table 20 – Transmission of integrated totals (telecounting) function conformance test procedures *(1 of 4)*

No.	Test	Description	Reference	Required
5.4.19.1	Transmission of integrated totals – sequential procedure: Mode A – Local freeze with spontaneous transmission	The Controlled station sends a Counter value (look at PICS for the supported ASDUs) as an event with COT = 3 (SPONT), M_IT_SPONT, and, if applicable, correct time tag to the Controlling station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Counter values are sent by the Controlled station at the configured intervals	IEC 60870-5-101, 7.4.8	PICS, 9.6
		The Counter value is either the locally memorised increment during the past interval or the locally frozen integrated total (memorised counter) at the end of the past interval (plausibility test)		PICS, 9.6
		The Sequence number of the transmitted Counter value (SQ) changes with each counter transmission interval (plausibility test)		PICS, 9.6
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		PICS, 9.6
		The tests in this table are performed correctly by every M_IT ASDU in the PICS that supports COT 3	IEC 60870-5-101, 8.5, 8.6	PICS, 9.6
5.4.19.10	Transmission of integrated totals – sequential procedure: Mode B – Local freeze with Counter Interrogation	The Controlling station sends a Counter interrogation command (ASDU 101) with COT=6, C_CI_ACT, FRZ=0 (no freeze/reset) and RQT=1..5 (general or counter group 1..4) to the Controlled station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Controlling station sends the Counter Interrogation command at the configured intervals		PICS, 9.6 PIXIT
		The Controlled station mirrors the counter interrogation command (ASDU 101) with COT=7, C_CI_ACTCON, to the Controlling station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		All Counter Information Objects that are part of the Counter Interrogation for the requested RQT are sent with the corresponding COT (37-41) to the Controlling station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Counter value is either the locally memorised increment during the past interval or the locally frozen integrated total (memorised counter) at the end of the past interval (plausibility test)		PICS, 9.6 PIXIT
		The Sequence number of the transmitted Counter value (SQ) changes with each counter transmission interval (plausibility test)		PICS, 9.6 PIXIT
		The Controlled station sends the same Counter interrogation command it received (ASDU 101) with COT = 10, C_CI_ACTTERM, to the Controlling station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 9.1	PICS, 9.6
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		PICS, 9.6 PIXIT
		The tests in this table are performed correctly by every M_IT ASDU in the PICS that supports COT 10	IEC 60870-5-101, 8.5, 8.6	PICS, 9.6 PIXIT
No.	Test	Description	Reference	Required

No.	Test	Description	Reference	Required
5.4.19.20	Transmission of integrated totals – sequential procedure: Mode C – Remote initiated freeze with Counter Interrogation	The Controlling station sends a Counter interrogation command (ASDU 101) with COT=6, C_CI_ACT, FRZ=1..3 (freeze, freeze with reset, reset) and RQT=1..5 (general or counter group 1..4) to the Controlled station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Freeze Counter interrogation command is sent at the configured interval		PICS, 9.6 PIXIT
		The Controlled station sends a confirmation of the same counter interrogation command it received (ASDU 101) with COT=7, C_CI_ACTCON, to the Controlling station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Controlled station memorises the counters indicated in the RQT field without affecting other counter values or counters pending for transmission	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Controlling station sends a Counter interrogation command (ASDU 101) with COT=6, C_CI_ACT, FRZ =0 (no freeze/reset) and RQT=1..5 to the Controlled station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Counter Interrogation command is sent at the configured intervals		PICS, 9.6 PIXIT
		The Controlled station sends a confirmation of the same counter interrogation command it received (ASDU 101) with COT=7 (ACTCON) to the Controlling station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		All Information Objects that are part of the Counter Interrogation for the requested RQT are sent with the corresponding COT (37-41) to the Controlling station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Counter value is either the increment or the integrated total (memorised counter) that was memorised during the previous Memorise Counter command (plausibility test)		PICS, 9.6
		The Sequence number of the transmitted Counter value (SQ) changes with each counter transmission interval (plausibility test)		PICS, 9.6
		The Controlled station sends the same Counter interrogation command it received (ASDU 101) with COT = 10, C_CI_ACTTERM, to the Controlling station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		PICS, 9.6
		The tests in this table are performed correctly by every M_IT ASDU in the PICS that supports COT 10	IEC 60870-5-101, 8.5, 8.6	PICS, 9.6

No.	Test	Description	Reference	Required
5.4.19.30	Transmission of integrated totals – sequential procedure: Mode D – Remote initiated freeze with spontaneous transmission	The Controlling station sends a Counter interrogation command (ASDU 101) with COT=6, C_CI_ACT, FRZ=1..3 (freeze, freeze with reset, reset) and RQT=1..5 (general or counter group 1..4) to the Controlled station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Freeze Counter interrogation command is sent at the configured interval		PICS, 9.6 PIXIT
		The Controlled station sends a confirmation of the same counter interrogation command it received (ASDU 101) with COT=7, C_CI_ACTCON, to the Controlling station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Controlled station memorises the counters indicated in the RQT field without affecting other counter values or counters pending for transmission	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Controlled station sends a Counter value (look at PICS for the supported ASDUs) as an event with COT = 3 (SPONT), M_IT_SPONT, and, if applicable, correct time tag to the Controlling station	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Counter values are sent by the Controlled station at the configured Intervals		PICS, 9.6 PIXIT
		The Counter value is either the increment or the integrated total (memorised counter) that was memorised during the previous Memorise Counter command (plausibility test)	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The Sequence number of the transmitted Counter value (SQ) changes with each counter transmission interval (plausibility test)	IEC 60870-5-101, 7.4.8 IEC 60870-5-5, 6.9.1	PICS, 9.6
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		PICS, 9.6
		The tests in this table are performed correctly by every M_IT ASDU in the PICS that supports COT 3	IEC 60870-5-101, 8.5, 8.6	PICS, 9.6
5.4.19.40	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		PICS, 9

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Transmission of integrated totals using Mode A. If 'M' is mentioned, the test case is mandatory for systems with the relevant Transmission of integrated totals options marked in the PICS: – PICS, 9.5, "System information in control direction" – PICS, 9.6 section Transmission of integrated totals, "Mode A".				
5.4.20.1	Transmission of integrated totals – sequential procedure: Mode A – Local freeze with spontaneous transmission	The Controlled station sends a Counter value (look at PICS for the supported ASDUs) as an event with COT = 3 (SPONT), M_IT_SPONT, and, if applicable, correct time tag to the Controlling station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Counter values are sent by the Controlled station at the configured intervals	IEC 60870-5-101:2003, 7.4.8	M
		The Counter value is either the locally memorised increment during the past interval or the locally frozen integrated total (memorised counter) at the end of the past interval (plausibility test)		M
		The Sequence number of the transmitted Counter value (SQ) changes with each counter transmission interval (plausibility test)		M
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		M
		The tests in this table are performed correctly by every M_IT ASDU in the PICS that supports COT 3	IEC 60870-5-101:2003, 8.5, 8.6	M

Table 20 *(2 of 4)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Transmission of integrated totals using Mode B. If 'M' is mentioned, the test case is mandatory for systems with the relevant Transmission of integrated totals options marked in the PICS: – PICS, 9.5, "System information in control direction" – PICS, 9.6 section Transmission of integrated totals, "Mode B".				
5.4.20.10	Transmission of integrated totals – sequential procedure: Mode B – Local freeze with Counter Interrogation	The Controlling station sends a Counter interrogation command (ASDU 101) with COT=6, C_CI_ACT, FRZ=0 (no freeze/reset) and RQT=1 (general) to the Controlled station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Controlling station sends the Counter Interrogation command at the configured intervals		M
		The Controlled station mirrors the counter interrogation command (ASDU 101) with COT=7, C_CI_ACTCON, to the Controlling station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		All Counter Information Objects that are part of the Counter Interrogation for the requested RQT are sent with the corresponding COT (37-41) to the Controlling station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Counter value is either the locally memorised increment during the past interval or the locally frozen integrated total (memorised counter) at the end of the past interval (plausibility test)		M
		The Sequence number of the transmitted Counter value (SQ) changes with each counter transmission interval (plausibility test)		M
		The Controlled station sends the same Counter interrogation command it received (ASDU 101) with COT = 10, C_CI_ACTTERM, to the Controlling station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 9.1	M
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		PIXIT
		The tests in this table are performed correctly by every M_IT ASDU in the PICS that supports COT 37-41	IEC 60870-5-101:2003, 8.5, 8.6	M
		The tests in this Table are performed correctly for supported Counter Interrogation groups: The Controlling station sends a Counter Interrogation Command (ASDU 101) with COT = 6, C_CI_ACT, FRZ=0 (no freeze/reset) to the Controlled station with RQT=1…4 (group 1…4). At least 2 groups need to be tested (unless only 1 group is supported).	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	PICS, 9.6 *Transmission of integrated totals*
		If supported, the Counter interrogation command should also be tested with the Broadcast CASDU address. The Controlled station should reply with its own CASDU(s)	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	PIXIT

Table 20 *(3 of 4)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Transmission of integrated totals using Mode C. If 'M' is mentioned, the test case is mandatory for systems with the relevant Transmission of integrated totals options marked in the PICS: – PICS, 9.5, "System information in control direction" – PICS, 9.6 section Transmission of integrated totals, "Mode C".				
5.4.20.20	Transmission of integrated totals – sequential procedure: Mode C – Remote initiated freeze with Counter Interrogation	The Controlling station sends a Counter interrogation command (ASDU 101) with COT=6, C_CI_ACT, FRZ=1..3 (freeze, freeze with reset, reset) and RQT= (general) to the Controlled station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Freeze Counter interrogation command is sent at the configured interval		M
		The Controlled station sends a confirmation of the same counter interrogation command it received (ASDU 101) with COT=7, C_CI_ACTCON, to the Controlling station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Controlled station memorises the counters indicated in the RQT field without affecting other counter values or counters pending for transmission	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Controlling station sends a Counter interrogation command (ASDU 101) with COT=6, C_CI_ACT, FRZ =0 (no freeze/reset) and RQT=1..5 to the Controlled station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Counter Interrogation command is sent at the configured intervals		M
		The Controlled station sends a confirmation of the same counter interrogation command it received (ASDU 101) with COT=7 (ACTCON) to the Controlling station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		All Information Objects that are part of the Counter Interrogation for the requested RQT are sent with the corresponding COT (37-41) to the Controlling station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Counter value is either the increment or the integrated total (memorised counter) that was memorised during the previous Memorise Counter command (plausibility test)		M
		The Sequence number of the transmitted Counter value (SQ) changes with each counter transmission interval (plausibility test)		M
		The Controlled station sends the same Counter interrogation command it received (ASDU 101) with COT = 10, C_CI_ACTTERM, to the Controlling station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		M
		The tests in this table are performed correctly by every M_IT ASDU in the PICS that supports COT 37-41	IEC 60870-5-101:2003, 8.5, 8.6	M
		The tests in this Table are performed correctly for supported Counter Interrogation groups: The Controlling station sends a Counter Interrogation Command (ASDU 101) with COT = 6, C_CI_ACT, FRZ=1 (freeze) to the Controlled station with RQT=1…4 (group 1…4). At least 2 groups need to be tested (unless only 1 group is supported).	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	PICS, 9.6 *Transmission of integrated totals*
		The tests in this Table are performed correctly for each supported Counter reset option: The Controlling station sends a Counter Interrogation Command (ASDU 101) with COT = 6, C_CI_ACT, FRZ=2 or 3 (freeze with reset or reset only) to the Controlled station with RQT=5 (general).	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	PICS, 9.6 *Transmission of integrated totals*
		If supported, the Counter interrogation command should also be tested with the Broadcast CASDU address. The Controlled station should reply with its own CASDU(s)	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	PIXIT

Table 20 *(4 of 4)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Transmission of integrated totals using Mode D. If 'M' is mentioned, the test case is mandatory for systems with the relevant Transmission of integrated totals options marked in the PICS: – PICS, 9.5, "System information in control direction" – PICS, 9.6 section Transmission of integrated totals, "Mode D".				
5.4.20.30	Transmission of integrated totals – sequential procedure: Mode D – Remote initiated freeze with spontaneous transmission	The Controlling station sends a Counter interrogation command (ASDU 101) with COT=6, C_CI_ACT, FRZ=1..3 (freeze, freeze with reset, reset) and RQT=5 (general) to the Controlled station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Freeze Counter interrogation command is sent at the configured interval		M
		The Controlled station sends a confirmation of the same counter interrogation command it received (ASDU 101) with COT=7, C_CI_ACTCON, to the Controlling station	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Controlled station memorises the counters indicated in the RQT field without affecting other counter values or counters pending for transmission	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Controlled station sends a Counter value (look at PICS for the supported ASDUs) as an event with COT = 3 (SPONT), M_IT_SPONT, and, if applicable, correct time tag to the Controlling station Note: The order of sending C_CI_ACTCON and M_IT_SPONT by the Controlled station is not relevant and shall not be tested	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Counter values are sent by the Controlled station at the configured intervals		M
		The Counter value is either the increment or the integrated total (memorised counter) that was memorised during the previous Memorise Counter command (plausibility test)	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The Sequence number of the transmitted Counter value (SQ) changes with each counter transmission interval (plausibility test)	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	M
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		M
		The tests in this table are performed correctly by every M_IT ASDU in the PICS that supports COT 3	IEC 60870-5-101:2003, 8.5, 8.6	M
		The tests in this Table are performed correctly for supported Counter Interrogation groups: The Controlling station sends a Counter Interrogation Command (ASDU 101) with COT = 6, C_CI_ACT, FRZ=1 (freeze) to the Controlled station with RQT=1…4 (group 1…4). At least 2 groups need to be tested (unless only 1 group is supported).	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	PICS, 9.6 *Transmission of integrated totals*
		The tests in this Table are performed correctly for each supported Counter reset option: The Controlling station sends a Counter Interrogation Command (ASDU 101) with COT = 6, C_CI_ACT, FRZ=2 or 3 (freeze with reset or reset only) to the Controlled station with RQT=5 (general).	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	PICS, 9.6 *Transmission of integrated totals*
		If supported, the Counter interrogation command should also be tested with the Broadcast CASDU address. The Controlled station should reply with its own CASDU(s)	IEC 60870-5-101:2003, 7.4.8 IEC 60870-5-5:1995, 6.9.1	PIXIT
5.4.20.40	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		PICS, 9.5 *System info in control direction*

Table 21 – Parameter loading function conformance test procedures

No.	Test	Description	Reference	Required
5.4.20.1	Parameter loading – sequential procedure: Load and activate parameter	The Controlling station sends a Parameter load message (look at PICS for the supported ASDUs) with COT = 6 ACT to the Controlled station	IEC 60870-5-5, 6.10.1	PICS, 9.6
		The parameter is loaded and will be activated immediately (after check for feasibility and acceptance of being a valid value)	IEC 60870-5-5, 6.10.1 IEC 60870-5-101, 7.4.9	PICS, 9.6
		The Controlled station mirrors the same ASDU, with COT=7_ACTCONpos, to the Controlling station, which contain the actual parameter value that is in operation. The actual value in this case is the "new" value and not the old parameter value!	IEC 60870-5-5, 6.10.1 IEC 60870-5-101, 7.4.9	PICS, 9.6 PIXIT
		The actual parameter value in the ACTCON is equal to the operational parameter in the controlled station (plausibility test)	IEC 60870-5-101, 7.4.9 PICS, PID	PICS, 9.6
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		PICS, 9.6
		The tests in this table are performed correctly by every ASDU in the PICS that supports the applicable COT	IEC 60870-5-101, 8.5, 8.6	PICS, 9.6
5.4.20.10	Parameter loading – sequential procedure: Load and activate parameter with Negative Confirmation by Controlled station	The Controlling station sends a Parameter load message (look at PICS for the supported ASDUs) with COT = 6 ACT to the Controlled station	IEC 60870-5-5, 6.10.1	PICS, 9.5
		The parameter is loaded but CANNOT be activated immediately (after check for feasibility and acceptance of being a valid value) Negative values for the parameters Threshold value and Smoothing factor always are considered as invalid and not activated	IEC 60870-5-5, 6.10.1	PICS, 9.5
		The Controlled station mirrors the same ASDU with COT=7(ACTCONneg) to the Controlling station, which indicates that the parameter could not be loaded and/or activated. The actual value in this case is the "old" existing value and not the parameter that could not be activated!	IEC 60870-5-5, 6.10.1 IEC 60870-5-101, 7.4.9	PICS, 9.5
		The actual parameter value in the ACTCON (must be valid and the operation parameter in the controlled station must match	IEC 60870-5-101, 7.4.9 PICS, PID	PICS, 9.5
		ASDUs sent or received with the wrong IOA are not accepted, ignored or negatively confirmed with COT=47 and P/N=<1> negative	IEC 60870-5-101, 7.2.3	PICS, 9.5
5.4.20.20	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 6.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		PICS, 9

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Parameter loading. If 'M' is mentioned, the test case is mandatory for systems with the relevant Parameter loading options marked in the PICS: – PICS, 9.5, "Parameter in control direction"				
5.4.21.1	Parameter loading – sequential procedure: Load and activate parameter	The Controlling station sends a Parameter command (look at PICS for the supported ASDUs) with COT = 6 ACT to the Controlled station	IEC 60870-5-5:1995, 6.10.1	M
		The parameter is loaded and will be activated immediately (after check for feasibility and acceptance of being a valid value)	IEC 60870-5-5:1995, 6.10.1 IEC 60870-5-101:2003, 7.4.9	M
		The Controlled station mirrors the same ASDU, with COT=7_ACTCONpos, to the Controlling station, which contain the actual parameter value that is in operation. - The actual value in this case is the "new" value and not the old parameter value!	IEC 60870-5-5:1995, 6.10.1 IEC 60870-5-101:2003, 7.4.9	M
		The actual parameter value in the ACTCON is equal to the operational parameter in the controlled station (plausibility test)	IEC 60870-5-101:2003, 7.4.9 PICS, PID	M
		The values of the object(s) transferred and stored on the controlling station should represent the actual values on the controlled station		M
		The tests in this table are performed correctly by every ASDU in the PICS that supports the applicable COT and for each supported parameter (Threshold, smoothing factor, high/low limit). Look at PICS 9.6 section Parameter loading for the supported parameters.	IEC 60870-5-101:2003, 8.5, 8.6	M
5.4.21.10	Parameter loading – sequential procedure: Load and activate parameter with Negative Confirmation by Controlled station	The Controlling station sends a Parameter command (look at PICS for the supported ASDUs) with COT = 6 ACT to the Controlled station	IEC 60870-5-5:1995, 6.10.1	PICS, 9.6 *Parameter loading, supported parameters*
		The parameter is loaded but CANNOT be activated immediately (after check for feasibility and acceptance of being a valid value) Negative values for the parameters Threshold value and Smoothing factor always are considered as invalid and not activated. If all values for the supported parameters are considered valid, then this test can be skipped.	IEC 60870-5-5:1995, 6.10.1	PICS, 9.6 *Parameter loading, supported parameters*
		The Controlled station mirrors the same ASDU with COT=7(ACTCONneg) to the Controlling station, which indicates that the parameter could not be loaded and/or activated. The actual value in this case is the "old" existing value and not the parameter that could not be activated!	IEC 60870-5-5:1995, 6.10.1 IEC 60870-5-101:2003, 7.4.9	PICS, 9.6 *Parameter loading, supported parameters*
5.4.21.15	Parameter loading – Parameter activation	The Controlled station will reject any received Parameter Activation command (ASDU 113) with QPA = 1 or 2. The Controlled station mirrors the same ASDU with P/N = 1 negative (and with COT = 44, if supported) to the Controlling station	IEC 60870-5-101:2003, 7.2.6.25	M
5.4.21.20	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		M

Table 22 – Test procedure function conformance test procedures

~~No.~~	~~Test~~	~~Description~~	~~Reference~~	~~Required~~
~~5.4.21.1~~	~~Test procedure – sequential procedure~~	~~The Primary station sends a Test command (ASDU 107) with COT = 6, C_TS_ACT, to the Secondary station, after which the local TSC is incremented with 1. The Test command contains the time of sending the Test command and the current value of the Test Sequence Counter TSC in the Primary Station~~	~~IEC 60870-5-104, 7.10~~ ~~IEC 60870-5-5, 6.11.1~~	~~PICS, 9.6~~
		~~The Test command is sent at the configured interval period~~	~~PID~~ ~~IEC 60870-5-5, 6.11.1~~	~~PICS, 9.6~~
		~~The Secondary station sends the same Test command (ASDU 107) with COT = 7, C_TS_ACTCON, to the Primary station, after which the local TSC is incremented with 1. The Test command contains the time of sending the Test command and the current value of the Test Sequence Counter TSC in the Secondary Station~~	~~IEC 60870-5-104, 7.10~~ ~~IEC 60870-5-5, 6.11.1~~	~~PICS, 9.6~~
		~~After local initialisation of the Controlling station the Test Sequence Counter in the Controlling station starts with 0~~	~~IEC 60870-5-104, 8.8~~	~~PICS, 9.6~~
		~~After local initialisation of the Controlled station the Test Sequence Counter in the Controlled station starts with 0~~	~~IEC 60870-5-104, 8.8~~	~~PICS, 9.6~~
		~~Mismatching values of TSC other than 0 are detected by the both the Primary and Secondary station~~	~~IEC 60870-5-104, 8.8~~	~~PICS, 9.6~~
~~5.4.21.10~~	~~COMPATIBILITY WITH OTHER TEST CASES~~	~~All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation~~		~~PICS, 9~~

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Test procedure. If 'M' is mentioned, the test case is mandatory for systems with the relevant Test procedure options marked in the PICS: – PICS, 9.5, "System information in control direction", "Test command" – PICS, 9.6 section Test procedure				
5.4.22.1	Test procedure – sequential procedure	The Primary station sends a Test command (ASDU 107) with COT = 6, C_TS_ACT, to the Secondary station. The Primary station may choose any value of TSC	IEC 60870-5-104:2006, 8.8 IEC 60870-5-101:2003, 7.4.10	M
		The Test command is sent at the configured interval period	PID	PIXIT
		The Secondary station sends the same Test command (ASDU 107) with COT = 7, C_TS_ACTCON, to the Primary station. The TSC in the response shall match the request, and the time in the response shall also exactly match the time in the request	IEC 60870-5-104:2006, 8.8 IEC 60870-5-101:2003, 7.4.10	M
		Mismatching values of TSC are detected by the Primary station	IEC 60870-5-104:2006, 8.8 IEC 60870-5-101:2003, 7.4.10	M
5.4.22.10	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		M

Table 23 – File transfer procedure function conformance test procedures *(1 of 3)*

No.	Test	Description	Reference	Required
5.4.22.1	File transfer procedure (monitor direction) – sequential procedure	The Controlling station sends a call directory command (ASDU 122) with COT = 5 (REQ) to the Controlled station	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlled station sends a file directory (ASDU 126) with COT = 5 (FILE) to the Controlling station	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlling station sends a select file (ASDU 122) with COT = 13 (FILE) to the Controlled station, SCQ=1	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlled station sends a file ready (ASDU 120) with COT = 13 (FILE) to the Controlling station, FRQ=0	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlling station sends a call file (ASDU 122) with COT = 13 (FILE) to the Controlled station, SCQ=2	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlled station sends a section ready (ASDU 121) with COT = 13 (FILE) to the Controlling station, SRQ=0	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlling station sends a call section (ASDU 122) with COT = 13 (FILE) to the Controlled station, SCQ=6	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlled station sends a number of segments (ASDU 125) with COT = 13 (FILE) to the Controlling station	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlled station sends a last segment (ASDU 123) with COT = 13 (FILE) to the Controlling station, LSQ=3	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlling station sends an acknowledge section (ASDU 124) with COT = 13 (FILE) to the Controlled station, AFQ=3. On negative acknowledge (AFQ=4) the same section is transmitted again.	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The procedure from ASDU 121 (COT=13, SRQ=0) to ASDU 124 (COT=13, AFQ=3) is repeated for all sections in the file	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlled station sends a last section (ASDU 123) with COT = 13 (FILE) to the Controlling station, LSQ=1	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6

No.	Test	Description	Reference	Required
		The Controlling station sends an acknowledge file (ASDU 124) with COT = 13 (FILE) to the Controlled station, AFQ=1	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		Select a specific section (ASDU 122, SCQ=5) and abort section (ASDU 122, SCQ=7) are supported	PID	PICS, 9.6
5.4.22.10	File transfer procedure (control direction) – sequential procedure	The Controlling station sends a file ready command (ASDU 120) with COT = 13 (REQ) to the Controlled station	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlled station sends a call file (ASDU 122) with COT = 13 (FILE) to the Controlling station, SCQ=2	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlling station sends a section ready (ASDU 121) with COT = 13 (FILE) to the Controlled station, SRQ=0	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlled station sends a call section (ASDU 122) with COT = 13 (FILE) to the Controlling station, SCQ=6	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlling station sends a number of segments (ASDU 125) with COT = 13 (FILE) to the Controlled station	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlling station sends a last segment (ASDU 123) with COT = 13 (FILE) to the Controlled station, LSQ=3	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlled station sends an acknowledge section (ASDU 124) with COT = 13 (FILE) to the Controlling station, AFQ=3. On negative acknowledge (AFQ=4) the same section is transmitted again	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The procedure from ASDU 121 (COT=13, SRQ=0) to ASDU 124 (COT=13, AFQ=3) is repeated for all sections in the file	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlling station sends a last section (ASDU 123) with COT = 13 (FILE) to the Controlled station, LSQ=1	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		The Controlled station sends an acknowledge file (ASDU 124) with COT = 13 (FILE) to the Controlling station, AFQ=1	IEC 60870-5-101, 7.4.11 IEC 60870-5-5, 6.12	PICS, 9.6
		Select a specific section (ASDU 122, SCQ=5) and abort section (ASDU 122, SCQ=7) are supported	PID	PICS, 9.6
		ASDUs sent or received with the not configured or not applicable IOA are not accepted, ignored or negatively confirmed with COT=44 and P/N=<1> negative	IEC 60870-5-101, 7.2.3	PICS, 9.6
5.4.22.20	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		PICS, 9

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting File transfer in monitor direction. If 'M' is mentioned, the test case is mandatory for systems with the relevant File transfer options marked in the PICS: – PICS, 9.5, "File transfer" – PICS, 9.6 section File transfer, File transfer in monitor direction				
5.4.23.1	File transfer procedure (monitor direction) – sequential procedure	The Controlling station sends a call directory command (ASDU 122) with COT = 5, F_SC_REQ, to the Controlled station	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	PICS, 9.5 *Type id and COT assignments:* *ASDU 122-COT 5* *ASDU 126-COT 5*
		The Controlled station sends a file directory (ASDU 126) with COT = 5, F_DR_REQ, to the Controlling station	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	PICS, 9.5 *Type id and COT assignments:* *ASDU 122-COT 5* *ASDU 126-COT 5*
		The Controlling station sends a select file (ASDU 122) with COT = 13, F_SC_FILE, to the Controlled station, SCQ=1	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlled station sends a file ready (ASDU 120) with COT = 13, F_FR_FILE, to the Controlling station, FRQ=0	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlling station sends a call file (ASDU 122) with COT = 13, F_SC_FILE, to the Controlled station, SCQ=2	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlled station sends a section ready (ASDU 121) with COT = 13, F_SR_FILE, to the Controlling station, SRQ=0	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlling station sends a call section (ASDU 122) with COT = 13, F_SC_FILE, to the Controlled station, SCQ=6	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlled station sends a number of segments (ASDU 125) with COT = 13, F_SG_FILE, to the Controlling station	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlled station sends a last segment (ASDU 123) with COT = 13, F_LS_FILE, to the Controlling station, LSQ=3	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlling station sends an acknowledge section (ASDU 124) with COT = 13, F_AF_FILE, to the Controlled station, AFQ=3. On negative acknowledge (AFQ=4) the same section is transmitted again	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The procedure from ASDU 121 with COT=13, F_SR_FILE (SRQ=0) to ASDU 124 with COT=13 (AFQ=3) is repeated for all sections in the file	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlled station sends a last section (ASDU 123) with COT = 13, F_AF_FILE, to the Controlling station, LSQ=1	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M

Table 23 *(2 of 3)*

No.	Test	Description	Reference	Required
		The Controlling station sends an acknowledge file (ASDU 124) with COT = 13, F_AF_FILE, to the Controlled station, AFQ=1	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		Select a specific section (ASDU 122, F_SC, SCQ=5) and abort section (ASDU 122, F_SC, SCQ=7) are supported	PID	PIXIT
NOTE The following tests are only required for systems supporting File transfer in control direction. If 'M' is mentioned, the test case is mandatory for systems with the relevant File transfer options marked in the PICS: – PICS, 9.5, "File transfer" – PICS, 9.6 section File transfer, File transfer in control direction				
5.4.23.10	File transfer procedure (control direction) – sequential procedure	The Controlling station sends a file ready command (ASDU 120) with COT = 13, F_FR_FILE, to the Controlled station	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlled station sends a call file (ASDU 122) with COT = 13, F_SC_FILE, to the Controlling station, SCQ=2	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlling station sends a section ready (ASDU 121) with COT = 13, F_SR_FILE, to the Controlled station, SRQ=0	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlled station sends a call section (ASDU 122) with COT = 13, F_SC_FILE, to the Controlling station, SCQ=6	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlling station sends a number of segments (ASDU 125) with COT = 13, F_SG_FILE, to the Controlled station	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlling station sends a last segment (ASDU 123) with COT = 13, F_LS_FILE, to the Controlled station, LSQ=3	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlled station sends an acknowledge section (ASDU 124) with COT = 13, F_AF_FILE, to the Controlling station, AFQ=3. On negative acknowledge (AFQ=4) the same section is transmitted again	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The procedure from ASDU 121 with COT=13, F_SR_FILE (SRQ=0) to ASDU 124 with COT=13, F_AF_FILE (AFQ=3) is repeated for all sections in the file	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlling station sends a last section (ASDU 123) with COT = 13, F_LS_FILE, to the Controlled station, LSQ=1	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		The Controlled station sends an acknowledge file (ASDU 124) with COT = 13, F_AF_FILE, to the Controlling station, AFQ=1	IEC 60870-5-101:2003, 7.4.11 IEC 60870-5-5:1995, 6.12	M
		Select a specific section (ASDU 122, F_SC, SCQ=5) and abort section (ASDU 122, F_SC, SCQ=7) are supported	PID	PIXIT
		ASDUs sent or received with the not configured or not applicable IOA are not accepted, ignored or negatively confirmed with COT=44 and P/N=<1> negative	IEC 60870-5-101:2003, 7.2.3	M

Table 23 *(3 of 3)*

No.	Test	Description	Reference	Required
5.4.23.15	File transfer procedure – Query Log	The requesting station sends a Query Log (ASDU 127) with COT = 13 (FILE) to the receiving station	IEC 60870-5-104:2006, 8.9	PICS, 9.5 *Type id and COT assignment: COT 13 / ASDU 127*
		The receiving station selects the records according the range specified in the request and starts the normal file transfer procedure	IEC 60870-5-104:2006, 8.9	PICS, 9.5 *Type id and COT assignment: COT 13 / ASDU 127*
		These tests are performed correctly for the following combinations of RangeStartTime and RangeStopTime: – RangeStartTime: Available, RangeStopTime: Available – RangeStartTime: 0 (all zeros), RangeStopTime: Available – RangeStartTime: Available, RangeStopTime: 0 (all zeros) – RangeStartTime: 0 (all zeros), RangeStopTime: 0 (all zeros)	IEC 60870-5-104:2006, 8.9	PICS, 9.5 *Type id and COT assignment: COT 13 / ASDU 127*
5.4.23.20	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 “Verification of IEC 60870-5-104 communication” have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		PICS, 9.6 *File transfer*

Table 24 – Additional conformance test procedures

No.	Test	Description	Reference	Required
5.4.23.1	Out of service behaviour	Behaviour on main voltage supply interruptions of the Controlled system. System is able to start automatically without any manual assistance		M
		Behaviour on main voltage supply interruptions of the Controlling system. System is able to start automatically without any manual assistance		M
		Behaviour on disconnection of the physical communication to the Controlled system. System is able to connect automatically without any manual assistance		M
		Behaviour on disconnection of the physical communication to the Controlling system. System is able to connect automatically without any manual assistance		M
5.4.23.10	Miscellaneous	The controlled station does not respond or responds with P/N=1 negative if a BAF is not implemented or used	IEC 60870-5-101, 7.2.3	M
		The controlling station detects the receipt of a P/N=1 negative and shows this on an HMI or a test tool	IEC 60870-5-101, 7.2.3	M
5.4.23.20	Time invalid	After receipt of an ASDU with time stamp marked invalid (IV=1) the controlling station immediately initiates a Clock synchronisation procedure (if supported) after the Clock synchronisation procedure has been completed as part of the Initialisation procedure	IEC 60870-5-101, 7.4.6	PIXIT
5.4.23.30	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		PICS, 9

No.	Test	Description	Reference	Required
5.4.24.1	Out of service behaviour	Behaviour on main voltage supply interruptions of the Controlled system. System is able to start automatically without any manual assistance		M
		Behaviour on main voltage supply interruptions of the Controlling system. System is able to start automatically without any manual assistance		M
		Behaviour on disconnection of the physical communication to the Controlled system. System is able to connect automatically without any manual assistance		M
		Behaviour on disconnection of the physical communication to the Controlling system. System is able to connect automatically without any manual assistance		M
		These tests are performed correctly in the situation when there is no active Basic application function and when there is an active Basic application function (for example a running General Interrogation). After any connection re-establishment, unconfirmed messages may be transmitted when the Start procedure is completed, if required by the user process.	IEC 60870-5-104:2006, 5.3	M
5.4.24.10	Miscellaneous	The controlled station responds with P/N=1negative (with COT = 44, if supported) if a BAF is not implemented or used	IEC 60870-5-101:2003, 7.2.3	M
		The controlling station detects the receipt of a P/N=1 negative and (optionally) shows this on an HMI or a test tool	IEC 60870-5-101:2003, 7.2.3	M
5.4.24.20	Time invalid	After receipt of an ASDU with time stamp marked invalid (IV=1) the controlling station immediately initiates a Clock synchronisation procedure (if supported) after the Clock synchronisation procedure has been completed as part of the Initialisation procedure	IEC 60870-5-104:2006, 7.6	PIXIT
5.4.24.30	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 “Verification of IEC 60870-5-104 communication” have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		M

Table 25 – Negative conformance test procedures

No.	Test	Description	Reference	Required
5.4.24.1	TCP/IP Connection with unknown IP address	Establishing a connection by the controlling station having an IP address that is not known in the controlled station is not possible		PIXIT
5.4.24.2	Quality descriptor	The quality descriptor consist of five defined quality bits which can be set independently from each other		PIXIT
5.4.24.3	Command transmission	Direct Execute commands sent to an object configured as Select before Operate command are answered with ACT_CON_NEG and not executed by the controlled station		PIXIT
5.4.24.4	Summer time – Summer time bit is taken into account when using commands and events	Summer/Wintertime change including the situation that one station is in winter time mode and one station is in summer time mode is extensively tested for all concerning ASDU's and COT's. Expected result: – A command using summer time bit must be used to either accept or ignore the command based on its configured acceptable delay for command transmission – The time stamp of an event is recalculated and the summer time bit is taken into account to define the valid time stamp for the receiving station. For all commands and events as in the PICS the following combinations are tested: – sending station SU=0, receiving station SU=0 – sending station SU=0, receiving station SU=1 – sending station SU=1, receiving station SU=0 – sending station SU=1, receiving station SU=1 Examples: – A command sent with SU=1 time 15:00:000 to the receiving station with SU=0 14:00:000 is executed. A command sent with SU=1 time 15:00:000 to the receiving station with SU=1 14:00:000 is NOT executed, but ignored		PIXIT
5.4.24.50	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		M

No.	Test	Description	Reference	Required
5.4.25.1	TCP/IP Connection with unknown IP address	Establishing a connection by the controlling station having an IP address that is not known in the controlled station is not possible		PIXIT
5.4.25.2	Quality descriptor	The quality descriptor consist of five defined quality bits which can be set independently from each other		PIXIT
5.4.25.3	Command transmission	Direct Execute commands sent to an object configured as Select before Operate command are answered with ACT_CON_NEG and not executed by the controlled station		PIXIT
5.4.25.4	Summer time – Summer time bit is taken into account when using commands and events	Summer/Wintertime change including the situation that one station is in winter time mode and one station is in summer time mode is extensively tested for all concerning ASDU's and COT's. Expected result: – A command using summer time bit shall be used to either accept or ignore the command based on its configured acceptable delay for command transmission – The time stamp of an event is recalculated and the summer time bit is taken into account to define the valid time stamp for the receiving station. For all commands and events as in the PICS the following combinations are tested: – sending station not in summer time, receiving station not in summer time – sending station not in summer time, receiving station in summer time – sending station in summer time, receiving station not in summer time – sending station in summer time, receiving station in summer time Examples: – A command sent with SU-bit =1 (in summer time) and time 15:00:000 is executed by the DUT when its time is 14:00:000 not in summer time. – A command sent with SU-bit =1 (in summer time) and time 15:00:000 is NOT executed (ignored) by the DUT when its time is 14:00:000 in summer time		PIXIT
5.4.25.50	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 "Verification of IEC 60870-5-104 communication" have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		M

Table 26 – PIXIT related conformance test procedures

This table can be used for specific PIXIT related test procedures. If there are no specific PIXIT related test cases then this table can be skipped.

No.	Test	Description	Reference	Required
5.4.26.1	Function		PIXIT, section	
5.4.26.2			PIXIT, section	
5.4.26.3			PIXIT, section	
5.4.26.4			PIXIT, section	
5.4.26.50	Function		PIXIT, section	
5.4.26.51			PIXIT, section	
5.4.26.52			PIXIT, section	
5.4.26.53			PIXIT, section	
5.4.26.100	Function		PIXIT, section	
5.4.26.101			PIXIT, section	
5.4.26.102			PIXIT, section	
5.4.26.103			PIXIT, section	
5.4.26.150	Function		PIXIT, section	
5.4.26.151			PIXIT, section	
5.4.26.152			PIXIT, section	
5.4.26.153			PIXIT, section	

5.5 Test results chart

The results of the test procedures in 5.2, 5.3, and 5.4 ~~need to~~ shall be charted in Table 27. For all configuration settings, the test procedures should be performed unless indicated otherwise.

Table 27 – Test results chart

	Record the conformance test procedure result for each of the supported configuration parameter values on the right	Station Type		Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)	Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
Frame length	5.2.0.1 Maximum length L (control direction)				
	5.2.0.2 Maximum length L (monitor direction)				
Common Address of ASDU	5.2.0.70 Two (2) octets for Common Address of ASDU (CASDU)				
Information Object Address	5.2.0.80 Three (3) octets for Information Object Address (structured or unstructured)				
Cause of Transmission	5.2.0.90 Two (2) octets for COT field (2nd octet is Originator address)				
Tests on Transport Provider Level	5.3.1.1 IP Frame				
	5.3.1.3 TCP Frame				
	5.3.1.10 CS104 Frame Layout				
	5.3.1.20 CS104 I-Format APDU				
	5.3.1.25 CS104 S-Format APDU				
	5.3.1.30 CS104 U-Format APDU				
	5.3.1.50 Transmission Procedure				
	5.3.1.70 Transmission Control Using START/STOP				
	5.3.1.90 Time Out Intervals				
	Record the conformance test procedure result for each of the supported configuration parameter values on the right	Station Type		Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)	Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
Verification of Data	5.3.2.1 Type Identification				

	Record the conformance test procedure result for each of the supported configuration parameter values on the right	Station Type		Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)	Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
Unit Identifier	5.3.2.10 Cause of Transmission				
	5.3.2.20 Common Address of ASDU				
Verification of ASDUs	5.3.3.10 ASDU 1 Single-point Information				
	5.3.3.30 ASDU 3 Double-point Information				
	5.3.3.50 ASDU 5 Step-position Information				
	5.3.3.70 ASDU 7 Bitstring of 32 bit				
	5.3.3.90 ASDU 9 Measured value, normalised value				
	5.3.3.110 ASDU 11 Measured value, scaled value				
	5.3.3.130 ASDU 13 Measured value, short floating point number				
	5.3.3.150 ASDU 15 Integrated Totals				
	5.3.3.170 ASDU 20 Packed single-point information with status change detection				
	5.3.3.190 ASDU 21 Measured value, normalised value without quality descriptor				
	5.3.3.210 ASDU 30 Single-point information with time tag CP56Time2a				
	5.3.3.230 ASDU 31 Double-point information with time tag CP56Time2a				
	5.3.3.250 ASDU 32 Step-position information with time tag CP56Time2a				
	5.3.3.280 ASDU 33 Bitstring of 32 bit with time tag CP56Time2a				
	5.3.3.310 ASDU 34 Measured value, normalised value with time tag CP56Time2a				
	5.3.3.340 ASDU 35 Measured value, scaled value with time tag CP56Time2a				
	5.3.3.370 ASDU 36 Measured value, short floating point number with time tag CP56Time2a				
	5.3.3.400 ASDU 37 Integrated totals with time tag CP56Time2a				
	5.3.3.430 ASDU 38 Event of protection equipment with time tag CP56Time2a				
	5.3.3.460 ASDU 39 Packed start events of protection equipment with time tag CP56Time2a				
	Record the conformance test procedure result for each of the supported configuration parameter values on the right	Station Type		Direction	

		Station Type		Direction
		Controlling station test (Master)	Controlled station test (Slave)	Normal Direction / Reversed Direction
√ indicates the Test Procedure PASSED for that configuration value.	**Record the conformance test procedure result for each of the supported configuration parameter values on the right**			
FAIL indicates Test Procedure failed for at least one of the Test Cases.				
N.A indicates that configuration value is not supported by the device.				
Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)				
	5.3.3.490 ASDU 40 Packet output circuit information of protection equipment with time tag CP56Time2a			
	5.3.4.1 ASDU 45 Single Command			
	5.3.4.10 ASDU 46 Double Command			
	5.3.4.20 ASDU 47 Regulating step command			
	5.3.4.30 ASDU 48 Set point command, normalised value			
	5.3.4.40 ASDU 49 Set point command, scaled value			
	5.3.4.50 ASDU 50 Set point command, short floating point value			
	5.3.4.60 ASDU 51 Bitstring of 32 bits			
	5.3.4.70 ASDU 58 Single command with time tag CP56Time2a			
	5.3.4.90 ASDU 59 Double command with time tag CP56Time2a			
	5.3.4.110 ASDU 60 Regulating step command with time tag CP56Time2a			
	5.3.4.130 ASDU 61 Set point command, normalised value with time tag CP56Time2a			
	5.3.4.150 ASDU 62 Set point command, scaled value with time tag CP56Time2a			
	5.3.4.170 ASDU 63 Set point command, short floating point value with time tag CP56Time2a			
	5.3.4.190 ASDU 64 Bitstring of 32 bits with time tag CP56Time2a			
	5.3.5.1 ASDU 70 End of Initialisation			
	5.3.6.1 ASDU 100 Interrogation command			
	5.3.6.10 ASDU 101 Counter interrogation command			
	5.3.6.20 ASDU 102 Read command			
	5.3.6.30 ASDU 103 Clock synchronisation Command			
	5.3.6.60 ASDU 105 Reset process command			
	5.3.6.70 ASDU 107 Test command with time tag CP56Time2a			
	5.3.7.1 ASDU 110 Parameter of measured value, normalised value			

		Controlling station (Master)	Controlled station (Slave)	Normal Direction	Reversed Direction
		Station Type		Direction	
√ indicates the Test Procedure PASSED for that configuration value.					
FAIL indicates Test Procedure failed for at least one of the Test Cases.					
N.A indicates that configuration value is not supported by the device.					
Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)					
	5.3.7.10 ASDU 111 Parameter of measured values, scaled value				
	5.3.7.20 ASDU 112 Parameter of measured values, short floating point number				
	5.3.7.30 ASDU 113 Parameter activation				
	5.3.8.1 ASDU 120 File ready				
	5.3.8.10 ASDU 121 Section ready				
	5.3.8.30 ASDU 122 Call directory, select file, call file, call section				
	5.3.8.40 ASDU 123 Last section, last segment				
	5.3.8.50 ASDU 124 ACK file, ACK section				
	5.3.8.60 ASDU 125 Segment				
	5.3.8.70 ASDU 126 Directory				
Data Unit Identifier	5.4.9.1 Type Identification				
	5.4.9.4 Cause Of Transmission				
	5.4.9.10 Common Address of ASDU				
Information object address	5.4.10.1 Object Address				
Station initialisation function	5.4.11.1 Local Initialisation of the Controlling station: (re)boot				
	5.4.11.10 Local initialisation of the Controlled station: (re-)boot				
	5.4.11.20 Remote initialisation of the Controlled station				
	5.4.11.30 Re-establishing a lost Started connection between the Controlling and the Controlled station when no other connections are available				
	5.4.11.40 Compatibility With Other Test Cases				
	Record the conformance test procedure result for each of the supported configuration parameter values on the right				
√ indicates the Test Procedure PASSED for that configuration value.					
FAIL indicates Test Procedure failed for at least one of the Test Cases.					
N.A indicates that configuration value is not supported by the device.					
Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)					
Redundant Link	5.4.12.1 Periodic check of ALL redundant connections				

	Record the conformance test procedure result for each of the supported configuration parameter values on the right	Station Type: Controlling station test (Master) / Controlled station test (Slave)	Direction: Normal Direction / Reversed Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)			
	5.4.12.10 Re-establishing a lost Started connection between the Controlling and the Controlled station when redundant connections are available: (automatic switch over)			
	5.4.12.20 Re-establishing a lost redundant connection between the Controlling and the Controlled station			
	5.4.12.30 Manual switching over the Started connection to another redundant (Stopped connection: (manual switch over)			
Cyclic data transmission function	5.4.13.1 Cyclic data transmission and Background Scan – sequential procedure			
	5.4.13.10 Compatibility With Other Test Cases			
Data acquisition through Read function	5.4.14.1 Data acquisition through Read – sequential procedure			
	5.4.14.10 Compatibility With Other Test Cases			
Acquisition of events function	5.4.15.1 Acquisition of events – sequential procedure			
	5.4.15.10 Compatibility With Other Test Cases			
General interrogation function	5.4.16.1 Outstation interrogation – one Logical Remote Unit (LRU) available in the controlled station			
	5.4.16.10 Outstation interrogation – more than one Logical Remote Unit (LRU) available in the controlled station			
	5.4.16.20 Re-activate a running Outstation interrogation – Option 1: the running GI continues			
	5.4.16.30 Re-activate a running Outstation interrogation Option 2: the running GI is stopped and the second GI is started			
	5.4.16.40 Re-activate a running Outstation interrogation Option 3: the running GI continues and after activation termination (COT=10) the second GI is started. (Option 3 can be described as undesirable behaviour!!)			
	5.4.16.50 Deactivate a running Outstation interrogation			
	5.4.16.60 Compatibility With Other Test Cases			
	Record the conformance test procedure result for each of the supported configuration parameter values on the right	Station Type	Direction	

		Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)	**Station Type**				**Direction**
Clock synchronisation function	5.4.17.1 Clock synchronisation – sequential procedure				
	5.4.17.10 Clock synchronisation – Change the clock				
	5.4.17.20 Compatibility With Other Test Cases				
Command transmission function	5.4.18.1 Select and Execute				
	5.4.18.10 Select and Deactivation				
	5.4.18.20 Direct Execute				
	5.4.18.30 Select with Negative Confirmation by Controlled station (Abort)				
	5.4.18.40 Select with Negative Execute Confirmation by Controlled station if Execute is received after configured delay in the controlling station				
	5.4.18.50 Direct Execute with Negative Confirmation by Controlled station				
	5.4.18.60 Command transmission with network delay supervision – sequential procedure:Command received WITHIN configured delay				
	5.4.18.70 Command transmission with network delay supervision sequential procedure:Command received AFTER configured delay				
	5.4.18.80 Test for all supported ASDU's				
	5.4.18.90 Compatibility With Other Test Cases				
Transmission of integrated totals (telecounting) function	5.4.19.1 Mode A – Local freeze with spontaneous transmission				
	5.4.19.10 Mode B – Local freeze with Counter Interrogation				
	5.4.19.20 Mode C – Remote initiated freeze with Counter Interrogation				
	5.4.19.30 Mode D – Remote initiated freeze with spontaneous transmission				
	5.4.19.40 Compatibility With Other Test Cases				
Parameter loading function	5.4.20.1 Load and activate parameter				
	5.4.20.10 Load and activate parameter with Negative Confirmation by Controlled station				
	5.4.20.20 Compatibility With OtherTest Cases				
	Record the conformance test procedure result for each of the supported configuration parameter values on the right.				

		Controlling station Test (Master)	Controlled station Test (Slave)	Normal Direction	Reversed Direction
√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)					
Test procedure function	**5.4.21.1 Test procedure sequential procedure**				
	5.4.21.10 Compatibility With Other Test Cases				
File transfer procedure function	**5.4.22.1 File transfer procedure (monitor direction) – sequential procedure**				
	5.4.22.10 File transfer procedure (control direction) – sequential procedure				
	5.4.22.20 Compatibility With Other Test Cases				
Additional Conformance Test Procedures	**5.4.23.1 Out of service behaviour**				
	5.4.23.10 Miscellaneous				
	5.4.23.20 Time invalid				
	5.4.23.30 Compatibility With Other Test Cases				
Negative Conformance Test Procedures	**5.4.24.1 Negative tests**				
	5.4.24.50 Compatibility With Other Test Cases				
PIXIT related Conformance Test Procedures	**5.4.25.1 Function:**				
	5.4.25.50 Function:				

	Record the conformance test procedure result for each of the supported configuration parameter values on the right		Station Type		Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)		Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
System definition	**5.2.1.1**	**Controlling station test (Master)**				
	5.2.1.2	**Controlled station test (Slave)**				
Frame length	**5.2.1.50**	**Maximum length L (control direction)**				
	5.2.1.51	**Maximum length L (monitor direction)**				
Common Address of ASDU	**5.2.1.70**	**Two (2) octets for Common Address of ASDU (CASDU)**				
Information Object Address	**5.2.1.80**	**Three (3) octets for Information Object Address (structured or unstructured)**				
Cause of Transmission	**5.2.1.90**	**Two (2) octets for COT field (2nd octet is Originator address)**				
Tests on Transport Provider Level	**5.3.2.1**	**IP Frame**				
	5.3.2.3	**TCP Frame**				
	5.3.2.10	**CS104 Frame Layout**				
	5.3.2.20	**CS104 I-Format APDU**				
	5.3.2.25	**CS104 S-Format APDU**				
	5.3.2.30	**CS104 U-Format APDU**				
	5.3.2.50	**Transmission Procedure**				
	5.3.2.70	**Transmission Control Using START/STOP**				
	5.3.2.90	**Time Out Intervals**				

Table 27 *(2 of 7)*

	Record the conformance test procedure result for each of the supported configuration parameter values on the right		Station Type		Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)		Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
Verification of Data Unit Identifier	**5.3.3.1**	**Type Identification**				
	5.3.3.10	**Cause of Transmission**				
Verification of ASDUs	**5.3.4.10**	**ASDU 1 Single-point Information**				
	5.3.4.30	**ASDU 3 Double-point Information**				
	5.3.4.50	**ASDU 5 Step-position Information**				
	5.3.4.70	**ASDU 7 Bitstring of 32 bit**				
	5.3.4.90	**ASDU 9 Measured value, normalised value**				
	5.3.4.110	**ASDU 11 Measured value, scaled value**				
	5.3.4.130	**ASDU 13 Measured value, short floating point number**				
	5.3.4.150	**ASDU 15 Integrated Totals**				
	5.3.4.170	**ASDU 20 Packed single-point information with status change detection**				
	5.3.4.190	**ASDU 21 Measured value, normalised value without quality descriptor**				
	5.3.4.210	**ASDU 30 Single-point information with time-tag CP56Time2a**				
	5.3.4.230	**ASDU 31 Double-point information with time tag CP56Time2a**				
	5.3.4.250	**ASDU 32 Step-position information with time-tag CP56Time2a**				
	5.3.4.280	**ASDU 33 Bitstring of 32 bit with time-tag CP56Time2a**				
	5.3.4.310	**ASDU 34 Measured value, normalised value with time-tag CP56Time2a**				
	5.3.4.340	**ASDU 35 Measured value, scaled value with time-tag CP56Time2a**				
	5.3.4.370	**ASDU 36 Measured value, short floating point number with time-tag CP56Time2a**				
	5.3.4.400	**ASDU 37 Integrated totals with time tag CP56Time2a**				
	5.3.4.430	**ASDU 38 Event of protection equipment with time-tag CP56Time2a**				
	5.3.4.460	**ASDU 39 Packed start events of protection equipment with time-tag CP56Time2a**				

Table 27 *(3 of 7)*

	Record the conformance test procedure result for each of the supported configuration parameter values on the right		Station Type		Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)		Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
	5.3.4.490	**ASDU 40 Packet output circuit information of protection equipment with time tag CP56Time2a**				
	5.3.5.1	**ASDU 45 Single Command**				
	5.3.5.10	**ASDU 46 Double Command**				
	5.3.5.20	**ASDU 47 Regulating step command**				
	5.3.5.30	**ASDU 48 Set point command, normalised value**				
	5.3.5.40	**ASDU 49 Set point command, scaled value**				
	5.3.5.50	**ASDU 50 Set point command, short floating point value**				
	5.3.5.60	**ASDU 51 Bitstring of 32 bits**				
	5.3.5.70	**ASDU 58 Single command with time tag CP56Time2a**				
	5.3.5.90	**ASDU 59 Double command with time tag CP56Time2a**				
	5.3.5.110	**ASDU 60 Regulating step command with time tag CP56Time2a**				
	5.3.5.130	**ASDU 61 Set point command, normalised value with time tag CP56Time2a**				
	5.3.5.150	**ASDU 62 Set point command, scaled value with time tag CP56Time2a**				
	5.3.5.170	**ASDU 63 Set point command, short floating point value with time tag CP56Time2a**				
	5.3.5.190	**ASDU 64 Bitstring of 32 bits with time tag CP56Time2a**				
	5.3.6.1	**ASDU 70 End of Initialisation**				
	5.3.7.1	**ASDU 100 Interrogation command**				
	5.3.7.10	**ASDU 101 Counter interrogation command**				
	5.3.7.20	**ASDU 102 Read command**				
	5.3.7.30	**ASDU 103 Clock synchronisation command**				
	5.3.7.60	**ASDU 105 Reset process command**				
	5.3.7.70	**ASDU 107 Test command with time tag CP56Time2a**				
	5.3.8.1	**ASDU 110 Parameter of measured value, normalised value**				

Table 27 *(4 of 7)*

	Record the conformance test procedure result for each of the supported configuration parameter values on the right		Station Type		Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)		Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
	5.3.8.10	**ASDU 111 Parameter of measured values, scaled value**				
	5.3.8.20	**ASDU 112 Parameter of measured values, short floating point number**				
	5.3.8.30	**ASDU 113 Parameter activation**				
	5.3.9.1	**ASDU 120 File ready**				
	5.3.9.10	**ASDU 121 Section ready**				
	5.3.9.30	**ASDU 122 Call directory, select file, call file, call section**				
	5.3.9.40	**ASDU 123 Last section, last segment**				
	5.3.9.50	**ASDU 124 ACK file, ACK section**				
	5.3.9.60	**ASDU 125 Segment**				
	5.3.9.70	**ASDU 126 Directory**				
Data Unit Identifier	**5.4.10.1**	**Type Identification**				
	5.4.10.5	**Cause Of Transmission**				
	5.4.10.10	**Common Address of ASDU**				
Information object address	**5.4.11.1**	**Object Address**				
Station initialisation function	**5.4.12.1**	**Local Initialisation of the Controlling station: (re-)boot**				
	5.4.12.10	**Local initialisation of the Controlled station: (re-)boot**				
	5.4.12.20	**Remote initialisation of the Controlled station**				
	5.4.12.21	**Reset of pending information with time tag of the event buffer**				
	5.4.12.30	**Re-establishing a lost Started connection between the Controlling and the Controlled station when no other connections are available**				
	5.4.12.40	**Compatibility With Other Test Cases**				

Table 27 *(5 of 7)*

	Record the conformance test procedure result for each of the supported configuration parameter values on the right		Station Type		Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)		Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
Redundant Link	**5.4.13.1**	**Periodic check of ALL redundant connections**				
	5.4.13.10	**Re-establishing a lost Started connection between the Controlling and the Controlled station when redundant connections are available: (automatic switch-over)**				
	5.4.13.20	**Re-establishing a lost redundant connection between the Controlling and the Controlled station**				
	5.4.13.30	**Manual switching over the Started connection to another redundant Stopped connection: (manual switch-over)**				
Cyclic data transmission function	**5.4.14.1**	**Cyclic data transmission and Background Scan – sequential procedure**				
	5.4.14.10	**Compatibility With Other Test Cases**				
Data acquisition through Read function	**5.4.15.1**	**Data acquisition through Read – sequential procedure**				
	5.4.15.10	**Compatibility With Other Test Cases**				
Acquisition of events function	**5.4.16.1**	**Acquisition of events –sequential procedure**				
	5.4.16.10	**Compatibility With Other Test Cases**				
General interrogation function	**5.4.17.1**	**Outstation interrogation – one Logical Remote Unit (LRU) available in the controlled station -**				
	5.4.17.10	**Outstation interrogation – more than one Logical Remote Unit (LRU) available in the controlled station -**				
	5.4.17.20	**Re-activate a running Outstation interrogation – Option 1: the running GI continues.**				
	5.4.17.30	**Re-activate a running Outstation interrogation Option 2: the running GI is stopped and the second GI is started**				
	5.4.17.40	**Re-activate a running Outstation interrogation Option 3: the running GI continues and after activation termination (COT=10) the second GI is started.**				
	5.4.17.50	**Deactivate a running Outstation interrogation**				
	5.4.17.60	**Compatibility With Other Test Cases**				

Table 27 *(6 of 7)*

	Record the conformance test procedure result for each of the supported configuration parameter values on the right		Station Type		Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)		Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
Clock synchronisation function	**5.4.18.1**	**Clock synchronisation –sequential procedure**				
	5.4.18.10	**Clock synchronisation – Change the clock**				
	5.4.18.15	**Clock synchronisation – Broadcast**				
	5.4.18.20	**Compatibility With Other Test Cases**				
Command transmission function	**5.4.19.1**	**Select and Execute**				
	5.4.19.10	**Select and Deactivation**				
	5.4.19.20	**Direct Execute**				
	5.4.19.30	**Select with Negative Confirmation by Controlled station (Abort)**				
	5.4.19.40	**Select with Negative Execute Confirmation by Controlled station if Execute is received after configured delay in the controlling station**				
	5.4.19.50	**Direct Execute with Negative Confirmation by Controlled station**				
	5.4.19.60	**Command transmission with network delay supervision – sequential procedure:Command received WITHIN configured delay**				
	5.4.19.70	**Command transmission with network delay supervision – sequential procedure:Command received AFTER configured delay**				
	5.4.19.75	**Command transmission – Command received with time tag in the future**				
	5.4.19.80	**Test for all supported ASDU's**				
	5.4.19.85	**Command transmission – Commands with or without time tag**				
	5.4.19.86	**Command transmission – Command received during GI**				
	5.4.19.90	**Compatibility With Other Test Cases**				
Transmission of integrated totals (telecounting) function	**5.4.20.1**	**Mode A – Local freeze with spontaneous transmission**				
	5.4.20.10	**Mode B – Local freeze with Counter Interrogation**				
	5.4.20.20	**Mode C – Remote initiated freeze with Counter Interrogation**				
	5.4.20.30	**Mode D – Remote initiated freeze with spontaneous transmission**				
	5.4.20.40	**Compatibility With Other Test Cases**				
Parameter loading function	**5.4.21.1**	**Load and activate parameter**				
	5.4.21.10	**Load and activate parameter with Negative Confirmation by Controlled station**				
	5.4.21.15	**Parameter activation**				
	5.4.21.20	**Compatibility With Other Test Cases**				

Table 27 *(7 of 7)*

	Record the conformance test procedure result for each of the supported configuration parameter values on the right		Station Type		Direction	
	√ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete)		Controlling station test (Master)	Controlled station test (Slave)	Normal Direction	Reversed Direction
Test procedure function	**5.4.22.1**	**Test procedure – sequential procedure**				
	5.4.22.10	**Compatibility With Other Test Cases**				
File transfer procedure function	**5.4.23.1**	**File transfer procedure (monitor direction) – sequential procedure**				
	5.4.23.10	**File transfer procedure (control direction) – sequential procedure**				
	5.4.23.15	**File transfer procedure – Query log**				
	5.4.23.20	**Compatibility With Other Test Cases**				
Additional Conformance Test Procedures	**5.4.24.1**	**Out of service behaviour**				
	5.4.24.10	**Miscellaneous**				
	5.4.24.20	**Time invalid**				
	5.4.24.30	**Compatibility With Other Test Cases**				
Negative Conformance Test Procedures	**5.4.15.1**	**Negative tests**				
	5.4.25.50	**Compatibility With Other Test Cases**				
PIXIT related Conformance Test Procedures	**5.4.26.1**	**Function:**				
	5.4.26.50	**Function:**				
	5.4.26.100	**Function:**				

5.6 Test results of command transmission

5.6.1 General

Tables 28 to 31 provide an example of the detailed results required by the test procedures specified in Table 19.

5.6.2 Test results of single command transmission

Table 28 – Test results of single command transmission *(1 of 3)*

Test results of the Single command (SCO) √ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete). Detailed information on enclosures per Command type. The datalink services are not shown in the details, only the command ASDUs. Each IOA could be configured S/E or only E. S+E on/off = Select and Execute command on/off S+D = Select and Deactivate command on/off E on/off = Direct Execute command on/off	ACTCONpos=Positive Activation Confirmation ACTCONneg=Negative Activation Confirmation DEACTCONpos=Deactivation Confirmation positive ACTTERM=Activation Termination If ACTTERM is stated in row 'message from the RTU', ACTCONpos with S/E=0 execute has been received before. In the case of a S+E command also ACTCONpos with S/E=1 select has been received before the ACT with S/E=0! NOTE This table shows the only correct behaviour. Other behaviour means the test failed!

ASDU type = 45	S+E on	S+E off	S+D on	S+D off	Eon	Eoff
QU=0 (no add. def.)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N)?						

Table 28 *(2 of 3)*

ASDU type = 45	S+E on	S+E off	S+D on	S+D off	Eon	Eoff
QU=1 (short pulse)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change Process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N) ?						
ASDU type = 45	S+E on	S+E off	S+D on	S+D off	Eon	Eoff
QU=2 (long pulse)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N) ?						

Table 28 *(3 of 3)*

ASDU type = 45	S+E on	S+E off	S+D on	S+D off	Eon	Eoff
QU=3 (persistent)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N)?						
General remarks						

5.6.3 Test results of double command transmission

Table 29 – Test results of double command transmission *(1 of 3)*

Test results of the Double command (DCO) √ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete). Detailed information on enclosures per Command type. The datalink services are not shown in the details, only the command ASDUs. Each IOA could be configured S/E or only E. S+E on/off = Select and Execute command on/off S+D = Select and Deactivate command on/off E on/off = Direct Execute command on/off	ACTCONpos=Positive Activation Confirmation ACTCONneg=Negative Activation Confirmation DEACTCONpos=Deactivation Confirmation positive ACTTERM=Activation Termination If ACTTERM is stated in row 'message from the RTU', ACTCONpos with S/E=0 execute has been received before. In the case of a S+E command also ACTCONpos with S/E=1 select has been received before the ACT with S/E=0! NOTE This table shows the only correct behaviour. Other behaviour means the test failed!

ASDU type = 46	S+E on	S+E off	S+D on	S+D off	Eon	Eoff
QU=0 (no add. def.)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N)?						

Table 29 *(2 of 3)*

ASDU type = 46	S+E on	S+E off	S+D on	S+D off	Eon	Eoff
QU=1 (short pulse)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N) ?						
ASDU type = 46	S+E on	S+E off	S+D on	S+D off	Eon	Eoff
QU=2 (long pulse)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N) ?						

Table 29 *(3 of 3)*

ASDU type = 46	S+E on	S+E off	S+D on	S+D off	Eon	Eoff
QU=3 (persistent)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N)?						
General remarks:						

5.6.4 Test results of regulating step command transmission

Table 30 – Test results of regulating step command transmission *(1 of 3)*

Test results of the Regulating step command (RCO) √ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete). Detailed information on enclosures per Command type. The datalink services are not shown in the details, only the command ASDUs. Each IOA could be configured S/E or only E. S+E on/off = Select and Execute command on/off S+D = Select and Deactivate command on/off E on/off = Direct Execute command on/off	ACTCONpos=Positive Activation Confirmation ACTCONneg=Negative Activation Confirmation DEACTCONpos=Deactivation Confirmation positive ACTTERM=Activation Termination If ACTTERM is stated in row 'message from the RTU', ACTCONpos with S/E=0 execute has been received before. In the case of a S+E command also ACTCONpos with S/E=1 select has been received before the ACT with S/E=0! NOTE This table shows the only correct behaviour. Other behaviour means the test failed!

ASDU type = 47	S+E up	S+E down	S+D up	S+D down	E up	E down
QU=0 (no add. def.)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N)?						

Table 30 *(2 of 3)*

ASDU type = 47	S+E up	S+E down	S+D up	S+D down	E up	E down
QU=1 (short pulse)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N)?						
ASDU type = 47	S+E on	S+E off	S+D on	S+D off	Eon	Eoff
QU=2 (long pulse)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select / Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N)?						

Table 30 *(3 of 3)*

ASDU type = 47	S+E on	S+E off	S+D on	S+D off	Eon	Eoff
QU=3 (persistent)						
Message from RTU	ACTTERMpos	ACTTERMpos	DEACTCONpos	DEACTCONpos	ACTTERMpos	ACTTERMpos
Shown behaviour after Select/Execute	E	E	S or E	S or E	E	E
Status change RTU	Yes, HMI	Yes, HMI	No	No	Yes, HMI	Yes, HMI
Status change process	If available	If available	No	No	If available	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result						
Log file available (Y/N)?						
General remarks						

5.6.5 Test results of setpoint command transmission

Table 31 – Test results of setpoint command transmission *(1 of 2)*

Test results of the Setpoint command (NVA) √ indicates the Test Procedure PASSED for that configuration value. FAIL indicates Test Procedure failed for at least one of the Test Cases. N.A. indicates that configuration value is not supported by the device. Empty indicates the Test Procedure was not performed. (There should be no empty boxes when testing is complete). Detailed information on enclosures per Command type. The datalink services are not shown in the details, only the command ASDUs. Each IOA could be configured S/E or only E. They should not be able to support both at a time. S+E on/off = Select and Execute command on/off S+D = Select and Deactivate command on/off E on/off = Direct Execute command on/off			ACTCONpos=Positive Activation Confirmation ACTCONneg=Negative Activation Confirmation DEACTCONpos=Deactivation Confirmation positive ACTTERM=Activation Termination If ACTTERM is stated in row 'message from the RTU', ACTCONpos with S/E=0 execute has been received before. In the case of a S+E command also ACTCONpos with S/E=1 select has been received before the ACT with S/E=0! NOTE This table shows the only correct behaviour. Other behaviour means the test failed!
ASDU type = 48	S+E	S+D	E
QL=0			
Message from RTU	ACTCONpos / ACTTERMpos[2]	DEACTCONpos	ACTCONpos / ACTTERMpos[2]
After S or E	E	S or E	E
Status change RTU	Yes, HMI	No	Yes, HMI
Status change process	If available	No	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result			
Log files available (Y/N)?			
General remarks			

2 If the PICS states ACTTERM is used, ACTTERM is applicable, if not ACTCON is applicable.

Table 31 *(2 of 2)*

ASDU type = 49	S+E	S+D	E
QL=0			
Message from RTU	ACTCONpos / ACTTERMpos[3]	DEACTCONpos	ACTCONpos / ACTTERMpos[3]
After S or E	E	S or E	E
Status change RTU	Yes, HMI	No	Yes, HMI
Status change process	If available	No	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result			
Log files available (Y/N)?			
General remarks			
ASDU type = 50	S+E	S+D	E
QL=0			
Message from RTU	ACTCONpos / ACTTERMpos[3]	DEACTCONpos	ACTCONpos / ACTTERMpos[3]
After S or E	E	S or E	E
Status change RTU	Yes, HMI	No	Yes, HMI
Status change process	If available	No	If available
Required	PICS, 9.5 9.6	PICS, 9.5 9.6	PICS, 9.5 9.6
Result			
Log files available (Y/N)?			
General remarks			

3 If the PICS states ACTTERM is used ACTTERM is applicable, if not ACTCON is applicable.

IEC TS 60870-5-604

Edition 2.0 2016-06

TECHNICAL SPECIFICATION

Telecontrol equipment and systems –
Part 5-604: Conformance test cases for the IEC 60870-5-104 companion standard

IEC TS 60870-5-604:2016-06(en)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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TELECONTROL EQUIPMENT AND SYSTEMS –

Part 5-604: Conformance test cases for the IEC 60870-5-104 companion standard

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 60870-5-604, which is a technical specification, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Resolution of ambiguities between IEC 60870-5-104:2006 and IEC TS 60870-5-604:2016 (together with IEC 60870-5-104/AMD1);
b) Refinement of some test cases to enhance operability between tested devices;
c) Additional test cases (mainly negative test cases) added.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
57/1614/DTS	57/1683/RVC

Full information on the voting for the approval of this technical specification 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.

A list of all parts of IEC 60870 series, published under the general title *Telecontrol equipment and systems,* can be found on the IEC website.

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 60870, which is a technical specification, describes test cases for conformance testing of telecontrol equipment or systems using the IEC 60870-5-104 companion standard and IEC 60870-5-6, *Guidelines for conformance testing for the IEC 60870-5 companion standards*.

TELECONTROL EQUIPMENT AND SYSTEMS –

Part 5-604: Conformance test cases for the IEC 60870-5-104 companion standard

1 Scope

This part of IEC 60870, which is a technical specification, describes test cases for conformance testing of telecontrol equipment, Substation Automation Systems (SAS) and telecontrol systems, including front-end functions of SCADA, using the IEC 60870-5-104 companion standard and IEC 60870-5-6, *Guidelines for conformance testing for the IEC 60870-5 companion standards*.

The use of this part of IEC 60870 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 specification during testing will minimize the risk of non-interoperability.

The goal of this part of IEC 60870 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 IEC 60870-5-6. 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 a technical specification. Other functionality may need additional test cases but this is outside the scope of this part of IEC 60870. For proper testing, it is recommended to define these additional test cases. This document is such a Technical Specification for the mentioned companion standard.

This part of IEC 60870 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 is done according to these standards.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.[1]

IEC 60870-5-4:1993, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 4: Definition and coding of application information elements*

IEC 60870-5-5:1995, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 5: Basic application functions*

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[1] The base standard always takes precedence. In case of ambiguity between this technical specification and the base standards (IEC 60870-5-1 to IEC 60870-5-5, IEC 60870-5-104), this part of IEC 60870 needs to be clarified or amended.

When testing, negative behaviour is not described in the base standard, the behaviour described in this document prevails and should be observed.

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

IEC 60870-5-6:2006, *Telecontrol equipment and systems – Part 5-6: Guidelines for conformance testing for the IEC 60870-5 companion standards*

IEC 60870-5-101:2003, *Telecontrol equipment and systems – Part 5-101: Transmission protocols – Companion standard for basic telecontrol tasks*

IEC 60870-5-104:2006, *Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles*

IETF RFC2200, *Internet Official Protocol Standards*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60870-5-6 apply.

4 Abbreviated terms

For the purposes of this document, the abbreviations given in IEC 60870-5-6 apply.

5 Conformance testing for IEC 60870-5-104

5.1 Overview and legend

An overview of tests is given in Tables 1 to 26. Procedural and functional testing shall always start with the Station Initialisation function and proceeds with the next Basic Application Functions. The procedure in each test case shall be followed, which means that the DUT is able to function as described in the specific test case.

The test procedures in Tables 1 through 11 shall be carried out with no errors detected during testing of all the Basic Application Functions in Tables 12 through 26. These tests are preferably automatically performed by the used test platform.

In addition to the performance criteria listed in the test procedures, 5.3 lists the protocol specifications that shall be verified automatically by the testing software or verified manually by review of the test history log after execution of the test procedures. The verification shall result in no errors detected during the complete test procedure.

This test plan has a direct reference to the PICS and possibly a PIXIT. Without a reference to a PICS or PIXIT this test plan is obsolete.

Test case numbering syntax is subclause number + table number + test case number.

Test cases are mandatory depending on the description in the column ‘Required’. The following situations are possible:

M = Mandatory test case regardless if enabled in the PICS/PIXIT, not only in one situation but during execution of all the tests as in the PICS and/or PIXIT

PICS, x.x = Mandatory test case if the functionality is enabled in the PICS (by marking the applicable check box), with a reference to the section number of the PICS (x.x);

NOTE PICS 9.x always refers to 60870-5-104:2006, Clause 9.

PIXIT = Mandatory test case if the functionality is enabled/described in the PIXIT. Verification of these test cases by the user/owner of the PIXIT is required before the test is started.

For each test case the test results shall be marked in the appropriate column of the test result chart in 5.5 and 5.6. Each test case can either pass the test (Passed), fail the test (Failed), not applicable, when the configuration value is not supported by the device (N.A.), or the test case was not performed (Empty). Ideally, there should be no empty boxes when testing is complete.

For testing reverse direction, the same test procedures apply in the opposite direction (replace "Controlling" with "Controlled" and vice versa), except for COT44-47 which are only defined in Monitor direction (only a controlled station is allowed to send these COT).

The test tables are divided into 5 subclauses:

- Subclause 5.2 Configuration parameters IEC 60870-5-104
- Subclause 5.3 Verification of IEC 60870-5-104 communication
- Subclause 5.4 Conformance test procedures
- Subclause 5.5 Test result chart
- Subclause 5.6 Test results of command transmission

The procedure to perform all the mandatory test cases, according to the PID, is shown in Figure 1.

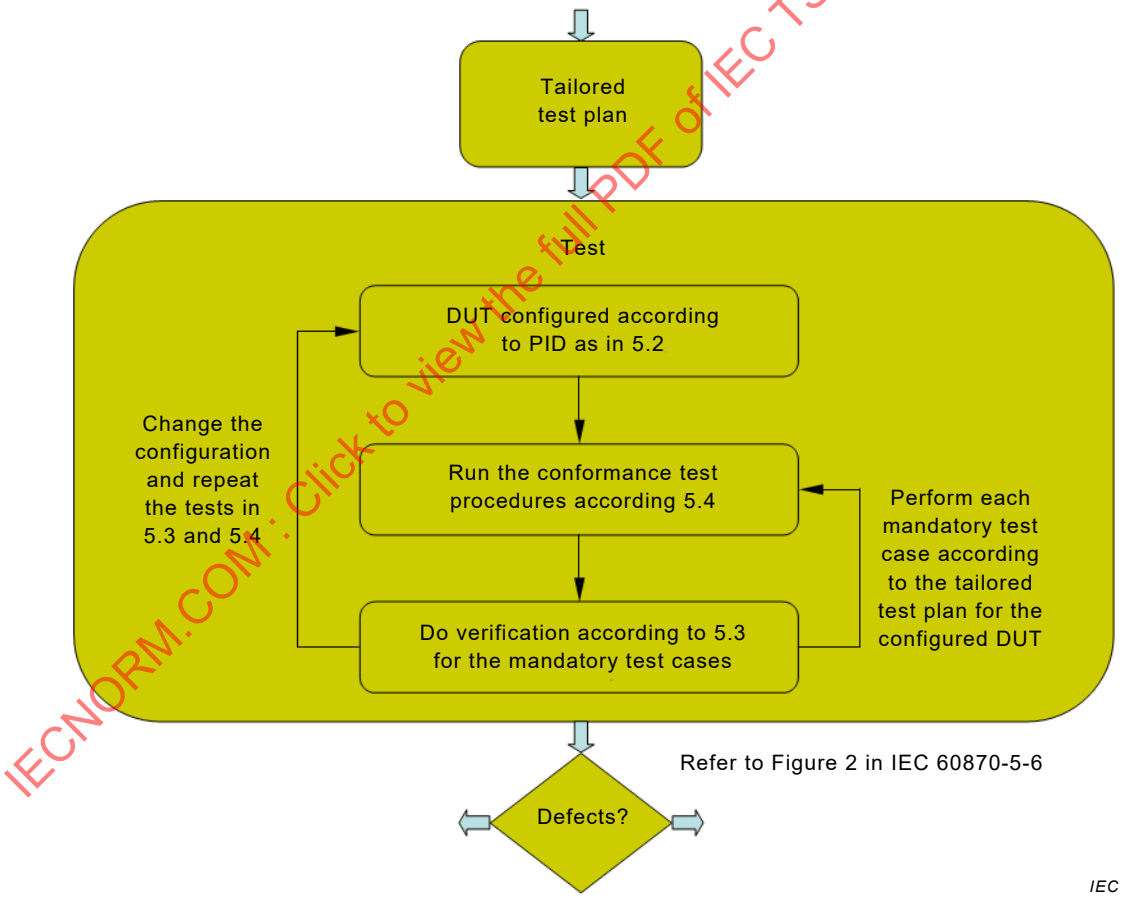

Figure 1 – Test procedure

5.2 Configuration parameters IEC 60870-5-104

Since IEC 60870-5-104 contains a number of configuration parameters affecting protocol behaviour, the conformance test procedures in 5.4 and verification in 5.3 shall be performed at least once for each supported value of the parameters listed in Table 1. Basically the DUT shall be tested if the functionality in 5.3 and 5.4 behaviour is correct for the configuration(s) in Table 1.

Table 1 – Run the Conformance Test Procedures for each of the following supported configuration parameter values

No.	Test	Description	Reference	Required
5.2.1.1	System definition	Controlling station test (Master)		PICS, 9.1
5.2.1.2		Controlled station test (Slave)		PICS, 9.1
5.2.1.50	Frame length	Maximum length L (control direction)	IEC 60870-5-101:2003, 6.2	PICS, 9.4
5.2.1.51		Maximum length L (monitor direction)	IEC 60870-5-101:2003, 6.2	PICS, 9.4
5.2.1.70	COMMON ADDRESS of ASDU	Two (2) octets for Common Address of ASDU (CASDU)	IEC 60870-5-101:2003, 7.2.4	PICS, 9.5
5.2.1.80	INFORMATION OBJECT ADDRESS	Three (3) octets for Information Object Address (structured or unstructured)	IEC 60870-5-101:2003, 7.2.5	PICS, 9.5
5.2.1.90	CAUSE OF TRANSMISSION	Two (2) octets for COT field (2nd octet is Originator address)	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5

5.3 Verification of IEC 60870-5-104 communication

This subclause lists the protocol specifications that shall be verified automatically by the testing software or verified manually by review of the test history log after execution of the test procedures. Every test case describes functionality that has passed the test if the functionality as in the the description column was shown to be correct. Correct means: the functionality shall be checked either automatically or manually, and also be checked by the test engineer in a human readable format log-file. For example to test the IV qualifier of some information elements, the ASDU containing this element shall be sent with the IV=1. Every test case marked “Passed”, has to be verifiable during testing and archived in log-files for post assessment.

To identify if a test case is mandatory, it is necessary to read 5.1 carefully.

Table 2 – Tests on transport provider level *(1 of 5)*

No.	Test	Description	Reference	Required
5.3.2.1	IP FRAME	IP Header, IP Fragment Re-assembling	IETF RFC2200	M
5.3.2.2		Source Address, Destination address	IETF RFC2200	M
5.3.2.3	TCP FRAME	TCP Header, TCP Control field (specifically ACK, RST, SYN, FIN), TCP Sequencing	IETF RFC2200	M
5.3.2.4		[The server (controlled station) uses the] port number 2404 [(confirmed by IANA) in all cases, both for the listening port and established connections. The client (controlling station) is free to use ephemeral port number, e.g. as allocated by the client's TCP/IP implementation]	IEC 60870-5-104:2006, 5.4	M
5.3.2.5		Actively *opening* a new TCP connection starts with a TCP frame containing (SYN) from the node that takes the initiative to establish the TCP connection. This is answered by the other node with (SYN, ACK), which in turn is answered by the initiating node with (ACK). Thereinafter the TCP connection is established	IETF RFC2200 IEC 60870-5-104:2006, 7.1	M
5.3.2.6		Actively *closing* an established TCP connection starts with a TCP frame containing (FIN) from the node that takes the initiative to close the TCP connection. This is answered by the other node (ACK) followed by a TCP frame from this same other node containing also (FIN). This in turn is answered by the initiating node with (ACK). Thereinafter the TCP connection is closed. It can be accepted if a node combines an (ACK) and a (FIN) in a single TCP frame in reply to a TCP frame with a (FIN).	IETF RFC2200 IEC 60870-5-104:2006, 7.1, Figure 19	M
5.3.2.7		During the test no problems should be detected on TCP/IP level	IETF RFC2200	M
5.3.2.10	CS104 APDU FRAME LAYOUT	Start character of APDU: 68_H	IEC 60870-5-104:2006, Clause 5	M
5.3.2.11		Configured number of octets L as the maximum number of Data octets (ASDU + Control field) in APDU: The maximum length of APDU for both directions is 253. It is a fixed system parameter.	IEC 60870-5-104:2006, Clause 5	M
5.3.2.12		4-octet Control field	IEC 60870-5-104:2006, Clause 5	M

Table 2 *(2 of 5)*

No.	Test	Description	Reference	Required
5.3.2.20	CS104 I-FORMAT APDU Information transfer frame	Control field octet 1 bit 1 (LSB) = 0	IEC 60870-5-104:2006, Clause 5	M
5.3.2.21		Control field octets 1-2, bit 2..16 contain end sequence number N(S) range 0..Maximum value 32767	IEC 60870-5-104:2006, Clause 5	M
5.3.2.22		Control field octet 3 bit 1 (bit 17) = 0	IEC 60870-5-104:2006, Clause 5	M
5.3.2.23		Control field octets 3-4, bit 18..32 contain Receive sequence number N(R) range 0..maximum value 32767	IEC 60870-5-104:2006, Clause 5	M
5.3.2.24		I-format frame contains exactly one ASDU	IEC 60870-5-104:2006, Clause 5	M
5.3.2.25	CS104 S-FORMAT APDU Numbered Supervisory function frame	Control field octet 1, bit 1-2 have value 01_B	IEC 60870-5-104:2006, Clause 5	M
5.3.2.26		Control field octets 1-2, bit 3..16 all contain value 0	IEC 60870-5-104:2006, Clause 5	M
5.3.2.27		Control field octet 3 bit 1 (bit 17) = 0	IEC 60870-5-104:2006, Clause 5	M
5.3.2.28		Control field octets 3-4, bit 18..32 contain Receive sequence number N(R) range 0..maximum value 32767	IEC 60870-5-104:2006, Clause 5	M
5.3.2.29		S-frame APDU only contains a single APCI field	IEC 60870-5-104:2006, Clause 5	M
5.3.2.30	CS104 U-FORMAT APDU Unnumbered Control function frame	Control field octet 1, bit 1-2 have value 11_B	IEC 60870-5-104:2006, Clause 5	M
5.3.2.31		Control field octet 1, bit 3 used for control function STARTDT Activation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.32		Control field octet 1, bit 4 used for control function STARTDT Confirmation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.33		Control field octet 1, bit 5 used for control function STOPDT Activation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.34		Control field octet 1, bit 6 used for control function STOPDT Confirmation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.35		Control field octet 1, bit 7 used for control function TESTFR Activation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.36		Control field octet 1, bit 8 used for control function TESTFR Confirmation	IEC 60870-5-104:2006, Clause 5	M
5.3.2.37		Control field bit 3..8 contains exactly one active (bit with value 1) Control function (TESTFR, STARTDT, STOPDT, either Activation or Confirmation) per U-frame	IEC 60870-5-104:2006, Clause 5	M
5.3.2.38		Control field octets 2-4, bit 9..32 all contain value 0	IEC 60870-5-104:2006, Clause 5	M
5.3.2.39		U-frame APDU only contains a single APCI field	IEC 60870-5-104:2006, Clause 5	M

Table 2 *(3 of 5)*

No.	Test	Description	Reference	Required
5.3.2.50	TRANSMISSION PROCEDURE	Balanced transmission (after TCP connection has been established)	IEC 60870-5-104:2006, Introduction	M
		The initial values of the Send sequence number N(S) and the Receive sequence number N(R) are set to 0 (zero) after a new TCP connection is successfully established which is then a Stopped connection	IEC 60870-5-104:2006, 5.1	M
		An I-frame contains the current values of the Send sequence number N(S) and the Receive sequence number N(R)	IEC 60870-5-104:2006, 5.1	M
		After *sending* an I-frame, the Send sequence number N(S) in the Primary station is incremented with 1	IEC 60870-5-104:2006, 5.1	M
		After *receiving* a valid I-frame, the Receive sequence number N(R) in the Secondary station is incremented with 1	IEC 60870-5-104:2006, 5.1	M
		Yet unacknowledged I-frames from the Primary station are acknowledged by either an I-frame or an S-frame from the Secondary station	IEC 60870-5-104:2006, 5.1	M
		The Receive sequence number N(R) acknowledges all yet unacknowledged I-frames with N(S) < N(R)	IEC 60870-5-104:2006, 5.1	M
		A Primary station **sends at most the configured amount of K unacknowledged I-frames** before it stops and waits for an acknowledgement	IEC 60870-5-104:2006, 5.5	M
		A Secondary station sends an acknowledgement after **receiving at most the configured amount of W I-frames**	IEC 60870-5-104:2006, 5.5	M
		An APDU with a Send sequence number N(S) that is *higher or lower (called "out of sequence")* than the current Receive sequence number N(R), results in [sending an S-frame to confirm the I-frames that it has received (if applicable) after which] a TCP Active close (TCP Control field FIN) is given by the Secondary Station (because one or more previous APDUs may have been lost along the way to their destination due to connection failures)	IEC 60870-5-104:2006, 5.1	M
		U-Frame Control function STARTDT_ACT answered with STARTDT_CON	IEC 60870-5-104:2006, 5.3	M
		U-Frame Control function STOPDT_ACT answered with STOPDT_CON	IEC 60870-5-104:2006, 5.3	M
		U-Frame Control function TESTFR_ACT answered with TESTFR_CON	IEC 60870-5-104:2006, 5.2	M

Table 2 *(4 of 5)*

No.	Test	Description	Reference	Required
5.3.2.70	TRANSMISSION CONTROL USING START/STOP	After a TCP connection has been established, initially a *Stopped connection* is created (a Stopped connection is an open ("established") TCP connection that is in confirmed STOPDT state) and allows the exchange of U-frames in controlling and controlled direction	IEC 60870-5-104:2006, 5.3	M
		The receipt of I- and S-frames in a *Stopped connection* results in a TCP Active close (TCP Control field FIN).	IEC 60870-5-104:2006, 5.3	M
		The controlling station sends a STARTDT_ACT after which a *Pending Started connection* is created. If no redundant links are configured, the controlling station may send U-, I-, and S- frames immediately after the STARTDT_ACT which will be accepted by the controlled station	IEC 60870-5-104:2006, 5.3	M
		The controlled station explicitly disables the transfer of I- and S-frames and the controlling station does not accept I- or S-frames in a *Pending Started connection,* but only U-frames	IEC 60870-5-104:2006, 5.3	M
		After the controlling station has received STARTDT_CON, the *Started connection* is created and the controlled station may sent U-, I-, and S- frames immediately after the STARTDT_CON. Controlled and controlling stations are allowed to send U-, I-, and S- frames	IEC 60870-5-104:2006, 5.3	M
		The Controlling station explicitly disables the transfer of I-frames in monitoring direction by sending a STOPDT_ACT to the Controlled station, after which a *Pending Stopped connection* is created	IEC 60870-5-104:2006, 5.3	M
		The controlled station disables the transfer of I-frames after the STOPDT_ACT is received. The controlling station may receive I-frames, which are transferred before the receipt of the STOPDT_ACT	IEC 60870-5-104:2006, 5.3	M
		If unconfirmed I-frames are in the controlled station, the *Pending Stopped connection* is called the *Pending Unconfirmed Stopped connection*. If the controlled station receives the S-frame to confirm the I-frames (immediately or after time-out t2 of the controlling station expires) the controlled station sends the STOPDT_CON after the *Stopped connection* is created	IEC 60870-5-104:2006, 5.3	M
		If NO unconfirmed I-frames are in the controlled station the controlled station sends a STOPDT_CON to the controlling station after which the *Stopped connection* is created	IEC 60870-5-104:2006, 5.3	M
		Send sequence number N(S) and Receive Sequence number N(R) remain unchanged during the use of U-frames with STARTDT / STOPDT indications	IEC 60870-5-104:2006, 5.3	M

Table 2 *(5 of 5)*

No.	Test	Description	Reference	Required
5.3.2.90	TIME OUT INTERVALS	An unanswered TCP Active open by the (fixed) Controlling Station (TCP Control field SYN: CONNECTION REQUEST) is actually cancelled after the configured **time out** t_0 (range 1..255 s) and subsequently restarted. It is highly recommended to cancel the current timed out TCP Active open, to prevent against an increasing number of "not cancelled" TCP connections because of the limited number of available open connections in a system	IEC 60870-5-104:2006, 7.1, Figure 19	PIXIT
		A TCP Passive open by the Controlled Station (LISTEN) remains active infinitely until a CONNECT is received	IEC 60870-5-104:2006, 7.1	M
		An I-frame from the Primary Station that is not acknowledged within the configured **time out** t_1 (range 1..255 s) results in a TCP Active close (TCP Control field FIN) by the Primary Station. [The **time out** t_1 runs for every I-frame individually and is cancelled if that particular I-frame has been confirmed.]	IEC 60870-5-104:2006, 5.1, Figure 12 IEC 60870-5-104:2006, 5.2 IEC 60870-5-104:2006, 5.3	M
		A U-frame from the Primary Station that is not confirmed within the configured **time out** t_1 (range 1..255 s) results in a TCP Active close (TCP Control field FIN) by the Primary Station	IEC 60870-5-104:2006, 5.1 IEC 60870-5-104:2006, 5.2	M
		After the configured **time period** t_2 (range 1..254 s) of transmitting I-frames, [which starts after the first unconfirmed frame is received], from the Primary Station in one direction only, an S-frame is sent by the Secondary Station to acknowledge the last I-frame	IEC 60870-5-104:2006, 5.1, Figure 10	M
		$t_2 < t_1$	IEC 60870-5-104:2006, 9.6	M
		After the configured **time period** t_3 (range 1 s..48 h, resolution 1 s) of inactivity (no reception of I-, S- or U-frames on the connection by either Primary or Secondary station), a U-frame with TESTFR_ACT is sent. The reception of every frame – I frame, S frame or U frame – retriggers timer t3 and all time out interval rules apply	IEC 60870-5-104:2006, 5.2	M
		$t_3 > t_1$	IEC 60870-5-104:2006, 9.6	M

Table 3 – Tests on data unit identifier

No.	Test	Description	Reference	Required
5.3.3.1	TYPE IDENTIFICATION	Compatible ASDU type used/accepted for all ASDUs as in the PICS	IEC 60870-5-101:2003, 7.2.1.1 IEC 60870-5-101:2003, 7.3.1 IEC 60870-5-104:2006, Clause 8 PID	PICS, 9.5
5.3.3.2	VARIABLE STRUCTURE QUALIFIER	Variable structure qualifier SQ (Sequence or Set) as defined for each ASDU	IEC 60870-5-101:2003, 7.2.2 IEC 60870-5-101:2003, 7.3.1	M
5.3.3.3		SQ:=1 only for COT Spontaneous (3), Cyclic/Periodic (1), Background Scan (2) or Interrogation (20..36). Check the PICS for the supported COT values	IEC 60870-5-101:2003, 7.2.2	PIXIT
5.3.3.4		Variable structure qualifier i (Number of elements) according to transmitted number of information elements	IEC 60870-5-101:2003, 7.2.2	M
5.3.3.5		Defined number of octets for ASDU	IEC 60870-5-101:2003, 7.2	M
5.3.3.10	CAUSE OF TRANSMISSION	Originator address identifies source application of Primary station or 0 if present but not used	IEC 60870-5-101:2003, 7.2.3 IEC 60870-5-104:2006, 9.5	PIXIT
5.3.3.11		Compatible Cause Of Transmission (COT) used/accepted. Check the PICS for the supported COT values	IEC 60870-5-101:2003, 7.2.3 IEC 60870-5-101:2003, 7.2.3	PICS, 9.5
5.3.3.12		P/N bit = 0: positive confirmation of activation	IEC 60870-5-101:2003, 7.2.3	M
5.3.3.13		P/N bit = 1: negative confirmation of activation	IEC 60870-5-101:2003, 7.2.3	M
5.3.3.14		Test bit = 0: ASDU generated during normal conditions	IEC 60870-5-101:2003, 7.2.3	M
5.3.3.15		Test bit = 1: ASDU generated during test conditions	IEC 60870-5-101:2003, 7.2.3	PIXIT

Table 4 – Verification of ASDUs for process information in monitor (normal) direction *(1 of 18)*

No.	Test	Description	Reference	Required
5.3.4.10	M_SP_NA_1 ASDU 1 Single-point information	SIQ with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.1	PICS, 9.5
5.3.4.11		SIQ with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.1	PIXIT
5.3.4.12		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.1	PICS, 9.5
5.3.4.13	SIQ	SPI = 0 (OFF), 1 (ON)	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.14		RES = 0	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.15		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.16		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.17		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.18		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.30	M_DP_NA_1 ASDU 3 Double-point information	DIQ with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.3	PICS, 9.5
5.3.4.31		DIQ with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.3	PIXIT
5.3.4.32		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.3	PICS, 9.5
5.3.4.33	DIQ	DPI = 0 (indeterminate or intermediate state), 1 (OFF), 2 (ON), 3 (indeterminate state)	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5
5.3.4.34		RES = 0	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5
5.3.4.35		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.36		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.37		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.38		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5

Table 4 *(2 of 18)*

No.	Test	Description	Reference	Required
5.3.4.50	M_ST_NA_1 ASDU 5 Step-position information	VTI with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.5	PICS, 9.5
5.3.4.51		VTI with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.5	PIXIT
5.3.4.52		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.5	PICS, 9.5
5.3.4.53	VTI	Value valid range −64..+63	IEC 60870-5-101:2003, 7.2.6.5	PICS, 9.5
5.3.4.54		Transient = 0,1	IEC 60870-5-101:2003, 7.2.6.5	PICS, 9.5
5.3.4.55	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.56		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.57		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.58		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.59		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.60		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.70	M_BO_NA_1 ASDU 7 Bitstring of 32 bit	BSI with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.7	PICS, 9.5
5.3.4.71		BSI with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.7	PIXIT
5.3.4.72		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.7	PICS, 9.5
5.3.4.73	BSI	BSI = 0,1	IEC 60870-5-101:2003, 7.2.6.13	PICS, 9.5
5.3.4.74	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.75		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT

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No.	Test	Description	Reference	Required
5.3.4.76		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.77		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.78		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.79		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.90	M_ME_NA_1	NVA with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.9	PICS, 9.5
5.3.4.91	ASDU 9 Measured value, normalised value	NVA with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.9	PIXIT
5.3.4.92		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.9	PICS, 9.5
5.3.4.93	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.4.94		Range -1 to $+1-2^{-15}$	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5
5.3.4.95	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.96		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.97		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.98		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.99		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.100		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.110	M_ME_NB_1 ASDU 11 Measured value, scaled value	SVA with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.11	PICS, 9.5
5.3.4.111		SVA with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.11	PIXIT
5.3.4.112		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.11	PICS, 9.5
5.3.4.113	SVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5 PIXIT
5.3.4.114		Range -2^{15} to $2^{15} - 1$	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5
5.3.4.115	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.116		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.117		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.118		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.119		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.120		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.130	M_ME_NC_1 ASDU 13 Measured value, short floating point number	IEEE STD 754 with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.13	PICS, 9.5
5.3.4.131		IEEE STD 754 with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.13	PIXIT
5.3.4.132		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.13	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.133	IEEE STD 754	Fraction = 0.. $1-2^{-23}$	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.134		Exponent = 0.. 255	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.135		Sign = 0,1	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.136	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.137		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.138		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.139		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.140		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.141		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.150	M_IT_NA_1 ASDU 15 Integrated totals	BCR with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.15	PICS, 9.5
5.3.4.151		BCR with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.15	PIXIT
5.3.4.152		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.15	PICS, 9.5
5.3.4.153	BCR	Value range -2^{31} to $+2^{31}-1$	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.154		Sequence Number SQ range 0 to 31	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.155		CY = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.156		CA = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.157		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.170	M_PS_NA_1 ASDU 20 Packed single-point information with status change detection	SCD with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.20	PICS, 9.5
5.3.4.171		SCD with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.20	PIXIT
5.3.4.172		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.20	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.173	SCD	STi = 0,1	IEC 60870-5-101:2003, 7.2.6.40	PIXIT
5.3.4.174		CDi = 0,1	IEC 60870-5-101:2003, 7.2.6.40	PIXIT
5.3.4.175	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.176		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.177		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.178		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.179		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.180		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.190	M_ME_ND_1	NVA with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.21	PICS, 9.5
5.3.4.191	ASDU 21 Measured value, normalised value without quality descriptor	NVA with SQ = 1, with only the IOA of the 1st element and the following Information Elements are identified by numbers incrementing continuously by +1 from this offset (see IEC 60870-5-101:2003, 7.2.2.1)	IEC 60870-5-101:2003, 7.3.1.21	PIXIT
5.3.4.192		COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.21	PICS, 9.5
5.3.4.193	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.4.194		Range −1 to $+1-2^{-15}$	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5
5.3.4.210	M_SP_TB_1	SIQ with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.22	PICS, 9.5
5.3.4.211	ASDU 30 Single-point information with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.22	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.212	SIQ	SPI = 0 (OFF), 1 (ON)	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.213		RES = 0	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.214		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.215		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.216		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PIXIT
5.3.4.217		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.1	PICS, 9.5
5.3.4.218	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.219		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.220		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.221		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.222		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.223		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.224		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.225		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.226		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.227		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.228		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.230	M_DP_TB_1	DIQ with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.23	PICS, 9.5
5.3.4.231	ASDU 31 Double-point information with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.23	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.232	DIQ	DIQ = 0 (indeterminate or intermediate state), 1 (OFF), 2 (ON), 3 (indeterminate state)	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5
5.3.4.233		RES = 0	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5
5.3.4.234		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.235		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.236		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PIXIT
5.3.4.237		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.2	PICS, 9.5
5.3.4.238	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.239		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.240		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.241		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.242		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.243		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.244		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.245		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.246		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.247		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.248		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.250	M_ST_TB_1	VTI with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.24	PICS, 9.5
5.3.4.251	ASDU 32 Step-position information with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.24	PICS, 9.5
5.3.4.252	VTI	Value valid range –64..+63	IEC 60870-5-101:2003, 7.2.6.5	PICS, 9.5
5.3.4.253		Transient = 0,1	IEC 60870-5-101:2003, 7.2.6.5	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.254	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.255		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.256		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.257		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.258		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.259		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.260	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.261		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.262		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.263		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.264		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.265		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.266		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.267		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.268		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.269		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.270		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.280	M_BO_TB_1	BSI with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.25	PICS, 9.5
5.3.4.281	ASDU 33 Bitstring of 32 bit with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.25	PICS, 9.5
5.3.4.282	BSI	BSI = 0,1	IEC 60870-5-101:2003, 7.2.6.13	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.283	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.284		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.285		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.286		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.287		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.288		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.289	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.290		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.291		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.292		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.293		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.294		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.295		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.296		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.297		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.298		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.299		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.310	M_ME_TD_1	NVA with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.26	PICS, 9.5
5.3.4.311	ASDU 34 Measured value, normalised value with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.26	PICS, 9.5
5.3.4.312	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.4.313		Range –1 to $+1–2^{-15}$	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.314	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.315		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.316		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.317		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.318		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.319		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.320	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.321		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.322		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.323		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.324		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.325		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.326		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.327		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.328		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.329		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.330		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.340	M_ME_TE_1	SVA with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.27	PICS, 9.5
5.3.4.341	ASDU 35 Measured value, scaled value with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.27	PICS, 9.5
5.3.4.342	SVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5 PIXIT
5.3.4.343		Range -2^{15} to $2^{15} - 1$	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.344	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.345		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.346		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.347		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.348		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.349		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.350	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.351		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.352		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.353		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.354		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.355		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.356		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.357		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.358		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.359		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.360		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.370	M_ME_TF_1	IEEE STD 754 with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.28	PICS, 9.5
5.3.4.371	ASDU 36 Measured value, short floating point number with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.28	PICS, 9.5

Table 4 *(13 of 18)*

No.	Test	Description	Reference	Required
5.3.4.372	IEEE STD 754	Fraction = 0.. $1–2^{-23}$	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.373		Exponent = 0.. 255	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.374		Sign = 0,1	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.4.375	QDS	RES = 0	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.376		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.377		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.378		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PIXIT
5.3.4.379		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.380		OV = 0,1	IEC 60870-5-101:2003, 7.2.6.3	PICS, 9.5
5.3.4.381	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.382		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.383		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.384		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.385		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.386		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.387		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.388		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.389		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.390		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.391		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.400	M_IT_TB_1	BCR with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.29	PICS, 9.5
5.3.4.401	ASDU 37 Integrated totals with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.29	PICS, 9.5
5.3.4.402	BCR	range -2^{31} to $+2^{31}-1$	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.403		Sequence Number SQ range 0 to 31	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.404		CY = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.405		CA = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.406		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.9	PICS, 9.5
5.3.4.407	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.408		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.409		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.410		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.411		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.412		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.413		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.414		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.415		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.416		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.417		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.430	M_EP_TD_1	SEP with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.30	PICS, 9.5
5.3.4.431	ASDU 38 Event of protection equipment with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.30	PICS, 9.5
5.3.4.432	SEP	ES = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PIXIT
5.3.4.433		RES = 0	IEC 60870-5-101:2003, 7.2.6.10	PICS, 9.5
5.3.4.434		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PIXIT
5.3.4.435		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PIXIT
5.3.4.436		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PIXIT
5.3.4.437		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PICS, 9.5
5.3.4.438		EI = 0,1	IEC 60870-5-101:2003, 7.2.6.10	PIXIT
5.3.4.439	CP16Time2a	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.20	PICS, 9.5
5.3.4.440	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.441		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.442		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.443		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.444		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.445		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.446		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.447		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.448		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.449		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.450		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.460	M_EP_TE_1	SPE with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.31	PICS, 9.5
5.3.4.461	ASDU 39 Packed start events of protection equipment with time-tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.31	PICS, 9.5
5.3.4.462	SPE	GS = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.463		SL1 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.464		SL2 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.465		SL3 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.466		SIE = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.467		SRD = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.468		RES = 0	IEC 60870-5-101:2003, 7.2.6.11	PICS, 9.5
5.3.4.469	QDP	RES = 0	IEC 60870-5-101:2003, 7.2.6.4	PICS, 9.5
5.3.4.470		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.471		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.472		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.473		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PICS, 9.5
5.3.4.474		EI = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT

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No.	Test	Description	Reference	Required
	CP16Time2a	**milliseconds = 0..59999**	**IEC 60870-5-101:2003, 7.2.6.20**	**PICS, 9.5**
5.3.4.475	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.476		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.477		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.478		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.479		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.480		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.481		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.482		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.483		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.484		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.485		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.490	M_EP_TF_1	OCI with SQ = 0, each element with its own IOA	IEC 60870-5-101:2003, 7.3.1.32	PICS, 9.5
5.3.4.491	ASDU 40 Packet output circuit information of protection equipment with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.1.32	PICS, 9.5
5.3.4.492	OCI	GC = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.493		CL1 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.494		CL2 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.495		CL3 = 0,1	IEC 60870-5-101:2003, 7.2.6.11	PIXIT
5.3.4.496		RES = 0	IEC 60870-5-101:2003, 7.2.6.11	PICS, 9.5

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No.	Test	Description	Reference	Required
5.3.4.497	QDP	RES = 0	IEC 60870-5-101:2003, 7.2.6.4	PICS, 9.5
5.3.4.498		BL = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.499		SB = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.500		NT = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PIXIT
5.3.4.501		IV = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PICS, 9.5
5.3.4.502		EI = 0,1	IEC 60870-5-101:2003, 7.2.6.4	PICS, 9.5
5.3.4.503	CP16Time2a	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.20	PICS, 9.5
5.3.4.504	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.505		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.506		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.507		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.508		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.509		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.510		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.511		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.512		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.513		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.4.514		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

Table 5 – Verification of ASDUs for process information in control (normal) direction *(1 of 8)*

No.	Test	Description	Reference	Required
5.3.5.1	C_SC_NA_1 ASDU 45 Single command	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.1	PICS, 9.5
5.3.5.2	SCO	SCS = 0 (OFF), 1 (ON)	IEC 60870-5-101:2003, 7.2.6.15	PICS, 9.5
5.3.5.3		RES = 0	IEC 60870-5-101:2003, 7.2.6.15	PICS, 9.5
5.3.5.4		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.5		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.6		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT
5.3.5.10	C_DC_NA_1 ASDU 46 Double command	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.2	PICS, 9.5
5.3.5.11	DCO	DCS = 1 (OFF), 2 (ON)	IEC 60870-5-101:2003, 7.2.6.16	PICS, 9.5
5.3.5.12		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.13		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.14		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT
5.3.5.20	C_RC_NA_1 ASDU 47 Regulating step command	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.3	PICS, 9.5
5.3.5.21	RCO	RCS = 1 (next step LOWER), 2 (next step HIGHER)	IEC 60870-5-101:2003, 7.2.6.17	PICS, 9.5
5.3.5.22		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.23		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.24		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT

Table 5 *(2 of 8)*

No.	Test	Description	Reference	Required
5.3.5.30	C_SE_NA_1 ASDU 48 Set point command, normalised value	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.4	PICS, 9.5
5.3.5.31	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.5.32		Range –1 to +1–2^{-15}	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5
5.3.5.33	QOS	QL = 0, 1…63 or 64…127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.34		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT
5.3.5.40	C_SE_NB_1 ASDU 49 Set point command, scaled value	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.5	PICS, 9.5
5.3.5.41	SVA	Value (with scaling factor)	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5 PIXIT
5.3.5.42		Range –2^{15} to 2^{15} – 1	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5
5.3.5.43	QOS	QL = 0, 1…63 or 64…127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.44		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT
5.3.5.50	C_SE_NC_1 ASDU 50 Set point command, short floating point value	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.6	PICS, 9.5
5.3.5.51	IEEE STD 754	Fraction = 0.. 1–2^{-23}	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4, 6.5	PICS, 9.5
5.3.5.52		Exponent = 0..255	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4, 6.5	PICS, 9.5
5.3.5.53		Sign = 0,1	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4, 6.5	PICS, 9.5
5.3.5.54	QOS	QL = 0, 1…63 or 64…127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.55		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT

Table 5 *(3 of 8)*

No.	Test	Description	Reference	Required
5.3.5.60	C_BO_NA_1 ASDU 51 Bitstring of 32 bits	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.2.7	PICS, 9.5
5.3.5.61	BSI	BSI = 0,1	IEC 60870-5-101:2003, 7.2.6.13	PICS, 9.5
5.3.5.70	C_SC_TA_1 ASDU 58 Single command with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.1	PICS, 9.5
5.3.5.71	SCO	SCS = 0 (OFF), 1 (ON)	IEC 60870-5-101:2003, 7.2.6.15	PICS, 9.5
5.3.5.72		RES = 0	IEC 60870-5-101:2003, 7.2.6.15	PICS, 9.5
5.3.5.73		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.74		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.75		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT
5.3.5.76	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.77		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.78		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.79		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.80		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.81		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.82		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.83		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.84		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.85		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.86		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.90	C_DC_TA_1 ASDU 59 Double command with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.2	PICS, 9.5

Table 5 *(4 of 8)*

No.	Test	Description	Reference	Required
5.3.5.91	DCO	DCS = 1 (OFF), 2 (ON)	IEC 60870-5-101:2003, 7.2.6.16	PICS, 9.5
5.3.5.92		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.93		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.94		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT
5.3.5.95	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.96		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.97		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.98		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.99		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.100		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.101		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.102		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.103		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.104		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.105		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.110	C_RC_TA_1 ASDU 60 Regulating step command with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.3	PICS, 9.5

Table 5 *(5 of 8)*

No.	Test	Description	Reference	Required
5.3.5.111	RCO	RCS = 1 (next step LOWER), 2 (next step HIGHER)	IEC 60870-5-101:2003, 7.2.6.17	PICS, 9.5
5.3.5.112		QU = 0 (no additional), 1 (short pulse), 2 (long pulse), 3 (persistent)	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6
5.3.5.113		QU = 4 to 8, 9 to 15, 16 to 31	IEC 60870-5-101:2003, 7.2.6.26	PIXIT
5.3.5.114		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.26	PICS, 9.6 PIXIT
5.3.5.115	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.116		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.117		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.118		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.119		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.120		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.121		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.122		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.123		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.124		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.125		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.130	C_SE_TA_1 ASDU 61 Set point command, normalised value with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.4	PICS, 9.5
5.3.5.131	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.5.132		Range -1 to $+1-2^{-15}$	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5

Table 5 *(6 of 8)*

No.	Test	Description	Reference	Required
5.3.5.133	QOS	QL = 0, 1…63 or 64…127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.134		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT
5.3.5.135	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.136		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.137		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.138		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.139		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.140		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.141		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.142		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.143		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.144		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.145		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.150	C_SE_TB_1 ASDU 62 Set point command, scaled value with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.5	PICS, 9.5
5.3.5.151	SVA	Value (with scaling factor)	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5 PIXIT
5.3.5.152		Range -2^{15} to $2^{15} - 1$	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5
5.3.5.153	QOS	QL = 0, 1…63 or 64…127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.154		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT

Table 5 *(7 of 8)*

No.	Test	Description	Reference	Required
5.3.5.155	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.156		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.157		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.158		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.159		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.160		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.161		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.162		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.163		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.164		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.165		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.170	C_SE_TC_1 ASDU 63 Set point command, short floating point value with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.6	PICS, 9.5
5.3.5.171	IEEE STD 754	Fraction = 0.. $1–2^{-23}$	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.5.172		Exponent = 0.. 255	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.5.173		Sign = 0,1	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.5.174	QOS	QL = 0, 1...63 or 64...127	IEC 60870-5-101:2003, 7.2.6.39	PIXIT
5.3.5.175		S/E = 0, 1	IEC 60870-5-101:2003, 7.2.6.39	PICS, 9.6 PIXIT

Table 5 *(8 of 8)*

No.	Test	Description	Reference	Required
5.3.5.176	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.177		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.178		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.179		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.180		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.181		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.182		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.183		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.184		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.185		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.186		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.190	C_BO_TA_1 ASDU 64 Bitstring of 32 bits with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.7	PICS, 9.5
5.3.5.191	BSI	BSI = 0,1	IEC 60870-5-101:2003, 7.2.6.13	PICS, 9.5
5.3.5.192	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.193		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.194		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.195		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.196		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.197		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.198		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.199		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.200		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.201		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.202		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.5.220	PROCESS CONTROL TIME TAGS	Either the set of Process Control ASDUs without time tag or the set of Process Control ASDUs with CP56Time2a is used	IEC 60870-5-104:2006, 9.5	PICS, 9.5

Table 6 – Verification of ASDUs for system information in monitor (normal) direction

No.	Test	Description	Reference	Required
5.3.6.1	M_EI_NA_1	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.3.1	PICS, 9.5
5.3.6.2	ASDU 70 End of initialisation	Information Object Address = 0	IEC 60870-5-101:2003, 7.3.3.1	PICS, 9.5
5.3.6.3	COI	UI =0, 1, 2, 3-31 or 32-127	IEC 60870-5-101:2003, 7.2.6.21	PIXIT
5.3.6.4		BS = 0,1	IEC 60870-5-101:2003, 7.2.6.21	PIXIT

Table 7 – Verification of ASDUs for system information in control (normal) direction *(1 of 3)*

No.	Test	Description	Reference	Required
5.3.7.1	C_IC_NA_1	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.4.1	PICS, 9.5
5.3.7.2	ASDU 100 Interrogation command	Information Object Address = 0	IEC 60870-5-101:2003, 7.3.4.1	PICS, 9.5
5.3.7.3	QOI	QOI = 1.. 19 or 20…36 or 37…63 or 64…255	IEC 60870-5-101:2003, 7.2.6.22	PIXIT
5.3.7.10	C_CI_NA_1	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.4.2	PICS, 9.5
5.3.7.11	ASDU 101 Counter interrogation command	Information Object Address = 0	IEC 60870-5-101:2003, 7.3.4.2	PICS, 9.5
5.3.7.12	QCC	RQT Counter request = 0…5	IEC 60870-5-101:2003, 7.2.6.23	PICS, 9.6
5.3.7.13		FRZ Counter freeze = 0…3	IEC 60870-5-101:2003, 7.2.6.23	PICS, 9.6
5.3.7.20	C_RD_NA_1 ASDU 102 Read command	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.4.3	PICS, 9.5
5.3.7.30	C_CS_NA_1	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.4.4	PICS, 9.5
5.3.7.31	ASDU 103 Clock synchronisation command	Information Object Address = 0	IEC 60870-5-101:2003, 7.3.4.4	PICS, 9.5

Table 7 *(2 of 3)*

No.	Test	Description	Reference	Required
5.3.7.32	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.33		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.34		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.35		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.36		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.37		res1 = <0> genuine time or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.6
5.3.7.38		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.39		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5 PICS, 9.6
5.3.7.40		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.41		day of week = <1..7>	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.6
5.3.7.42		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.43		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.44		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.60	C_RP_NA_1	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.4.6	PICS, 9.5
5.3.7.61	ASDU 105 Reset process command	Information Object Address = 0	IEC 60870-5-101:2003, 7.3.4.6	PICS, 9.5
5.3.7.62	QRP	QRP = 1, 2 (zero is not permitted)	IEC 60870-5-101:2003, 7.2.6.27	PIXIT
5.3.7.70	C_CD_NA_1 ASDU 107 Test command with time tag CP56Time2a	COT as defined in the attached PICS	IEC 60870-5-104:2006, 8.8	PICS, 9.5
5.3.7.71	TSC	Test sequence counter, 16 bit = UI16[1..16]<0..65535>	IEC 60870-5-104:2006, 8.8	PICS, 9.5

Table 7 *(3 of 3)*

No.	Test	Description	Reference	Required
5.3.7.72	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.73		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.74		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.75		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.76		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.77		res1 = <0> genuine time or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.6
5.3.7.78		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.79		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5 PICS, 9.6
5.3.7.80		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.81		day of week = <1..7>	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.6
5.3.7.82		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.83		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.7.84		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

Table 8 – Verification of ASDUs for parameters in control (normal) direction *(1 of 2)*

No.	Test	Description	Reference	Required
5.3.8.1	P_ME_NA_1 ASDU 110 Parameter of measured value, normalised value	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.5.1	PICS, 9.5
5.3.8.2	NVA	Value (translation considering the scaling factor)	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5 PIXIT
5.3.8.3		Range -1 to $+1-2^{-15}$	IEC 60870-5-101:2003, 7.2.6.6	PICS, 9.5
5.3.8.4	QPM	KPA = 0-4	IEC 60870-5-101:2003, 7.2.6.24	PICS, 9.6 PIXIT
5.3.8.5		LPC = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.6		POP = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.10	P_ME_NB_1 ASDU 111 Parameter of measured values, scaled value	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.5.2	PICS, 9.5
5.3.8.11	SVA	Value (with scaling factor)	IEC 60870-5-101:2003, 7.2.6.7 PID	PICS, 9.5 PIXIT
5.3.8.12		Range -2^{15} to $2^{15} - 1$	IEC 60870-5-101:2003, 7.2.6.7	PICS, 9.5
5.3.8.13	QPM	KPA = 0-4	IEC 60870-5-101:2003, 7.2.6.24	PICS, 9.6 PIXIT
5.3.8.14		LPC = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.15		POP = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.20	P_ME_NC_1 ASDU 112 Parameter of measured values, short floating point number	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.5.3	PICS, 9.5

Table 8 *(2 of 2)*

No.	Test	Description	Reference	Required
5.3.8.21	IEEE STD 754	Fraction = 0.. $1-2^{-23}$	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.8.22		Exponent = 0.. 255	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.8.23		Sign = 0,1	IEC 60870-5-101:2003, 7.2.6.8 IEC 60870-5-4:1993, 6.5	PICS, 9.5
5.3.8.24	QPM	KPA = 0-4	IEC 60870-5-101:2003, 7.2.6.24	PICS, 9.6 PIXIT
5.3.8.25		LPC = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.26		POP = 0,1	IEC 60870-5-101:2003, 7.2.6.24	PIXIT
5.3.8.30	P_AC_NA_1 ASDU 113 Parameter activation	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.5.4	PICS, 9.5
5.3.8.31	QPA	QPA = 3 (other values not permitted)	IEC 60870-5-101:2003, 7.2.6.25	PIXIT

Table 9 – Verification of ASDUs for file transfer (in monitor (normal) and control direction) *(1 of 4)*

No.	Test	Description	Reference	Required
5.3.9.1	F_FR_NA_1 ASDU 120 File ready	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.1	PICS, 9.5
5.3.9.2	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.3		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.4	LOF	LOF = 0	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.5		LOF = 1..16777215	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.6	FRQ	UI = 0	IEC 60870-5-101:2003, 7.2.6.28	PIXIT
5.3.9.7		BS = 0,1	IEC 60870-5-101:2003, 7.2.6.28	PIXIT
5.3.9.10	F_SR_NA_1 ASDU 121 Section ready	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.2	PICS, 9.5
5.3.9.11	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.12		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.13	NOS	NOS = 0	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.14		NOS = 1..255	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.15	LOS	LOS = 0	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.16		LOS = 1..16777215	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.17	SRQ	UI = 0	IEC 60870-5-101:2003, 7.2.6.29	PIXIT
5.3.9.18		BS = 0,1	IEC 60870-5-101:2003, 7.2.6.29	PIXIT
5.3.9.30	F_SC_NA_1 ASDU 122 Call directory, select file, call file, call section	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.3	PICS, 9.5
5.3.9.31	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.32		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5

Table 9 *(2 of 4)*

No.	Test	Description	Reference	Required
5.3.9.33	NOS	NOS = 0	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.34		NOS = 1..255	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.35	SCQ	UI1 = 0..7	IEC 60870-5-101:2003, 7.2.6.30	PICS, 9.5
5.3.9.36		UI2 = 0..5	IEC 60870-5-101:2003, 7.2.6.30	PICS, 9.5
5.3.9.40	F_LS_NA_1 ASDU 123 Last section, last segment	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.3	PICS, 9.5
5.3.9.41	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.42		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.43	NOS	NOS = 0	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.44		NOS = 1..255	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.45	LSQ	LSQ = 0..4	IEC 60870-5-101:2003, 7.2.6.36	PICS, 9.5
5.3.9.46	CHS	CHS = 0..255	IEC 60870-5-101:2003, 7.2.6.37	PICS, 9.5
5.3.9.50	F_AF_NA_1 ASDU 124 ACK file, ACK section	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.5	PICS, 9.5
5.3.9.51	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.52		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.53	NOS	NOS = 0	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.54		NOS = 1..255	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.55	AFQ	UI1 = 0..4	IEC 60870-5-101:2003, 7.2.6.32	PIXIT
5.3.9.56		UI2 = 0..5	IEC 60870-5-101:2003, 7.2.6.32	PIXIT
5.3.9.60	F_SG_NA_1 ASDU 125 Segment	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.5	PICS, 9.5

Table 9 *(3 of 4)*

No.	Test	Description	Reference	Required
5.3.9.61	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.62		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.63	NOS	NOS = 0	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.64		NOS = 1..255	IEC 60870-5-101:2003, 7.2.6.34	PICS, 9.5
5.3.9.65	LOS	LOS = 0	IEC 60870-5-101:2003, 7.2.6.36	PICS, 9.5
5.3.9.66		LOS = 1..234 (1..240)	IEC 60870-5-101:2003, 7.2.6.36	PICS, 9.5
5.3.9.67	Segment	Segment data	IEC 60870-5-101:2003, 7.3.6.6	PICS, 9.5
5.3.9.70	F_DR_TA_1 ASDU 126 Directory	COT as defined in the attached PICS	IEC 60870-5-101:2003, 7.3.6.7	PICS, 9.5
5.3.9.71	NOF	NOF = 0	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.72		NOF = 1..65535	IEC 60870-5-101:2003, 7.2.6.33	PICS, 9.5
5.3.9.73	LOF	LOF = 0	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.74		LOF = 1..16777215	IEC 60870-5-101:2003, 7.2.6.35	PICS, 9.5
5.3.9.75	SOF	STATUS = 0	IEC 60870-5-101:2003, 7.2.6.38	PICS, 9.5
5.3.9.76		RES1 = 0,1	IEC 60870-5-101:2003, 7.2.6.38	PICS, 9.5
5.3.9.77		FOR = 0,1	IEC 60870-5-101:2003, 7.2.6.38	PICS, 9.5
5.3.9.78		FA = 0,1	IEC 60870-5-101:2003, 7.2.6.38	PICS, 9.5

Table 9 *(4 of 4)*

No.	Test	Description	Reference	Required
5.3.9.79	CP56TIME2A	milliseconds = 0..59999	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.80		minutes = 0..59	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.81		hours = 0..23	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.82		Res1 = <0> genuine time, or <1> substituted time	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.83		res2, res3, res4 = 0	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.84		IV = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.85		SU = 0..1	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.86		day of week = 0 or 1..7	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.87		day of month = 1..31	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.88		month = 1..12	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5
5.3.9.89		year = 0..99 (year 2000 = 00, year 1999 is 99)	IEC 60870-5-101:2003, 7.2.6.18	PICS, 9.5

5.4 Conformance test procedures

The conformance test procedures shall be tested for all the mandatory test cases in 5.3 and for every configuration as in 5.2. See 5.1 for the procedure to execute all mandatory test cases.

A test is passed if the described behaviour has been automatically verified by the test software or shown to the test engineer in a human readable format. A specific Function has passed completely if all mandatory test cases in that group have passed.

To identify if a test case is mandatory, it is necessary to read 5.1 carefully.

Table 10 – Data unit identifier conformance test procedures *(1 of 2)*

No.	Test	Description	Reference	Required
5.4.10.1	TYPE IDENTIFICATION	If COT=44 is NOT supported, any undefined or not supported ASDU received by the controlled station should be mirrored with P/N=1 negative	IEC 60870-5-101:2003, 7.3	PICS, 9.5 *Type id and cot assignments: COT 44*
		Any undefined or not supported ASDU received by the controlling station is ignored (or discarded)	IEC 60870-5-101:2003, 7.3	PICS, 9.5 PIXIT
		If COT = 44 is supported, any undefined or not supported ASDU is mirrored by the controlled station with P/N = 1: negative confirmation of activation using COT = 44 (unknown type identification)	IEC 60870-5-101:2003, 7.3	PICS, 9.5 *Type id and cot assignments: COT 44*
		These tests are performed correctly for at least three undefined or not supported ASDUs. The test should include at least one undefined ASDU. If possible, the test should include at least one ASDU defined in the standard, but not supported by the DUT. Undefined ASDU = ASDU which is not defined by the standard. Unsupported ASDU = ASDU which is defined by the standard, but not supported by the DUT		M
5.4.10.5	CAUSE OF TRANSMISSION	Test bit = 0: ASDU generated during normal conditions	IEC 60870-5-101:2003, 7.2.3	M
		Test bit = 1: ASDU generated during test conditions	IEC 60870-5-101:2003, 7.2.3	PIXIT
		If COT=45 is NOT supported, any message received by the controlled station containing an undefined or not supported COT should be mirrored with P/N=1 negative	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5 *Type id and cot assignments: COT 45*
		Any message received by the controlling station containing an undefined or not supported COT is ignored (or discarded)	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5
		If COT=45 is supported, any undefined or not supported ASDU is mirrored by the controlled station with P/N = 1: negative confirmation of activation using COT = 45 (unknown cause of transmission)	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5 *Type id and cot assignments: COT 45*
		Originator address is zero or the applicable Originator address	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5
		These tests are performed correctly for at least three undefined or not supported COTs. The test should include at least one undefined COT. If possible, the test should include at least one COT defined in the standard, but not supported by the DUT. Undefined COT = COT which is not defined by the standard. Unsupported COT = COT which is defined by the standard, but not supported by the DUT.		M

Table 10 *(2 of 2)*

No.	Test	Description	Reference	Required
5.4.10.10	COMMON ADDRESS of ASDU	If COT=46 is NOT supported, any message received by the controlled station containing an undefined CASDU should be mirrored with P/N=1 negative	IEC 60870-5-101:2003, 7.2.4	PICS, 9.5 *Type id and cot assignments: COT 46*
		Any message received by the controlling station containing an undefined CASDU is ignored (or discarded)	IEC 60870-5-101:2003, 7.2.4	PICS, 9.5
		If COT=46 is supported, any ASDU with undefined CASDU is mirrored by the controlled station with P/N = 1: negative confirmation of activation using COT = 46 (unknown CASDU)	IEC 60870-5-101:2003, 7.2.4	PICS, 9.5 *Type id and cot assignments: COT 46*
		Broadcast CASDU value (0xFF<FF>) only used in control direction with ASDU Types 100 (Interrogation), 101 (Counter interrogation), 103 (Clock Sync) or 105 (Reset Process).	IEC 60870-5-101:2003, 7.2.4	PIXIT
		The Controlled station rejects all other ASDU Types with a Broadcast CASDU value by mirroring the ASDU with P/N = 1 negative (and with COT = 46, if supported)	IEC 60870-5-101:2003, 7.2.4	M
		The Controlling station handles any received ASDU with a Broadcast CASDU as an ASDU with an undefined CASDU	IEC 60870-5-101:2003, 7.2.4	M

Table 11 – Information object address conformance test procedures

No.	Test	Description	Reference	Required
5.4.11.1	OBJECT ADDRESS	If COT=47 is NOT supported, any message received by the controlled station containing an undefined IOA should be mirrored with P/N=1 negative	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5 *Type id and cot assignments: COT 47*
		Any message received by the controlling station containing an undefined IOA is ignored (or discarded)	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5
		If COT=47 is supported, any ASDU with undefined IOA in control direction is mirrored by the controlled station with P/N = 1: negative confirmation of activation using COT = 47 (unknown IOA)	IEC 60870-5-101:2003, 7.2.3	PICS, 9.5 *Type id and cot assignments: COT 47*
		These tests are performed correctly for each supported ASDU.		M

Table 12 – Station initialisation function conformance test procedures *(1 of 3)*

No.	Test	Description	Reference	Required
5.4.12.1	Local Initialisation of the Controlling station: (re-)boot	After its power on, hardware reset or warm boot, the Controlling station (which may be configured as a fixed selection in case of two equivalent Controlling stations) starts to create the number of configured Stopped connections (a TCP connection in STOPDT state) to each configured Controlled station	IEC 60870-5-104:2006, 7.1	M
		During or after the creation of one or more *new* Stopped connections, the Controlling station initiates the creation of exactly one Started connection to each configured Controlled station by sending a STARTDT_ACT. This STARTDT_ACT is sent over the Stopped connection that is configured as the preferred Started connection (if multiple Stopped connections to the same Controlled station are available) to that Controlled station	IEC 60870-5-104:2006, 5.3	M
		The Controlling station finishes the Station initialisation by starting the update of its internal process representation by issuing a General Interrogation command C_IC_ACT to each Controlled station	IEC 60870-5-104:2006, 7.1	M
		Each Controlled station enables the Stopped connection over which the STARTDT_ACT was received by sending a STARTDT_CON over that same connection to the Controlling station	IEC 60870-5-104:2006, 5.3	M
		Each Controlled station updates the Controlling station with the requested actual process information in the General interrogation cycle. The normal telecontrol operations may begin	IEC 60870-5-104:2006, 7.1	M
5.4.12.10	Local initialisation of the Controlled station: (re-)boot	After power on, hardware reset or warm boot the Controlled station waits for the establishment of one or (optional) more TCP connections from the Controlling station(s) after its transport provider (the TCP stack) and internal application components are initialised	IEC 60870-5-104:2006, 7.1	M
		The Controlled station only allows Active TCP connections from configured Controlling stations (optional, for security reasons)		PIXIT
		The Controlled station finishes the creation of exactly one Started connection by sending a STARTDT_CON after receiving a STARTDT_ACT from the Controlling station	IEC 60870-5-104:2006, 7.1	M
		The Controlled station finishes its local initialisation by sending the M_EI (End of initialisation) to the Controlling station (this is optional, but recommended, because it allows the Controlled station to distinguish between this initiated local initialisation and other connection establishment procedures like lost connections)	IEC 60870-5-104:2006, 7.1	PICS, 9.5 *System info in monitor direction*
		The Controlled station starts the General interrogation procedure to update the Controlling station with the actual process information after receipt of the General Interrogation command C_IC_ACT. The normal telecontrol operations may begin	IEC 60870-5-104:2006, 7.1	M

Table 12 *(2 of 3)*

No.	Test	Description	Reference	Required
NOTE The following tests are only required for systems supporting Remote initialization. If 'M' is mentioned, the test case is mandatory for systems with the relevant Remote initialization options marked in the PICS: - PICS, 9.5, "System information in control direction", "Reset process command". - PICS, 9.6, "Station initialization", "Remote initialization".				
5.4.12.20	Remote initialisation of the Controlled station	The Controlling station forces the Controlled station to do a restart of the Application processes by issuing a "Reset process" C_RP_ACT with QRP=1 over the Started connection	IEC 60870-5-104:2006, 7.1	M
		The Controlled station confirms the forced restart by sending a C_RP_ACTCON to the Controlling station ("Reset process" procedure means reset of layer 7 and User processes.)	IEC 60870-5-104:2006, 7.1 IEC 60870-5-101:2003, 6.2.3	M
		The Controlled station sends a TCP Active close (TCP Control field FIN) over the Started connection and all Stopped connections to the Controlling station to close all Started and Stopped connections between the two communication partners. The TCP Active close may be sent before, during or after the "Reset process" procedure, which is system dependent	IEC 60870-5-104:2006, 7.1	M
		The Controlling station continues to try to create the number of configured Stopped connections to the Controlled station	IEC 60870-5-104:2006, 7.1	M
		The Controlled station waits with the establishment of one or (optional) more Stopped connection(s), till its transport provider (the TCP stack) and internal application components are initialised	IEC 60870-5-104:2006, 7.1	M
		The Controlled station only allows Stopped connections from configured Controlling stations (optional, for security reasons)		M
		The Controlled station finishes the creation of exactly one Started connection by sending a STARTDT_CON after receiving a STARTDT_ACT from the Controlling station	IEC 60870-5-104:2006, 7.1	M
		The Controlled station finishes its local initialisation by sending the M_EI (End of initialisation) to the Controlling station (this is optional, but recommended, because it allows the Controlled station to distinguish between this initiated local initialisation and other connection establishment procedures like lost connections)	IEC 60870-5-104:2006, 7.1	PIXIT
		The Controlled station starts the General interrogation procedure to update the Controlling station with the actual process information after receipt of the General Interrogation command C_IC_ACT. The normal telecontrol operations may begin	IEC 60870-5-104:2006, 7.1	M
5.4.12.21	Reset of pending information with time tag of the event buffer	The Controlling station forces one LRU (using a specific CASDU address in the C_RP_ECT) or all LRUs (using broadcast CASDU address in the C_RP_ACT) in the Controlled station to do a restart of the Application processes. QRP is set to 2 in the C_RP_ACT. Run this test while the Controlled station has pending events in the buffer.	IEC 60870-5-5:1995, 6.1 IEC 60870-5-101:2003, 7.2.6.27	PIXIT
		The Controlled station confirms the Reset of pending information with time tag of the event buffer by sending a C_RP_ACTCON to the Controlling station from each addressed LRU (with the LRUs specific CASDU address) and resets its pending information with time tag in the event buffer. The Controlled station does not send any events anymore (until new events are generated).	IEC 60870-5-5:1995, 6.1 IEC 60870-5-101:2003, 7.2.6.27	PIXIT

Table 12 *(3 of 3)*

No.	Test	Description	Reference	Required
5.4.12.30	Re-establishing a lost Started connection between the Controlling and the Controlled station when no other connections are available	After the Started connection is inoperable for a longer period than time-out (t_1) allows, the **Primary** station (whether Controlling or Controlled) initiates a TCP active close on the Started connection (which may never arrive)	IEC 60870-5-104:2006, 5.3	M
		After detecting that the Started connection is inoperable and not yet closed, the **Secondary** station initiates a TCP active close on the Started connection (which may never arrive). Both sides of the inoperable Started connection have been closed now and the Started connection is no longer present	IEC 60870-5-104:2006, 5.3	M
		After detecting that the Started connection is no longer present, the Controlling station (which may be configured as a fixed selection in case of two equivalent Controlling stations) tries to create a new Stopped connection to the Controlled station at regular intervals	IEC 60870-5-104:2006, 5.3	M
		After the creation of the *new* Stopped connection, the Controlling station initiates the creation of the *new* Started connection to the Controlled station by sending a STARTDT_ACT over the new established Stopped connection	IEC 60870-5-104:2006, 5.3	M
		The Controlled station finishes the creation of the new Started connection by sending a STARTDT_CON over that same connection over which the STARTDT_ACT was received to the Controlling station	IEC 60870-5-104:2006, 5.3	M
		After re-establishment of the connection between Controlling and Controlled station, **no** M_EI (End of initialisation) is sent (nor needed) to the Controlling station. Normal operation continues with the application messages that have not yet been acknowledged (if supported and if available) and begins the General Interrogation procedure		M
5.4.12.40	COMPATIBILITY WITH OTHER TEST CASES	All of the applicable items in 5.3 “Verification of IEC 60870-5-104 communication” have been reviewed without any error during execution of the test cases in this table and no manual intervention was required for continued normal operation		M

Table 13 – Redundant link conformance test procedures *(1 of 3)*

Remark: these test cases are describing the redundancy mechanism (with multiple connections to a single Controlled station, of which exactly one is the Started connection and the other connections are Stopped connections), but not how this mechanism will be used in operational redundant systems. The diversity of operational systems requires additional testing.

No.	Test	Description	Reference	Required
NOTE: The tests in this Table are only required for systems supporting Redundant connections. If 'M' is mentioned, the test case is mandatory for systems with the relevant Redundant connections options marked in the PICS: - PICS, 9.6, "Redundant connections"				
5.4.13.1	Periodic check of *ALL* redundant connections	Both Controlling and Controlled station guard the configured inactivity **time period t_3 on the Started connection and start a TESTFR procedure when t_3 expires.** All time out interval rules apply	IEC 60870-5-104:2006, 10	M
		The Controlling and Controlled station guards the configured inactivity **time period t_3 on *all* the Stopped connections and starts a TESTFR procedure when t_3 expires.** All time out interval rules apply	IEC 60870-5-104:2006, 10	M
5.4.13.10	Re-establishing a lost Started connection between the Controlling and the Controlled station when redundant connections are available: (automatic switch-over)	After the Started connection is inoperable for a longer period than time-out (t_1) allows, the Primary station (whether Controlling or Controlled) initiates a TCP active close on the Started connection (which may never arrive)	IEC 60870-5-104:2006, 10	M
		After detection that the Started connection is no longer present, the Controlling station (which may be configured as a fixed selection in case of two equivalent Controlling stations) initiates the creation of a *new* Started connection by sending a STARTDT_ACT over one of the redundant, until now still Stopped connections to the same Controlled station	IEC 60870-5-104:2006, 10	M
		The Controlled station finishes the creation of the new Started connection by sending a STARTDT_CON over that same connection over which the STARTDT_ACT was received to the Controlling station. The Controlled station sends an active close on the old Started connection.	IEC 60870-5-104:2006, 10	M
		After re-establishment of the Started connection between Controlling and Controlled station, **no** M_EI (End of initialisation) is sent (nor needed) to the Controlling station. Normal operation continues with the application messages that have not yet been acknowledged (if supported and if available) and begins the General Interrogation procedure	IEC 60870-5-104:2006, 10	M
		The send- and receive counters are not reset to "0" as long as the TCP connection is established. Each TCP connection, not affected by STARTDT and STOPDT procedures or switch-over procedures, maintains its send- and receive counter	IEC 60870-5-104:2006, 5.3 IEC 60870-5-104:2006, 10	M

Table 13 *(2 of 3)*

No.	Test	Description	Reference	Required
5.4.13.20	Re-establishing a lost redundant connection between the Controlling and the Controlled station	After detecting that one of the redundant (Started or Stopped) connections is inoperable and not yet closed, the **Controlling** station (which may be configured as a fixed selection in case of two equivalent Controlling stations) initiates a TCP active close on the inoperable connection (which may never arrive)	IEC 60870-5-104:2006, 10	M
		After detecting that one of the redundant (Started or Stopped) connections is inoperable and not yet closed, the **Controlled** station initiates a TCP active close on the inoperable connection (which may never arrive)	IEC 60870-5-104:2006, 10	M
		The Controlling station tries at regular intervals to create a new Stopped connection for the now closed inoperable connection to the Controlled station	IEC 60870-5-104:2006, 10	M
5.4.13.30	Manual switching over the Started connection to another redundant Stopped connection: (manual switch-over)	The **Controlling** station (which may be configured as a fixed selection in case of two equivalent Controlling stations) issues a STOPDT_ACT on the current Started connection to the Controlled station	IEC 60870-5-104:2006, 10	M
		After sending the STOPDT_ACT, the Controlling station (optionally, but recommended) stops the transfer of I-frames on the Started connection that is then in pending STOPDT state	IEC 60870-5-104:2006, 10	M
		The Controlled station also stops the transfer of I-frames on the Started connection after receipt of the STOPDT_ACT, which then is in pending STOPDT state, even before the STOPDT_CON is sent. NOTE Due to timing effects, it is allowed that (which cannot be prevented) one I-frame will be sent after the controlled station has received the STOPDT_ACT because it is already handed over to the TCP socket	IEC 60870-5-104:2006, 10	M
		The Controlled station acknowledges all yet unacknowledged I-frames from the Controlling station with one or more S-frames	IEC 60870-5-104:2006, 5.3 IEC 60870-5-104:2006, 10	M
		The Controlling station also acknowledges all yet unacknowledged I-frames from the Controlled station with one or more S-frames within or according to time out t_2	IEC 60870-5-104:2006, 10	M
		The Controlled station finishes the pending STOPDT state for the Started connection by sending a STOPDT_CON to the Controlling station which transforms the previously Started connection to a Stopped connection	IEC 60870-5-104:2006, 10	M
		The Controlling station initiates the creation of a *new* Started connection by sending a STARTDT_ACT over the selected Stopped connection to the same Controlled station	IEC 60870-5-104:2006, 10	M

Table 13 *(3 of 3)*

No.	Test	Description	Reference	Required
		The Controlled station finishes the creation of the new Started connection by sending a STARTDT_CON over that same connection over which the STARTDT_ACT was received to the Controlling station	IEC 60870-5-104:2006, 10	M
		After establishing a new Started connection between Controlling and Controlled station, **no** M_EI (End of initialisation) is sent (nor needed) to the Controlling station. Normal operation continues	IEC 60870-5-104:2006, 10	M
		The send- and receive counters are not reset to "0" as long as the TCP connection is established. Each TCP connection, not affected by STARTDT and STOPDT procedures or switch-over procedures, maintains its send- and receive counter	IEC 60870-5-104:2006, 5.3 IEC 60870-5-104:2006, 10	M