



BSI Standards Publication

Public transport - Communication between contactless readers and fare media

Part 2: Test plan for ISO/IEC 14443

National foreword

This Published Document is the UK implementation of CEN/TS 16794-2:2017. It supersedes PD CEN/TS 16794-2:2015, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/278, Intelligent transport systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

**Public transport - Communication between contactless
readers and fare media - Part 2: Test plan for ISO/IEC
14443**

Transport Public - Communication entre terminaux et
objets sans contact - Partie 2 : Plan de test pour
l'ISO/IEC 14443

Öffentlicher Verkehr - Kommunikation zwischen
berührungslosen Lesegeräten und Fahrscheinmedien -
Teil 2: Prüfplan zur ISO/IEC 14443

This Technical Specification (CEN/TS) was approved by CEN on 17 April 2017 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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European foreword

This document (CEN/TS 16794-2:2017) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document will supersede CEN/TS 16794-2:2015.

This version updates the test plan to verify the requirements expressed within CEN/TS 16794-1:2017 and relies on the test method described in ISO/IEC 10373-6:2016.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This Technical Specification comes as a complement to the technical requirements expressed in CEN/TS 16794-1, for ensuring contactless communication interoperability between Public Transport (PT) devices or between PT devices compliant to CEN/TS 16794-1 and NFC mobiles devices compliant to NFC Forum specifications.

This document lists all the test conditions to be performed on a PT reader or a PT object in order to ensure that all the requirements specified in CEN/TS 16794-1 are met for the PT device under test.

This document applies to PT devices only:

- PT readers which are contactless fare management system terminals acting as a PCD contactless reader based on ISO/IEC 14443 standard series;
- PT objects which are contactless fare media acting as a PICC contactless object based on ISO/IEC 14443 standard series.

This document applies solely to the contactless communication layers described in parts 1 to 4 of the ISO/IEC 14443 standard series. Application-to-application exchanges executed once contactless communication has been established at RF level fall outside the scope of this document. However, a transport ticketing application will need to be used so as to make end-to-end transactions during tests on the RF communication layer.

This document does not duplicate the contents of ISO/IEC 14443 standard series or ISO/IEC 10373-6 standard. It makes reference to the ISO/IEC 10373-6 applicable test methods, specifies the test conditions to be used and describes the additional specific test conditions that may be run.

The list of test conditions applicable to the PT device under test will be conditioned by the Information Conformance Statement (ICS) declaration made by the device manufacturer. For each test case, the test conditions are clearly specified in order to determine the pertinence to run or not the test case in accordance with the device capabilities or in accordance with the device manufacturer's choice.

In order to facilitate the test report issuance, a test report template is included in Annex A of this document.

Although this document aims at becoming the primary basis for certification of contactless communication protocol applicable to PT readers and PT objects, it does not describe any certification or qualification processes as such processes should be defined between local or global transit industry stakeholders.

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.

CEN/TS 16794-1:2017, *Public transport — Communication between contactless readers and fare media — Part 1: Implementation requirements for ISO/IEC 14443*

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

ISO/IEC 14443-1:2016, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 1: Physical characteristics*

ISO/IEC 14443-2:2016, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 2: Radio frequency power and signal interface*

ISO/IEC 14443-3:2016, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 3: Initialization and anticollision*

ISO/IEC 14443-4:2016, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 4: Transmission protocol*

ISO/IEC 15693-2, *Identification cards — Contactless integrated circuit cards — Vicinity cards — Part 2: Air interface and initialization*

ISO/IEC 18092, *Information technology — Telecommunications and information exchange between systems — Near Field Communication — Interface and Protocol (NFCIP-1)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

PT device

PT reader or PT object

3.2

PT object

ISO/IEC 14443 PICC specifically designed for the use in PT systems

3.3

PT reader

ISO/IEC 14443 PCD specifically designed for the use in PT systems

3.4

Reference PICC

Reference PICC card as defined in test method ISO/IEC 10373-6:2016

4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in CEN/TS 16794-1, ISO/IEC 14443, ISO/IEC 10373-6 and the following apply.

t_{detect} Maximum Reference PICC time-to-detection

5 Description of the test environment

5.1 Test bench

The test bench shall conform to the specifications set out in ISO/IEC 10373-6:2016, Clause 5.

5.2 Tolerances applicable to ambient-environment tests

Parameter	Unit	Absolute tolerance
Temperature	Degrees Celsius (°C)	± 3 °C
Relative humidity	Percentage (%)	± 5 %

5.3 PCD or PICC test conditions

Parameter	Unit	Value
Temperature	Degrees Celsius (°C)	Minimum Temperature, Ambient Temperature and Maximum Temperature

5.4 Positional tolerance

Parameter	Unit	Tolerance
PICC-to-PCD distance	Millimetres (mm)	± 1 mm, except at 0

5.5 Admissible tolerances on the measurements

Tolerances specified in ISO/IEC 10373-6:2016 shall be applied.

6 PCD – Analog test plan

6.1 PCD general test conditions

Unless otherwise specified, each test shall be executed:

- with Reference PICCs 1, 2 and 3 at every position of range A (positions A1 to A5),
- with Reference PICC 3 at every position of range B (positions B1 to B3),

which makes a total of 18 test conditions.

For Common Readers (see CEN/TS 16794-1), the range A is limited to positions A1 to A2 and the range B is limited to positions B1 to B2. Consequently, for common readers, tests specified in several positions of range A and of range B shall be done only in positions A1, A2, B1 and B2.

As specified in CEN/TS 16794-1:2017, 9.2.3.3, if the measurements cannot be taken from position A1 then the measurements shall be taken from position A1' where the Reference PICC is in contact with the PCD device under test.

As specified in CEN/TS 16794-1:2017, 9.2.3.5, if the measurements cannot be taken from position B1 then the measurements shall be taken from position B1' where the Reference PICC is in contact with the PCD device under test.

6.2 Conformance of the PCD field strength

6.2.1 General

The maximum and minimum PCD field strength tests shall be done during an interval of time when the PCD produces a field. One possibility is to use an oscilloscope and measure the field strength during the interval of time preceding a request or wake-up command. Another possibility is to activate the "continuous unmodulated field" functionality of the PCD test mode, and to use a voltmeter.

6.2.2 TC_PCD_A_MaxFS: PCD maximum field strength

6.2.2.1 Scope / purpose

This test verifies the maximum magnetic field strength in the PCD operating volume (range A and range B).

6.2.2.2 Test conditions

At ambient temperature, Reference PICCs 1, 2 and 3 within range A and Reference PICC 3 within range B.

6.2.2.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 7.1.1.2.1 by moving the Reference PICCs in all the positions of the PCD operating volume defined in 6.2.2.2.

6.2.2.4 Test report

The test report shall give the maximum DC voltage measured at CON3 under the conditions applied.

Fill the TC_PCD_A_MaxFS row of test plan summary in accordance with Table 1.

Table 1 — Result criteria for maximum PCD field strength test

Explanation	Test result
Only when the DC voltages at CON3 do not exceed 3 V in all test conditions	PASS
When the DC voltages at CON3 exceed 3 V in at least one of the test conditions	FAIL

6.2.3 TC_PCD_A_MinFS: PCD minimum field strength

6.2.3.1 Scope / purpose

This test verifies the minimum magnetic field strength in the PCD operating volume (range A and range B).

6.2.3.2 Test conditions

At ambient temperature, Reference PICCs 1, 2 and 3 within range A and Reference PICC 3 within range B.

6.2.3.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 7.1.1.2.2 by moving the Reference PICCs in all the positions of the PCD operating volume defined in 6.2.3.2.

If future editions of ISO/IEC 10373-6 specify a lower V_{load} voltage for Class 1, this test procedure shall still be performed with a V_{load} of 6 V for Reference PICC 1 until 2020.

In addition, perform the previous procedure, using the minimum field strength specified for range B instead of H_{min} , by moving the Reference PICC 3 in all the positions of range B.

6.2.3.4 Test report

The test report shall give the minimum DC voltage measured at CON3 under the conditions applied.

If future editions of ISO/IEC 10373-6 specify a lower V_{load} voltage for Class 1, the two results for Reference PICC 1 (with 6 V and with this lower V_{load} voltage) shall be given in the test result until 2020.

Fill the TC_PCD_A_MinFS row of test plan summary in accordance with Table 2.

Table 2 — Result criteria for minimum PCD field strength test

Explanation	Test result
Only when the DC voltages at CON3 exceed V_{load} as defined in ISO/IEC 10373-6:2016, Table 3 in all test conditions	PASS
When the DC voltages at CON3 do not exceed V_{load} as defined in ISO/IEC 10373-6:2016, Table 3 in at least one of the test conditions	FAIL

6.2.4 TC_PCD_A_ALF: Alternating magnetic field

6.2.4.1 Scope / purpose

This test determines that the PCD generates a field strength not higher than the average value specified in ISO/IEC 14443-1, in any possible PICC position.

6.2.4.2 Test conditions

At ambient temperature, only Reference PICC 1.

6.2.4.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 6.1.1.2.

6.2.4.4 Test report

The test report shall give the DC voltage measured at CON3.

Fill the TC_PCD_A_ALF row of test plan summary in accordance with Table 3.

Table 3 — Result criteria for PCD alternating magnetic field test

Explanation	Test result
The DC voltage at CON3 does not exceed 3 V	PASS
The DC voltage at CON3 exceeds 3 V	FAIL

6.3 Conformance of the PCD modulation waveform

6.3.1 TC_PCD_A_TAMW: Type A modulation waveform

6.3.1.1 Scope / purpose

This test verifies the Type A modulation waveform in the PCD operating volume (range A and range B).

6.3.1.2 Test conditions

At ambient temperature, Reference PICCs 1 and 2 in position A1, Reference PICC 3 in position B1 and the calibration coil at an arbitrary position.

6.3.1.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 7.1.4.2 or K.2.1.1.2 for all the positions of the PCD operating volume defined in 6.3.1.2 and for all supported PCD to PICC bit rates.

6.3.1.4 Test report

The test report shall give the measured Type A modulation pulse, rise and fall times and overshoot values or the PR, ISI_m , ISI_d and the normalized differential phase noise values under the conditions applied.

Fill the TC_PCD_A_TAMW row of test plan summary in accordance with Table 4 for all supported PCD to PICC bit rates.

Table 4 — Result criteria for Type A modulation waveform test

Explanation	Test result
Only when the Type A modulation pulse, rise and fall times and overshoot values or the PR, ISI_m , ISI_d and the normalized differential phase noise values are compliant in all test conditions	PASS
When at least one value is not compliant in at least one of the test conditions	FAIL

6.3.2 TC_PCD_A_TBMW: Type B modulation index and waveform

6.3.2.1 Scope / purpose

This test verifies the Type B modulation index and the waveform in the PCD operating volume (range A and range B).

6.3.2.2 Test conditions

At ambient temperature, Reference PICCs 1 and 2 in position A1, Reference PICC 3 in position B1 and the calibration coil at an arbitrary position.

6.3.2.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 7.1.4.2 or K.2.1.1.2 for all the positions of the PCD operating volume defined in 6.3.2.2 and for all supported PCD to PICC bit rates.

6.3.2.4 Test report

The test report shall give the measured type B modulation index, rise and fall times and overshoot values under the conditions applied.

Fill the TC_PCD_A_TBMW row of test plan summary in accordance with Table 5 for all supported PCD to PICC bit rates.

Table 5 — Result criteria for Type B modulation index and waveform test

Explanation	Test result
Only when the Type B modulation index, rise and fall times and overshoot values are compliant in all test conditions	PASS
When at least one value is not compliant in at least one of the test conditions	FAIL

6.4 Conformance of the PCD load modulation reception

6.4.1 TC_PCD_A_TALMR: Type A load modulation reception

6.4.1.1 Scope / purpose

This test verifies the Type A load modulation reception in the PCD operating volume (range A and range B).

6.4.1.2 Test conditions

At ambient temperature, see 6.1.

At minimum and maximum temperatures, only Reference PICC 1 in Position A2 and Reference PICC 3 in Position B2.

6.4.1.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 7.1.5.2 in all the defined positions of the PCD operating volume and for all supported PICC to PCD bit rates, except bit rates of $fc/64$ (~212 kbit/s), $fc/32$ (~424 kbit/s) and $fc/16$ (~848 kbit/s).

6.4.1.4 Test report

The test report shall give the PCD Type A load modulation sensitivity under the conditions applied.

Fill the TC_PCD_A_TALMR row of test plan summary in accordance with Table 6 for all supported PICC to PCD bit rates.

Table 6 — Result criteria for Type A load modulation reception test

Explanation	Test result
Only when the PCD Type A load modulation sensitivity is below the standard limit in all test conditions	PASS
When the PCD Type A load modulation sensitivity is above the standard limit in at least one of the test conditions	FAIL

6.4.2 TC_PCD_A_TBLMR: Type B load modulation reception

6.4.2.1 Scope / purpose

This test verifies the Type B load modulation reception in the PCD operating volume (range A and range B).

6.4.2.2 Test conditions

At ambient temperature, see 6.1.

At minimum and maximum temperatures, only Reference PICC 1 in Position A2 and Reference PICC 3 in Position B2.

6.4.2.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 7.1.5.2 in all the defined positions of the PCD operating volume and for all supported PICC to PCD bit rates, except bit rates of $fc/64$ (~212 kbit/s), $fc/32$ (~424 kbit/s) and $fc/16$ (~848 kbit/s).

6.4.2.4 Test report

The test report shall give the PCD Type B load modulation sensitivity under the conditions applied.

Fill the TC_PCD_A_TBLMR row of test plan summary in accordance with Table 7 for all supported PICC to PCD bit rates.

Table 7 — Result criteria for Type B load modulation reception test

Explanation	Test result
Only when the PCD Type B load modulation sensitivity is below the standard limit in all test conditions	PASS
When the PCD Type B load modulation sensitivity is above the standard limit in at least one of the test conditions	FAIL

6.5 Conformance of the PCD sensitivity to electromagnetic disturbance

6.5.1 General

The following tests shall be performed on the first applicative command sent by the PCD.

6.5.2 TC_PCD_A_TAEI: Type A EMD immunity

6.5.2.1 Scope / purpose

This test verifies that the PCD is insensitive to any Type A load modulation amplitude below $V_{E,PCD}$.

6.5.2.2 Test conditions

At ambient temperature, only Reference PICC 1 in positions A1 and A2 of range A.

6.5.2.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 7.1.6.2 for all the positions of the PCD operating volume defined in 6.5.2.2 and for all supported PICC to PCD bit rates.

6.5.2.4 Test report

The test report shall state whether the PCD was insensitive to any Type A load modulation amplitude below $V_{E,PCD}$ under the conditions applied.

The test report shall indicate the V_{EMD} as obtained in accordance with step f) of ISO/IEC 10373-6:2016, 7.1.6.2 for all the positions of the PCD operating volume defined in 6.5.2.2 and for all supported PICC to PCD bit rates.

Fill the TC_PCD_A_TAEI row of test plan summary in accordance with Table 8 for all supported PICC to PCD bit rates.

Table 8 — Result criteria for Type A EMD immunity test

Explanation	Test result
Only when the PCD is insensitive to any Type A load modulation amplitude below $V_{E,PCD}$ in all test conditions	PASS
When the PCD is not insensitive to any Type A load modulation amplitude below $V_{E,PCD}$ in at least one of the test conditions	FAIL

6.5.3 TC_PCD_A_TBEI: Type B EMD immunity

6.5.3.1 Scope / purpose

This test verifies that the PCD is insensitive to any Type B load modulation amplitude below $V_{E,PCD}$.

6.5.3.2 Test conditions

At ambient temperature, only Reference PICC 1 in positions A1 and A2 of range A.

6.5.3.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 7.1.6.2 for all the positions of the PCD operating volume defined in 6.5.3.2 and for all supported PICC to PCD bit rates.

6.5.3.4 Test report

The test report shall state whether the PCD was insensitive to any Type B load modulation amplitude below $V_{E,PCD}$ under the conditions applied.

The test report shall indicate the V_{EMD} as obtained in accordance with step f) of ISO/IEC 10373-6:2016, 7.1.6.2 for all the positions of the PCD operating volume defined in 6.5.3.2 and for all supported PICC to PCD bit rates.

Fill the TC_PCD_A_TBEI row of test plan summary in accordance with Table 9 for all supported PICC to PCD bit rates.

Table 9 — Result criteria for Type B EMD immunity test

Explanation	Test result
Only when the PCD is insensitive to any Type B load modulation amplitude below $V_{E,PCD}$ in all test conditions	PASS
When the PCD is not insensitive to any Type B load modulation amplitude below $V_{E,PCD}$ in at least one of the test conditions	FAIL

6.5.4 TC_PCD_A_TAER: Type A EMD handling timing constraints

6.5.4.1 Scope / purpose

This test verifies that the PCD is not disturbed by a Type A test pattern sent $t_{E,PCD}$ before the Type A PICC answer.

6.5.4.2 Test conditions

At ambient temperature, only Reference PICC 1 in Position A2.

6.5.4.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 7.1.7.2 for all the positions of the PCD operating volume defined in 6.5.4.2 and only for mandatory $f_c/128$ (~106 kbit/s) PICC to PCD bit rate.

6.5.4.4 Test report

The test report shall state whether the PCD was not disturbed by a Type A test pattern sent $t_{E,PCD}$ before the PICC answer (or was able to recover from the test pattern) under the conditions applied.

Fill the TC_PCD_A_TAER row of test plan summary in accordance with Table 10 for all supported PICC to PCD bit rates.

Table 10 — Result criteria for Type A EMD recovery test

Explanation	Test result
Only when the PCD is not disturbed by a Type A test pattern sent $t_{E,PCD}$ before the Type A PICC answer	PASS
When the PCD is disturbed by a Type A test pattern sent $t_{E,PCD}$ before the Type A PICC answer	FAIL

6.5.5 TC_PCD_A_TBBER: Type B EMD handling timing constraints

6.5.5.1 Scope / purpose

This test verifies that the PCD is not disturbed by a Type B test pattern sent $t_{E,PCD}$ before the Type B PICC answer.

6.5.5.2 Test conditions

At ambient temperature, only Reference PICC 1 in Position A2.

6.5.5.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2016, 7.1.7.2 for all the positions of the PCD operating volume defined in 6.5.5.2 and only for mandatory $fc/128$ (~106 kbit/s) PICC to PCD bit rate.

6.5.5.4 Test report

The test report shall state whether the PCD was not disturbed by a Type B test pattern sent $t_{E,PCD}$ before the PICC answer (or was able to recover from the test pattern) under the conditions applied.

Fill the TC_PCD_A_TBBER row of test plan summary in accordance with Table 11 for all supported PICC to PCD bit rates.

Table 11 — Result criteria for Type B EMD recovery test

Explanation	Test result
Only when the PCD is not disturbed by a Type B test pattern sent $t_{E,PCD}$ before the Type B PICC answer	PASS
When the PCD is disturbed by a Type B test pattern sent $t_{E,PCD}$ before the Type B PICC answer	FAIL

6.6 TC_PCD_A_ALF: Alternating magnetic field

6.6.1 Scope / purpose

6.6.1.1 General

This test determines that the PCD generates a field strength not higher than the average value specified in ISO/IEC 14443-1, in any possible PICC position.

6.6.1.2 Test conditions

At ambient temperature, only Reference PICC 1.

6.6.1.3 Test procedure

Apply ISO/IEC 10373-6:2016, 6.1.1.2 test procedure.