

Smart Ticketing Alliance - Certification Working Group



STA Contactless Interface Certification for Public Transport Products Technical Guidelines



REVISION LIST

Version	Date	Modifications
V1.0	04/07/2106	First public version
V1.1	20/10/2016	Update following first round robin tests results
V1.2	14/06/2017	Version applicable for PCD and PICC testing according CEN/TS 16794:2015
V1.3	13/12/2017	Updated for PCDs which do not support transactions with more than one PICC in the Reader field
V1.4	05/07/2018	Updated after detection of some errors in Annex C and in G.3
V2.0	06/07/2018	Version applicable for PCD and PICC testing according to CEN/TS 16794:2017
V2.1	16/11/2018	Version applicable for PCD and PICC testing according to CEN/TS 16794:2017 Updated for PCD testing
V2.2	27/11/2020	Clarifications about PICC or PCD erratic behaviours in 3.2 Annex G updated for a test case
V2.3	23/11/2022	Clarifications about PICC re-certification process in case of "Type of card body structure Change"
V2.4	12/12/2023	Document updated to permit exceptionally the testing for PCD for which not all the Analog tests can be executed with the final hardware (at the end of 3.2)



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Acronyms

APDU	Application Protocol Data Unit
CB	Certification Body
CLF	Contactless Front-end
CWG	Certification Working Group
DUT	Device Under Test
ICS	Implementation Conformance Statement
PCD	Proximity Coupling Device
PICC	Proximity Integrated Circuit Card
RF	Radio Frequency
STA	Smart Ticketing Alliance
UICC	Universal Integrated Circuit Card

Terms and Definition

Certification Body: Third-party entity, member of the STA or sponsored by a STA member, in charge of the certification process as described in the ISO 17065:2012.

Implementation Conformance Statement: Document used for detailed identification of a product or system.

Mono component Product: single component device which encompasses both the contactless communication layers and the ticketing application in the same component.

Multi component Product: multiple component device having at least one component hosting the ticketing application and one component providing the contactless communication capabilities.

Product: Product, system or solution for which the certification of compliance with the Standard is requested.

Reference PICC: Reference PICC (test card) as defined in test method ISO/IEC 10373-6.

Test Commands: List of APDU commands and responses used for testing a PICC or a PCD.

Test Laboratory (or Test Lab): Entity performing the Evaluation of a Product.

Test Report: Result of the Product or system evaluation process performed by the Test Laboratory.

Test Results: Set of measurements produced by the Test Laboratory after Product testing.

Test Tools: Set of test apparatus and test circuits used for testing the contactless communication of Products.

Vendor: Provider of the Product which is candidate for certification.



1 Objectives of this Document

This document defines the technical guidelines for testing contactless communication between Public Transport readers and Public Transport objects hosting a transport ticketing application according to the Smart Ticketing Alliance (STA) certification process.

The present document applies to the **Evaluation / Test** step (referenced 3 in the following diagram) and performed by Test Laboratories.

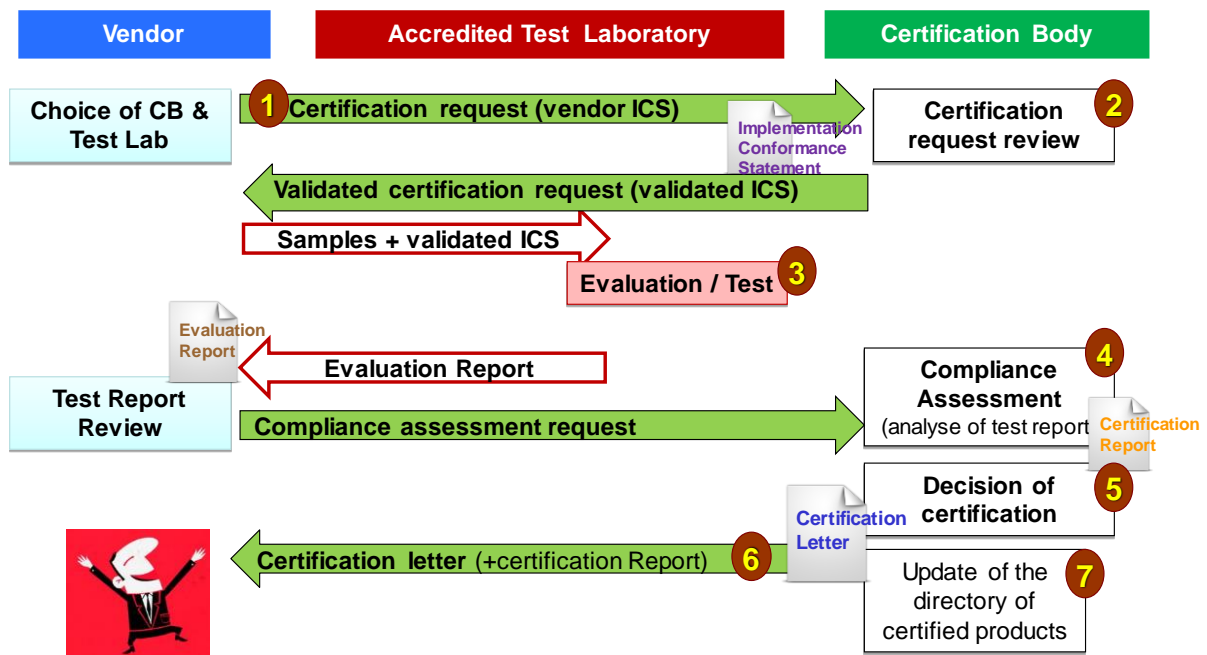


Figure 1 —Steps of a STA Certification Process



2 References

The following documents, in whole or in part, are 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 amendment) applies.

The STA documents are available in the STA repository (www.smart-ticketing.org).

[REF1] CEN/TS 16794-1:2017, “Public transport — Communication between contactless readers and fare media — Part 1: Implementation requirements”

[REF2] CEN/TS 16794-2:2017, “Public transport — Communication between contactless readers and fare media — Part 2: Test plan for ISO/IEC 14443”

[REF3] STA Contactless Interface Certification for Public Transport Products - Test Tools Validation Methodology v2.0

[REF4] STA Contactless Interface Certification for Public Transport Products - Implementation Conformance Statement (ICS) for PICC v2.1

[REF5] STA Contactless Interface Certification for Public Transport Products - Implementation Conformance Statement (ICS) for PCD v2.1

[REF6] GSMA - NFC Handset Requirements - Version 12.0 - 04 December 2017

[REF7] ISO/IEC 10373-6:2016, Identification cards — Test methods — Part 6: Proximity cards



3 General Description of the Evaluation/Test process

The present document aims at defining the technical inputs and outputs that shall be handled by the Test Laboratory for the Evaluation/Test process. It also specifies how the test parameters used for performing the tests are defined.

3.1 Receiving Samples and ICS

At the beginning of the Evaluation/Test step, the Test Laboratory chosen for performing Product testing shall receive from the Vendor the following items:

- identical samples of the Product to be tested,
- the Information Conformance Statement (ICS) form, which lists the characteristics of the Product to be tested and the test commands and sequence to be used to run the tests.

For PICC testing, the Vendor shall provide the Test Laboratory with 10 identical samples of the PICC under test.

For PCD testing, the Vendor shall provide the Test Laboratory with 1 sample of the PCD under test.

For PICC testing, the STA Implementation Conformance Statement for PICC [REF4] available for download from STA website shall be used.

For PCD testing, the STA Implementation Conformance Statement for PCD [REF5] available for download from STA website shall be used.

The ICS contents shall be validated by the Certification Body.

3.2 Performing the Evaluation/Test

For PICC testing, 9 identical samples shall be picked up by the Test Laboratory from the provided batch of samples:

- 6 identical samples shall be used for the Analog tests, which will be run:
 - on 3 samples for alternating magnetic test,
 - on 3 other samples for all other Analog tests.
- 3 identical samples shall be used for the Digital tests, which will be run:
 - on 3 samples for timing tests ([REF7], G.1.6.1),
 - on 1 sample for all other tests.

The test shall be performed on the samples in accordance with the Test Plan procedure specified in the CEN/TS 16794-2 test plan [REF2] and with the Corrigendum specified in Annex G of this document.

The Test Laboratory shall use Test Tools validated in a prior step in accordance with the process described in the STA Test Tools Validation Methodology [REF3].



The lists of tests to be performed - extracted from the CEN/TS 16794-2 test plan [REF2] - are described in the annexes:

- the list of Analog tests applicable for PCD Product under test is detailed in Annex C,
- the list of Analog tests applicable for PICC Product under test is detailed in Annex D,
- the list of Digital tests applicable for PCD Product under test is detailed in Annex E,
- the list of Digital tests applicable for PICC Product under test is detailed in Annex F.

Based on the characteristics defined in the ICS, the Test Laboratory shall determine which tests of the Test Plan described in the annexes are applicable.

The Analog tests shall be performed before the Digital tests on the Product under test.

Additionally, according to the form factor of the Product to be tested, different testing process may be undertaken:

a) Mono Component Product:

The Product is a single component device which encompasses both the contactless communication layers and the ticketing application in the same component. The Product is then tested as a whole.

Examples: all types of readers & smart cards with a contactless interface...

In this case, all the characteristics of the Products shall be indicated in the ICS by the Vendor.

The Test Laboratory shall run a test campaign with the DUT and execute the tests which are relevant according to the ICS information.

b) Multi Component Product:

The Product is a multi-component device requiring more than one component for correct operation:

- the DUT is the device containing the communication contactless layers,
- but the ticketing application is hosted in a separate component.

For these Products, some characteristics may be dependent on the component hosting the ticketing application.

Examples: UICC-based NFC handheld inspection terminals or USB tokens may have the ticketing application hosted on removable secure element, which is the UICC.

The present document addresses for the time being only the following cases for multi component Products:

- UICC-based NFC handheld terminals,
- UICC-based USB NFC Tokens.

Further configurations may be added in the future.



UICC-Based NFC Handheld Terminals/ UICC-Based USB NFC Tokens

For these Products, a set of 5 Reference UICC are provided to the Test Laboratory by the STA CWG for performing the testing. Each Reference UICC is configured with different characteristics to be able to test the Product in the widest possible situations. Their UICC characteristics (or UICC profiles) are defined in Annex A.

The Vendor shall only indicate in the ICS all the characteristics which are related to the Product and not dependent on the component hosting the application.

The Test Laboratory shall run one test campaign per DUT / Reference UICC combination and execute the tests which are relevant according to the ICS information. A separate Test Report will be produced for each DUT/ Reference UICC combination.

NOTE According to the supported types (A, B or A&B), the 5 Reference UICCs may not all necessarily be used for the test campaign.

Additionally, when the DUT is a battery powered PICC, some additional tests may be performed:

Battery Powered PICC:

Battery powered PICC will be tested in 2 modes:

- in nominal mode, **with** the battery fully charged;
- in "battery low" mode, as defined in the GSMA - NFC Handset Requirements [REF6].

The Test Laboratory shall run a test campaign with the DUT in nominal mode and execute all the applicable tests based on the ICS information.

An additional test campaign shall be executed with the Product in "battery low" mode if, and only if, the Vendor has provided the Test Laboratory with an environment allowing it to operate continuously with the DUT in "battery low" mode. For instance, this can be a battery providing a voltage corresponding to the "battery low" mode definition.

The list of tests to be performed in "battery low" mode is listed in Annex B.

If no battery low mode environment is provided by the Vendor, no test will be performed in "battery low" mode.

The lists of tests to be performed in nominal mode are listed in Annex D for PICC Analog tests and in Annex F for PICC Digital tests.

Tests on PCD need to be performed in final configuration, that is:

- whole test software installed,
- final hardware configuration: with cover, accessories, etc. which could have an impact on RF behaviour.

In case of a PCD for which not all the Analog tests can be executed (ex: casing volume not adapted to the climatic chamber, testing positions not accessible by the Reference PICC...) the ICS shall clearly



identify this limitation. The tests can be exceptionally performed on a modified hardware (i.e. different casing respecting 15 cm min around antenna). However, the PCD software version, reference of the contactless reader or antenna module, software version of the contactless reader or antenna module shall be tested as declared in the product description of the ICS. It shall be then clearly indicated in the certification letter what has been tested.

Test results shall be considered as FAIL if the PICC or PCD has an erratic behaviour*.

* No action external to the test procedure is allowed to help the PICC or PCD pass the test (for example a reset).

3.3 Producing the Test Report

The Test Report is provided by the Test Laboratory and shall be made up of:

- A header section including:
 - Identification of the Test Laboratory
 - Version number
 - Signature
 - Reference of the ICS
 - ICS data sheet
 - Reference of the form request
 - Reference of used Test Tool
 - Start and end dates of test execution
- Test Results based on the following Test Result templates:
 - for PICC product, templates provided in Annex D of the present document for Analog test results and in Annex F for Protocol and Digital test results,
 - for PCD product, templates provided in Annex C of the present document for Analog test results and in Annex E for Protocol and Digital test results.
- Any measurement files, logs, curves that may be requested or helpful to understand the Test Results.

The Test Results shall indicate the status of each compulsory test in the appropriate column:

- N/A: when the test is not applicable due to the Product characteristics indicated in the ICS,
- PASS: only when all steps of the test procedure succeeded,
- FAIL: when at least one of the steps of the test procedure failed,
- INCONCLUSIVE: when the lab was not able to conclude on the Test Result or to execute the test.

For each FAIL test, the Test Laboratory shall precisely describe the observed behaviour versus the expected behaviour.



For each INCONCLUSIVE or N/A test, the Test Laboratory shall explain why the test is INCONCLUSIVE or N/A.

When the measurement is out of the limit, but within the tolerance margin – as defined in section 5.5 of the CEN/TS 16794-2 test plan [REF2], or in Annex D of the STA Test Tools Validation Methodology [REF3], – the Test Result shall be stated as INCONCLUSIVE.

For informative tests, the status shall be INCONCLUSIVE and the Test Results are logged in a separate section of the Test Report.

When tests are performed on 3 samples, the Test Results shall follow the following rules:

- the Test result shall be FAIL, if the test result is FAIL for any one of the 3 samples,
- the Test result shall be PASS, if the test result is PASS for all 3 samples,
- measurements, when required by the test method, shall be provided on CB demand for each sample.

For Product acting both as a PICC and a PCD, the Test Results shall be provided for each mode.

For a multi component Product, a Test Report shall be provided for each test campaign performed with a Reference UICC.

For a battery powered PICC, the Test Results shall be provided for both nominal and “battery low” modes.



4 Process for Product Re-Certification

The following sections apply in case of product change and/or certification upgrade.

Section 4.1 applies when the initial and new certifications are performed according to the same version of the STA certification process.

Section 4.2 applies when the initial and new certifications are performed on the same Product samples.

When product change and certification upgrade occur, the applicable tests from both sections shall be performed.

4.1 Re-Certification Following a Product Change

Changes applied to an already certified Product will require part or full execution of the test campaign to grant a certification for the changed Product.

Depending on the change impacts, a subset of the tests shall be executed.

a) Mono Component Product:

Type of change	Required tests
PICC - Antenna Change	PICC Analog Test Plan in Annex D
PICC - Chip Change	PICC Analog Test Plan in Annex D PICC Digital and Protocol Test Plan in Annex F
PICC - Application Change	None
PICC - Type of card body structure Change	PICC Analog Test Plan in Annex D
PICC - Production site Change	PICC Analog Test Plan in Annex D
PCD - Antenna Change	PCD Analog Test Plan in Annex C
PCD - Casing Change	PCD Analog Test Plan in Annex C
PCD - Firmware Change	PCD Analog Test Plan in Annex C PCD Digital and Protocol Test Plan in Annex E
PCD - Polling sequence Change	PCD Digital and Protocol Test Plan in Annex E
PCD - Application Change	None
PCD - Production site Change	PCD Analog Test Plan in Annex C



b) Multi Component Product: UICC-Based NFC Handheld Terminals

Type of change	Required tests
Antenna Change	PCD Analog Test Plan in Annex C PICC Analog Test Plan in Annex D
Application Change	None
Operating System Change	None if no impact on NFC interface PCD Analog Test Plan in Annex C PICC Analog Test Plan in Annex D
NFC Controller firmware Change	PCD Digital and Protocol Test Plan in Annex E PICC Digital and Protocol Test Plan in Annex F
CLF Driver Software Change	PCD Digital and Protocol Test Plan in Annex E PICC Digital and Protocol Test Plan in Annex F
Production site Change	PCD Analog Test Plan in Annex C PICC Analog Test Plan in Annex D

c) Multi Component Product: UICC-Based USB NFC Tokens

Type of change	Required tests
Antenna Change	PCD Analog Test Plan in Annex C PICC Analog Test Plan in Annex D
Application Change	None
Operating System Change	None if no impact on NFC interface PCD Analog Test Plan Annex C PICC Analog Test Plan in Annex D
NFC Controller firmware Change	PCD Digital and Protocol Test Plan in Annex E PICC Digital and Protocol Test Plan in Annex F
Production site Change	PCD Analog Test Plan in Annex C PICC Analog Test Plan in Annex D

For any other change not listed in the table above, a complete test campaign shall be executed for granting certification for the changed Product.

4.2 Certification Upgrade

To upgrade a Product certification based on CEN/TS 16794:2015 to a certification based on CEN/TS 16794:2017 with no Product change, the following tests shall be carried out.

Test	Details
TC_PCD_A_ALF	Alternating magnetic field (Analog PCD test). Motivation: new test from edition 2
TC_PCD_D_TAMF	ATQA sent after modulated field (Digital PCD test). Motivation: new test from edition 2
TC_PCD_D_TBMF	ATQB sent after modulated field (Digital PCD test). Motivation: new test from edition 2
TC_PICC_A_OFS	Operating field strength (Analog PICC test) Motivation: test performed at minimum and maximum temperatures



TC_PICC_A_LDE	PICC maximum loading effect (Analog PICC test) Motivation: introduction of $V_{load} = 4,5 \text{ V}$
TC_PICC_A_ALF	Alternating magnetic field (Analog PICC test) Motivation: new test from edition 2

In addition, when the Product has been certified based on CEN/TS 16794:2015 for Temperature Class B or Class C, the Analog tests performed at Minimum or Maximum temperatures, defined in Annex C for PCD and in Annex D for PICC, shall be performed. The following table lists which test temperatures shall be used according to the Product type and Temperature Classes:

Product Type	Temperature Class (STA Edition 1)	Temperature Class (STA Edition 2)	Analog tests performed at Minimum or Maximum temperatures
PCD	Class B (-10 °C to + 50 °C)	Class D (-25 °C to + 55 °C)	Minimum (-25 °C) Maximum (+55 °C)
PCD	Class C (-20 °C to + 70 °C)	Class D (-25 °C to + 55 °C)	Minimum (-25 °C)
PICC	Class B (-10 °C to + 50 °C)	Class I (-10 °C to + 50 °C)	N/A
PICC	Class C (-20 °C to + 70 °C)	Class I (-10 °C to + 50 °C)	N/A



Annex A UICC Profiles for Multi Component PICC Test

This annex lists the UICC profiles to be used for performing tests on multi-component PICC UICC-based products. Five UICC profiles have been defined: 2 for Type A, 2 for Type B and 1 for Type A and Type B. Each Product shall be tested with the UICCs corresponding to the protocol(s) supported, and described in its ICS [PICC3.1] box.

For optimisation, it is not necessary to perform a full set of tests for each profile, as described in the following paragraphs.

A.1 UICC Profiles Type A

There are 2 profiles to be tested, as described in the following table. Protocol tests shall be performed on both profiles and RF tests on Profile 2 only.

Type A	ICS section	Profile 1	Profile 2
UID	[PICC4.4]	Random	Fixed - double size
SAK	N/A	FBh	20h
ATQA	N/A	100Ch	4400h
FWI	[PICC4.6]	0	7
SFGI	[PICC4.7]	0	8
CID	[PICC4.9]	No	Yes
Maximum bit rate in both directions	[PICC4.1] [PICC4.2]	<i>fc</i> /128 (~106 kbit/s)	<i>fc</i> /16 (~848 kbit/s)

NOTE Profile 1 is EMV compatible.

A.2 UICC Profiles Type B

There are 2 profiles to be tested. Protocol tests shall be performed on both profiles and RF tests on Profile 4 only.

Type B	ICS section	Profile 3	Profile 4
PUPI	[PICC5.4]	Random	Fixed
AFI	[PICC5.11]	00h	00h
FWI	[PICC5.5]	0	7
SFGI	[PICC5.9]	0	8
CID	[PICC5.7]	No	Yes
Maximum bit rate in both directions	[PICC5.1] [PICC5.2]	<i>fc</i> /128 (~106 kbit/s)	<i>fc</i> /16 (~848 kbit/s)

NOTE Profile 3 is EMV compatible.



A.3 UICC Profile Type A and Type B

There is only one profile to be tested. Protocol tests shall be performed on this profile, but no RF tests.

Type A and Type B	ICS section	Profile 5
UID	[PICC4.4]	Random
SAK	N/A	20h
ATQA	N/A	0400h
FWI	[PICC4.6]	7
SFGI	[PICC4.7]	8
CID	[PICC4.9]	Yes
Maximum bit rate in both directions	[PICC4.1] [PICC4.2]	$f_c/16$ (~848 kbit/s)
PUPI	[PICC5.4]	Random
AFI	[PICC5.11]	00h
FWI	[PICC5.5]	7
SFGI	[PICC5.9]	8
CID	[PICC5.7]	Yes
Maximum bit rate in both directions	[PICC5.1] [PICC5.2]	$f_c/16$ (~848 kbit/s)

NOTE Profile 5 is not EMV compatible.



Annex B List of Tests Applicable for PICC in “Battery Low Mode”

B.1 PICC Analog Test Results (detailed)

All the tests described in Annex D and performed at ambient temperature shall be passed.

B.2 PICC Digital and Protocol Test Results (detailed)

All the tests described in Annex F shall be passed.



Annex C List of Analog Tests Applicable for PCD Product

Test reference	Test title	Test Conditions						Test result	Comments
		PCD→PICC bit rate	PICC→PCD bit rate	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement positions		
TC_PCD_A_MaxFS	Maximum PCD field strength (ISO/IEC 10373-6:2016, 7.1.1.2)	N/A	N/A	19 MHz	Ambient	1	Range A		
						2	Range A		
						3	Range A		
Range B									
TC_PCD_A_MinFS	Minimum PCD field strength (ISO/IEC 10373-6:2016, 7.1.1.2)	N/A	N/A	13,56 MHz	Ambient	1	Range A		
						2	Range A		
						3	Range A		
Range B									
TC_PCD_A_ALF ¹	PCD alternating magnetic field (ISO/IEC 10373-6:2016, 6.1.1)	N/A	N/A	19 MHz	Ambient	1	Any possible PICC position		

¹ Corrected values from CEN/TS 16794



Test reference	Test title	Test Conditions						Test result	Comments
		PCD→PICC bit rate	PICC→PCD bit rate	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement positions		
TC_PCD_A_TAMW	Type A modulation waveform (ISO/IEC 10373-6:2016, 7.1.4.2)	All supported PCD→PICC bit rates	N/A	16,5 MHz	Ambient	1	Position A1		
						2	Position A1		
						3	Position B1		
						Cal. Coil	Arbitrary position		
TC_PCD_A_TBMW	Type B modulation waveform (ISO/IEC 10373-6:2016, 7.1.4.2)	All supported PCD→PICC bit rates	N/A	16,5 MHz	Ambient	1	Position A1		
						2	Position A1		
						3	Position B1		
						Cal. Coil	Arbitrary position		



Test reference	Test title	Test Conditions						Test result	Comments
		PCD→PICC bit rate	PICC→PCD bit rate	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement positions		
TC_PCD_A_TALMR	Type A load modulation reception (ISO/IEC 10373-6:2016, 7.1.5.2)	One supported PCD→PICC bit rate	All supported PICC→PCD bit rates, except bit rates of $f_c/64$ (~212 kbit/s), $f_c/32$ (~424 kbit/s) and $f_c/16$ (~848 kbit/s)	13,56 MHz	Ambient	1	Range A		
						2	Range A		
						3	Range A		
					Range B				
					Minimum	1	Position A2		
						3	Position B2		
				Maximum	1	Position A2			
					3	Position B2			
				15 MHz	Ambient	1	Range A		
						2	Range A		
						3	Range A		
					Range B				
Minimum	1	Position A2							
	3	Position B2							
Maximum	1	Position A2							
	3	Position B2							
TC_PCD_A_TBLMR	Type B load modulation reception (ISO/IEC 10373-6:2016, 7.1.5.2)	One supported PCD→PICC bit rate	13,56 MHz	Ambient	1	Range A			
					2	Range A			
					3	Range A			
				Range B					
				Minimum	1	Position A2			
					3	Position B2			
Maximum	1	Position A2							



Test reference	Test title	Test Conditions						Test result	Comments
		PCD→PICC bit rate	PICC→PCD bit rate	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement positions		
			All supported PICC→PCD bit rates, except bit rates of $f_c/64$ (~212 kbit/s), $f_c/32$ (~424 kbit/s) and $f_c/16$ (~848 kbit/s)	15 MHz	Ambient	3	Position B2		
						1	Range A		
						2	Range A		
						3	Range A		
							Range B		
						1	Position A2		
							3	Position B2	
						1	Position A2		
							3	Position B2	
TC_PCD_A_TAEI	Type A EMD immunity (ISO/IEC 10373-6:2016, 7.1.6.2)	One supported PCD→PICC bit rate	$f_c/128$ (~106 kbit/s)	13,56 MHz	Ambient	1	Position A1		
							Position A2		
TC_PCD_A_TBEI	Type B EMD immunity (ISO/IEC 10373-6:2016, 7.1.6.2)	One supported PCD→PICC bit rate	$f_c/128$ (~106 kbit/s)	13,56 MHz	Ambient	1	Position A1		
							Position A2		
TC_PCD_A_TAER	Type A EMD handling timing constraints (ISO/IEC 10373-6:2016, 7.1.7.2)	One supported PCD→PICC bit rate	$f_c/128$ (~106 kbit/s)	13,56 MHz	Ambient	1	Position A2		
TC_PCD_A_TBER	Type B EMD handling timing constraints (ISO/IEC 10373-6:2016, 7.1.7.2)	One supported PCD→PICC bit rate	$f_c/128$ (~106 kbit/s)	13,56 MHz	Ambient	1	Position A2		



Annex D List of Analog Tests Applicable for a PICC Product

Test reference	Test title	Test Conditions					Test result	Comments
		PCD→PICC bit rate	PICC→PCD bit rate	Temperature	Field strength	Waveform conditions		
TC_PICC_A_OFS	PICC operating field strength	All supported PCD→PICC bit rates	One supported PICC→PCD bit rate	Ambient	$H = H_{min}$	see [REF2], 7.2.1.2.2		
					$H = 2,0 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 2,5 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 3,5 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 4,5 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 6,0 \text{ A/m}$	see [REF2], 7.2.1.2.2		
				Minimum	$H = H_{min}$	see [REF2], 7.2.1.2.2		
					$H = H_{max}$	see [REF2], 7.2.1.2.2		
				Maximum	$H = H_{min}$	see [REF2], 7.2.1.2.2		
					$H = H_{max}$	see [REF2], 7.2.1.2.2		



Test reference	Test title	Test Conditions					Test result	Comments
		PCD→PICC bit rate	PICC→PCD bit rate	Temperature	Field strength	Waveform conditions		
TC_PICC_A_LMA	PICC transmission	One supported PCD→PICC bit rate	All supported PICC→PCD bit rates, except bit rates of $f_c/64$ (~212 kbit/s), $f_c/32$ (~424 kbit/s) and $f_c/16$ (~848 kbit/s)	Ambient	$H = H_{min}$	see [REF2], 7.2.1.2.2		
					$H = 2,0 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 2,5 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 3,5 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 4,5 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 6,0 \text{ A/m}$	see [REF2], 7.2.1.2.2		
				Minimum	$H = H_{min}$	see [REF2], 7.2.1.2.2		
					$H = H_{max}$	see [REF2], 7.2.1.2.2		
				Maximum	$H = H_{min}$	see [REF2], 7.2.1.2.2		
					$H = H_{max}$	see [REF2], 7.2.1.2.2		
TC_PICC_A_RCPT	PICC reception	All supported PCD→PICC bit rates	One supported PICC→PCD bit rate	Ambient	$H = H_{min}$	see [REF2], 7.2.3.2.2		
					$H = 2,0 \text{ A/m}$	see [REF2], 7.2.3.2.2		
					$H = 2,5 \text{ A/m}$	see [REF2], 7.2.3.2.2		
					$H = 3,5 \text{ A/m}$	see [REF2], 7.2.3.2.2		
					$H = 4,5 \text{ A/m}$	see [REF2], 7.2.3.2.2		
					$H = 6,0 \text{ A/m}$	see [REF2], 7.2.3.2.2		
					$H = H_{max}$	see [REF2], 7.2.3.2.2		



Test reference	Test title	Test Conditions					Test result	Comments
		PCD→PICC bit rate	PICC→PCD bit rate	Temperature	Field strength	Waveform conditions		
TC_PICC_A_LDE	PICC loading effect	N/A	N/A	Ambient	see 7.2.5.2	N/A		
TC_PICC_A_EMD	PICC EMD level and low EMD time	$f_c/128$ (~106 kbit/s)	$f_c/128$ (~106 kbit/s)	Ambient	$H = H_{min}$	see [REF2], 7.2.1.2.2		
					$H = 2,0 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 2,5 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 3,5 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 4,5 \text{ A/m}$	see [REF2], 7.2.1.2.2		
					$H = 6,0 \text{ A/m}$	see [REF2], 7.2.1.2.2		
TC_PICC_A_ALF	PICC alternating magnetic field	N/A	N/A	Ambient	$H = \frac{4}{3} H_{max}$	N/A		



Annex E List of Digital Tests Applicable for a PCD Product

Test reference	Test title	Test result (PASS, FAIL or N/A)	Comments when FAIL or N/A
[REF7], H.2.1	Frame delay time PICC to PCD		
[REF7], H.2.2	Request Guard Time		
[REF7], H.2.3	Handling of bit collision during ATQA		
[REF7], H.2.4	Handling of anticollision loop		
[REF7], H.2.5	Handling of RATS and ATS		
[REF7], H.2.7	Frame size selection mechanism		
[REF7], H.2.8	Handling of Start-up Frame Guard Time		
[REF7], H.2.9	Handling of the CID during activation by the PCD		
[REF7], H.3.1	I/O transmission timing		
[REF7], H.3.2	Frame size selection mechanism		
[REF7], H.3.3	Handling of the CID during activation by the PCD		
[REF7], H.4.1	Handling of the polling loop		
[REF7], H.4.2	Reaction of the PCD to request for waiting time extension		
[REF7], H.4.3	Error detection and recovery		
[REF7], H.4.4	Handling of NAD during chaining		
[REF7], H.5	Continuous monitoring of packets sent by the PCD		
[REF7], I.2.1	Bit rate selection, Type A		
[REF7], I.2.2	Bit rate selection, Type B		
[REF7], I.2.3	Bit rate selection using S(PARAMETERS) blocks		
[REF2], TC_PCD_D_TADT	PCD Type A detection time		



Test reference	Test title	Test result (PASS, FAIL or N/A)	Comments when FAIL or N/A
[REF2], TC_PCD_D_TBBDT	PCD Type B detection time		
[REF2], TC_PCD_D_AFI	AFI value sent by the PCD		
[REF2], TC_PCD_D_ATQB	PCD extended ATQB option		
[REF2], TC_PCD_D_RFU	Recommendations on RFU bits and values reception test		
[REF2], TC_PCD_D_PRO	Proprietary protocols management by the PCD		
[REF2], TC_PCD_D_TAMF	Correct detection of a Type A PICC after having previously received modulated field.		
[REF2], TC_PCD_D_TBMF	Correct detection of a Type B PICC after having previously received modulated field.		



Annex F List of Digital Tests Applicable for a PICC Product

Test reference	Test title	Test result	Comments
[REF7], G.3.2	Polling		
[REF7], G.3.3	Testing of the PICC Type A state transitions		
[REF7], G.3.4	Handling of Type A anticollision		
[REF7], G.3.6	Handling of PPS request		
[REF7], G.3.7	Handling of FSD		
[REF7], G.4.2	Polling		
[REF7], G.4.3	PICC Reception		
[REF7], G.4.4	Testing of the PICC Type B state transitions		
[REF7], G.4.5	Handling of Type B anticollision		
[REF7], G.4.6	Handling of ATTRIB		
[REF7], G.4.7	Handling of Maximum Frame Size		
[REF7], G.5.2	PICC reaction to ISO/IEC 14443-4 Scenarios		
[REF7], G.5.3	Handling of PICC error detection		
[REF7], G.5.4	PICC reaction on CID		
[REF7], G.5.5	PICC reaction on NAD		
[REF7], G.5.6	PICC reaction on S(PARAMETERS) blocks		
[REF7], G.5.7	PICC supporting Type A and Type B		
[REF7], G.1.5.1	RFU values		
[REF7], G.1.6.1	Timing measurements		
[REF2], TC_PICC_D_ATQB	PICC support of REQB/WUPB allowing extended ATQB		
[REF2], TC_PICC_D_RFU	Recommendations on RFU bits and values reception test		



Test reference	Test title	Test result	Comments
[REF2], TC_PICC_D_RAMP	Field ramp-ups and shut-offs		



Annex G Corrigendum to the CEN/TS 16794-2:2017 Test Plan

G.1 Test Cases TC_PCD_A_TAMW and TC_PCD_A_TBMW

The following absolute tolerances shall be used when verifying the DUT modulation waveform:

- for timings ($t_1, t_2, t_3, t_5, t_6, t_r, t_f$):
 - $1/f_c$ for a bit rate of $fc/128$
 - $0,5/f_c$ for a bit rate of $fc/64$
 - $0,3/f_c$ for bit rates higher than $fc/64$
- for envelope overshoot, Type A: $0,01 \times (1-a)$
- for envelope overshoot and undershoot, Type B: $0,01 \times (1-b)$
- for the modulation index m : 0,5 %
- for the pulse shape factor a : 0,02

G.2 Test Case ISO/IEC 10373-6:2016, H.2.5.2 Procedure 4

Add the following subclause H.2.5.2.4 after H.2.5.2.3:

H.2.5.2.4 Procedure 4 (proprietary and don't care bits)

Use the following sequence:

- a) The UT performs the activation procedure according to H.1.8.1.
- b) The LT waits until the PCD sends a valid REQA/WUPA command frame.
- c) The LT answers with ATQA indicating bit frame anticollision and UID size: single (bits b8 and b7 equal (00)b) and proprietary bits b12 to b9 set to (0000)b.
- d) The PCD shall send ANTICOLLISION command '93 20' (cascade level 1).
- e) The LT answers with UID CL1 (uid0 uid1 uid2 uid3 BCC).
- f) The PCD shall send SELECT command '93 70' uid0 uid1 uid2 uid3 BCC CRC_A.
- g) The LT answers with SAK (b3 = (0)b, b6 = (1)b, all other bits are set to (0)b).
- h) The PCD shall send a valid RATS command frame.
- i) Repeat the procedure using SAK (b3 = (0)b, b6 = (1)b, all other bits are set to (1)b) at step g) and using ATQA with proprietary bits b12 to b9 set to (1111)b at step a).



Scenario H.30 — Handling of RATS and ATS, Procedure 4

PCD		LT
REQA/WUPA	→	
	←	ATQA (single size UID, proprietary bits b12 to b9 set to (0)b) or ATQA (single size UID, proprietary bits b12 to b9 set to (1)b) ^a
ANTICOLLISION command Level 1 ('93 20')	→	
	←	UID CL1 (uid0 uid1 uid2 uid3 BCC)
SELECT command ('93 70' uid0 uid1 uid2 uid3 BCC CRC_A)	→	
	←	SAK(b3 = (0)b, b6 = (1)b, all other bits are set to (0)b) or SAK(b3 = (0)b, b6 = (1)b, all other bits are set to (1)b) ^a
RATS command frame (e.g. 'E0 01' CRC_A) ^b	→	
^a		Determined in step i).
^b		The PCD may send "proprietary" commands before sending RATS.

G.3 Test Cases ISO/IEC 10373-6:2016, H.2.7.1 and H.3.2.1

UT_TEST_COMMAND2 size shall not exceed the PCD internal output buffer size.

Answer to UT_TEST_COMMAND2 size shall not exceed the PCD internal input buffer size.

G.3.1 Test case H.2.7.1

This test shall be executed only for FSC values strictly less than the PCD internal buffer size and at least for FSCI set to '0' and to the coding of the largest FSC value that is strictly less than the PCD internal buffer size.

G.3.2 Test case H.3.2.1

This test shall be executed only for Maximum Frame Size values strictly less than the PCD internal buffer size and at least for Maximum Frame Size Code in ATQB set to '0' and to the coding of the Maximum Frame Size value that is strictly less than the PCD internal buffer size.

G.4 Test Case ISO/IEC 10373-6:2016, H.3.1

In step c), if an Extra Guard Time (EGT) between last character and EOF is detected, the result shall be considered as INCONCLUSIVE (if EGTs between other characters are within the limits).



G.5 Test Case ISO/IEC 10373-6:2016, H.4.3.2.8

Apply scenario H.25 with at least the combinations 1 and 9 of table H.14.

G.6 Test Case ISO/IEC 10373-6:2016, H.4.3.2.10 Procedure 10 (with chaining)

The clause ISO/IEC 10373-6:2016, H.4.3.2.10 is not correct. The Procedure described in the text differs from Scenario H.27.

The correct test to apply shall follow the table for Scenario H.27.

The textual procedure defined in steps a) to l) shall be ignored.

G.7 PICC Analog Tests Performed at Minimum and Maximum Temperatures

The operational temperature ranges for PICC defined in the STA certification process are different from the ones defined in CEN/TS 16794-1:2017 requirements [REF1].

Operational temperature ranges for PICC in CEN/TS 16794:2017	Operational temperature ranges for PICC in STA ICS Edition 2
Class A (Ambient)	Class A (Ambient)
Class B (-25 °C to + 55 °C)	Class I (-10 °C to + 50 °C)

As a consequence:

- The PICC Analog tests at Minimum temperature shall be performed at -10 °C,
- The PICC Analog tests at Maximum temperature shall be performed at + 50 °C.

G.8 Transactions with only one PICC in the Field

The Vendor shall indicate in the STA Implementation Conformance Statement [REF5] if the PCD supports a transaction with more than one PICC in the field, in the following ICS section:

[PCD2.2] Transaction supported when more than one PICC in the field: Yes No

When the support is set to Yes, no change is made to the current test plan.

When the support is set to No, in ISO/IEC 10373-6:2016, the following changes apply:

- H.2.3 Handling of bit collision during ATQA test shall be flagged as N/A in the test report,
- H.2.4.2.4 (Procedure 4) in H.2.4 Handling of anticollision loop test shall be flagged as N/A in the test report,
- all procedures having only steps referring to S(DESELECT) shall be deleted,
- all optional steps referring to S(DESELECT) shall be deleted.

The deletion of procedures and steps referring to S(DESELECT) implies at least the following changes:

- The following ISO/IEC 10373-6:2016 tests shall be flagged as N/A in the test report:



- H.4.3.2.4 (Procedure 4) in H.4.3 Error detection and recovery test,
- H.4.3.2.12 (Procedure 12) in H.4.3 Error detection and recovery test.
- In ISO/IEC 10373-6:2016, the following changes shall be made and the updated scenarios shall be performed successfully:
 - In H.4.3.2.2, delete steps e) and f) and update Scenario H.19 accordingly,
 - In H.4.3.2.3, delete the last two lines of Scenario H.20,
 - In H.4.3.2.6, delete steps e) and f) and update Scenario H.23 accordingly,
 - In I.2.1, update steps h) and i) to allow a field reset instead of an S(DESELECT) and update Scenario I.1 accordingly,
 - In I.2.2, update steps g) and h) to allow a field reset instead of an S(DESELECT) and update Scenario I.2 accordingly,
 - In I.2.3, update steps h) and i) to allow a field reset instead of an S(DESELECT) and update Scenario I.3 accordingly,
 - In L.1.1.3, update steps h) and i) to allow a field reset instead of an S(DESELECT) and update Scenario L.1 accordingly.

G.9 Climatic Chamber Conditions

G.9.1 General Conditions

For PCD and PICC testing, the DUT shall be located in an area without additional material disturbing the magnetic field. To confirm that there is no influence, one of following verifications shall be performed:

- The DUT and the test environment shall be more than 15 cm from any conductive material.
- For PCD testing:
 - First, TC_PCD_A_TALMR (or TC_PCD_A_TBLMR) test shall be performed at ambient temperature with the PCD under test placed outside the climatic chamber. Then, the test shall be performed with the PCD under test placed inside the climatic chamber at the same temperature and at least 90% of LMA measurements shall deviate by less than +2 mV or -2mV from the results obtained outside the climatic chamber.
- For PICC testing:
 - First, TC_PICC_A_LMA test shall be performed at ambient temperature with the PICC under test placed outside the climatic chamber. Then, the test shall be performed with the PICC under test placed inside the climatic chamber at the same temperature and LMA measurements shall not deviate from more than +5% or -5% from the results obtained outside the climatic chamber.

G.9.2 PCD Analog Tests

The PCD Analog tests shall be performed at Minimum and Maximum temperatures with the following test conditions:

- The PCD under test shall be placed inside the climatic chamber.
- The Test PCD assembly shall be placed outside the climatic chamber.



- The Reference PICC shall be alternately placed in the DUT position of the PCD under test into the climatic chamber and placed in the DUT position of the Test PCD assembly outside the climatic chamber.

G.9.3 PICC Analog Tests

As a temporary waiver to the General test conditions defined in §7.2.2.2.1 of CEN/TS 16794-2:2017, the test TC_PICC_A_LMA may be performed in a ventilated climatic chamber.

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