INTERNATIONAL STANDARD

ISO/IEC 10373-6

Second edition
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Identification cards — Test methods —

Part 6: Proximity cards

Cartes d'identification — Méthodes d'essai —

Partie 6: Cartes de proximité

Reference number
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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

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

ISO/IEC 10373-6 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and personal identification*.

This second edition cancels and replaces the first edition (ISO/IEC 10373-6:2001), which has been technically revised. It also includes the Amendments ISO/IEC 10373-6:2001/Amd.1:2007, ISO/IEC 10373-6:2001/Amd.2:2003, ISO/IEC 10373-6:2001/Amd.3:2006, ISO/IEC 10373-6:2001/Amd.4:2006 and ISO/IEC 10373-6:2001/Amd.5:2007.

ISO/IEC 10373 consists of the following parts, under the general title *Identification cards — Test methods*:

— *Part 1: General characteristics*

— *Part 2: Cards with magnetic stripes*

— *Part 3: Integrated circuit cards with contacts and related interface devices*

— *Part 5: Optical memory cards*

— *Part 6: Proximity cards*

— *Part 7: Vicinity cards*

— *Part 8: USB-ICC*

— *Part 9: Optical memory cards — Holographic recording method*

Identification cards — Test methods —

Part 6:
Proximity cards

1 Scope

ISO/IEC 10373 defines test methods for characteristics of identification cards according to the definition given in ISO/IEC 7810. Each test method is cross-referenced to one or more base standards, which can be ISO/IEC 7810 or one or more of the supplementary standards that define the information storage technologies employed in identification card applications.

NOTE 1 Criteria for acceptability do not form part of ISO/IEC 10373, but will be found in the International Standards mentioned above.

NOTE 2 Test methods defined in this part of ISO/IEC 10373 are intended to be performed separately. A given proximity card or object, or proximity coupling device, is not required to pass through all the tests sequentially.

This part of ISO/IEC 10373 defines test methods which are specific to proximity cards and objects, and proximity coupling devices, defined in ISO/IEC 14443-1:2008, ISO/IEC 14443-2:2010, ISO/IEC 14443-3:— and ISO/IEC 14443-4:2008. ISO/IEC 10373-1 defines test methods which are common to one or more integrated circuit card technologies and other parts deal with other technology-specific tests.

2 Normative references

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

ISO/IEC 7810:2003, *Identification cards — Physical characteristics*

ISO/IEC 14443-1:2008, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 1: Physical characteristics*

ISO/IEC 14443-2:2010, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 2: Radio frequency power and signal interface*

ISO/IEC 14443-3:—[1)], *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 3: Initialization and anticollision*

ISO/IEC 14443-4:2008, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 4: Transmission protocol*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*

1) To be published.

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms, definitions, abbreviations and symbols given in ISO/IEC 14443-1:2008, ISO/IEC 14443-2:2010, ISO/IEC 14443-3:—, ISO/IEC 14443-4:2008 and the following apply.

NOTE Elements in bold square brackets **[ ]** are optional definitions.

3.1 Terms and definitions

3.1.1
base standard
standard which the test method is used to verify conformance to

3.1.2
CascadeLevels
number of cascade levels of the PICC

3.1.3
"Class 1" PICC
PICC whose antenna is located as defined in ISO/IEC 14443-1:2008 and which passes the "Class 1" PICC maximum loading effect test defined in 7.2.4

3.1.4
Command Set
set describing the PICC commands during initialization and anticollision

NOTE See ISO/IEC 14443-3:—, 6.4 for PICC Type A and ISO/IEC 14443-3:—, 7.5 for PICC Type B.

3.1.5
Mute
no response within a specified timeout, e.g. expiration of FWT

3.1.6
PICC States
different PICC states during initialization and anticollision

NOTE See ISO/IEC 14443-3:—, 6.3 for PICC Type A and ISO/IEC 14443-3:—, 7.4 for PICC Type B.

3.1.7
Scenario
defined typical protocol and application specific communication to be used with the test methods defined in this part of ISO/IEC 10373

3.1.8
Test Initial State
TIS
element from PICC States that is the PICC state before performing a specific PICC command from Command Set

3.1.9
test method
method for testing characteristics of identification cards for the purpose of confirming their compliance with International Standards

3.1.10
Test Target State
TTS
element from PICC States that is the PICC state after performing a specific PICC command from Command Set

3.2 Symbols and abbreviated terms

(xxxxx)b	Data bit representations
'XY'	Hexadecimal notation, equal to XY in base 16
ATA(cid)	Answer to ATTRIB, i.e. (mbli+cid CRC_B), with mbli an arbitrary hex value (see ISO/IEC 14443-3:—, 7.11)
ATTRIB(cid, fsdi)	Default ATTRIB command with PUPI from ATQB, CID = cid and Maximum Frame Size Code value = fsdi i.e. ('1D' PUPI cid fsdi '01 00' CRC_B)
DUT	Device under test
ESD	Electrostatic Discharge
$I(c)_n$**(**inf **[**,CID = cid**] [**,NAD = nad**]** **[**,~CRC**])**	ISO/IEC 14443-4 I-block with chaining bit c∈{1,0}, block number n∈{1,0} and information field inf. By default no CID and no NAD will be transmitted. If CID = cid∈{0...15} is specified, it will be transmitted as second parameter. If NAD = nad∈{0...'FF'} is specified it will be transmitted as third parameter (or second parameter if no CID is transmitted). If the literal '~CRC' is not specified, a valid CRC corresponding to the type of the PICC will be transmitted by default (i.e. CRC_A or CRC_B)
IUT	Implementation Under Test (ISO/IEC 9646); within the scope of this part of ISO/IEC 10373, IUT represents the PCD under the test
LT	Lower Tester (ISO/IEC 9646), the PICC-emulation part of the PCD-test-apparatus
m	Modulation index
Mute	No response within a specified timeout
N/A	Not applicable
PPS(cid, dri, dsi)	Default PPS request with CID = cid, DRI = dri and DSI = dsi, i.e. ('D' + cid '11' dsi × 4 + dri CRC_A)
R(ACK **[**,CID = cid**] [**,~CRC**])**$_n$	ISO/IEC 14443-4 R(ACK) Block with block number n. The definition of the optional CID and ~CRC symbols is as described in the $I(c)_n$ block above
R(NAK **[**,CID = cid**][**,~CRC**])**$_n$	ISO/IEC 14443-4 R(NAK) Block with block number n. The definition of the optional CID and ~CRC symbols is as described in the $I(c)_n$ block above
RATS(cid, fsdi)	Default RATS command with CID = cid and FSDI value = fsdi i.e. ('E0' fsdi x 16+cid CRC_A)
READY(I)	READY state in cascade level I, I ∈ {1, 2, 3}; e.g. READY(2) is a PICC cascade level 2

READY*(I)	READY* state in cascade level I, I ∈ {1, 2, 3}; e.g. READY*(2) is a PICC cascade level 2
REQB(N)	REQB command with N as defined in ISO/IEC 14443-3:—, 7.7.4
S(WTX)(WTXM [,CID = cid][,~CRC])	ISO/IEC 14443-4 S(WTX) block with parameter WTXM. The definition of the optional CID and ~CRC symbols is as described in the $I(c)_n$ block above
S(DESELECT **[**,CID = cid**]** **[**,~CRC**]**)	ISO/IEC 14443-4 S(DESELECT) block. The definition of the optional CID and ~CRC symbols is as described in the $I(c)_n$ block above
SAK(cascade)	the SELECT(I) answer with the cascade bit (bit 3) set to (1)b
SAK(complete)	the SELECT(I) answer with the cascade bit (bit 3) set to (0)b
SEL(c)	Select code of level c (i.e. SEL(1) = '93', SEL(2) = '95', SEL(3) = '97')
SELECT(I)	SELECT command of cascade level I, i.e. SELECT(1) = ('93 70' $UIDTX_1$ BCC CRC_A) SELECT(2) = ('95 70' $UIDTX_2$ BCC CRC_A) SELECT(3) = ('97 70' $UIDTX_3$ BCC CRC_A)
SLOTMARKER(n)	Slot-MARKER command with slot number n, i.e. (16 × (n − 1) + 5 CRC_B)
TB-PDU	Transmission Block Protocol Data Unit, which consists of either I-block, R-block or S-block
TEST_COMMAND1(1)	Default test command consisting of one unchained I-block NOTE This command depends on the negotiated maximum frame size value of the PICC.
TEST_COMMAND1(n), n > 1	Default test command consisting of n chained I-blocks (PCD chaining) NOTE This command depends on the negotiated maximum frame size value of the PICC.
$TEST\_COMMAND1(n)_k$	INF field of k'th I-block chain of TEST_COMMAND1(n) NOTE This command depends on the negotiated maximum frame size value of the PICC.
TEST_COMMAND2(n), n > 1	Default test command which expects a response consisting of n chained I-blocks NOTE This command depends on the negotiated maximum frame size value of the PCD.
TEST_COMMAND3	Default test command consisting of one I-block which needs more than FWT time for execution
TEST_RESPONSE1(n)	INF field of the response to TEST_COMMAND1(n) NOTE This response is assumed to be always unchained.
TEST_RESPONSE2(n)	Response to TEST_COMMAND2(n)

NOTE This response depends on the negotiated maximum frame size value of the PCD.

TEST_RESPONSE2(n)$_k$ — INF field of k'th I-block chain of TEST_RESPONSE2(n)

NOTE This response depends on the negotiated maximum frame size value of the PCD.

TEST_RESPONSE3 — Response I-block to TEST_COMMAND3

NOTE This response is always assumed to be unchained.

TM- PDU — Test Management Protocol Data Unit (ISO/IEC 9646-1, PDU)

UIDTX$_l$ — Transmitted UID 32-bit data at cascade level l (see Table 1)

UT — Upper Tester (ISO/IEC 9646), the master part of the PCD-test-apparatus

UT_APDU — Upper Tester Application Protocol Data Unit: a packet of data to be sent by the PCD to the LT through the RF interface

WUPB(N) — WUPB command with N as defined in ISO/IEC 14443-3:—, 7.7.4

~X — Bit sequence consisting of the inverted bits of bit sequence X or any other bit sequence different from X

X[[a..b]] — Bit subsequence of bit sequence X consisting of the bits between position a and b included. If a > b then the sequence is empty

X[[n]] — Bit at position n of bit sequence X. First bit is at position 1

X[n] — Byte at position n of bit sequence X. First byte is at position 1 (i.e. X[n] = X[[(n − 1) × 8 + 1..n × 8]])

Table 1 — Mapping from UID to UIDTX

Cascade level	Single UID PICC	Double UID PICC	Triple UID PICC
UIDTX$_1$	UID0 UID1 UID2 UID3	'88' UID0 UID1 UID2	'88' UID0 UID1 UID2
UIDTX$_2$	---	UID3 UID4 UID5 UID6	'88' UID3 UID4 UID5
UIDTX$_3$	---	---	UID6 UID7 UID8 UID9

4 Default items applicable to the test methods

4.1 Test environment

Unless otherwise specified, testing shall take place in an environment of temperature 23 °C ± 3 °C (73 °F ± 5 °F) and of relative humidity 40 % to 60 %.

4.2 Pre-conditioning

No environmental pre-conditioning of PICCs or PCDs is required by the test methods in this document.

4.3 Default tolerance

Unless otherwise specified, a default tolerance of ± 5 % shall be applied to the quantity values given to specify the characteristics of the test equipment (e.g. linear dimensions) and the test method procedures (e.g. test equipment adjustments).

4.4 Spurious Inductance

Resistors and capacitors should have negligible inductance.

4.5 Total measurement uncertainty

The total measurement uncertainty for each quantity determined by these test methods shall be stated in the test report.

Basic information is given in ISO/IEC Guide 98-3:2008.

5 Apparatus and circuits for test of ISO/IEC 14443-1 and ISO/IEC 14443-2 parameters

This clause defines the test apparatus and test circuits for verifying the operation of a PICC or a PCD according to ISO/IEC 14443-1:2008 and ISO/IEC 14443-2:2010. The test apparatus includes:

— Measurement instruments (see 5.1);

— Calibration coil (see 5.2);

— Test PCD assembly (see 5.3);

— Reference PICC (see 5.4).

These are described in the following clauses.

5.1 Minimum requirements for measurement instruments

5.1.1 Oscilloscope

The digital sampling oscilloscope shall be capable of sampling at a rate of at least 500 million samples per second with a resolution of at least 8 bits at optimum scaling and shall have an overall minimum bandwidth of 250 MHz. The oscilloscope should have the capability to output the sampled data as a text file to facilitate mathematical and other operations such as windowing on the sampled data using external software programs (see Annexes E and F).

NOTE The overall bandwidth is the combination of oscilloscope and probing system bandwidth.

5.2 Calibration coil

This clause defines the size, thickness and characteristics of the calibration coil.

5.2.1 Size of the calibration coil card

The calibration coil card shall consist of an area which has the height and width of an ID-1 type defined in ISO/IEC 7810:2003 containing a single turn coil concentric with the card outline (see Figure 1).

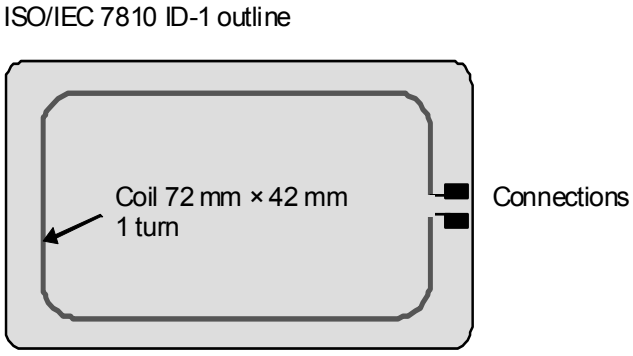

Figure 1 — Calibration coil

5.2.2 Thickness and material of the calibration coil card

The thickness of the calibration coil card shall be less than that of an ID-1 card. It shall be constructed of a suitable insulating material.

5.2.3 Coil characteristics

The coil on the calibration coil card shall have one turn. The outer size of the coil shall be 72 mm × 42 mm with corner radius 5 mm. Relative dimensional tolerance shall be ± 2 %.

NOTE 1 The area over which the field is integrated is approximately 3000 mm^2.

The coil shall be made as a printed coil on printed circuit board (PCB) plated with 35 µm copper. Track width shall be 500 µm with a relative tolerance of ± 20 %. The size of the connection pads shall be 1,5 mm × 1,5 mm.

NOTE 2 At 13,56 MHz the approximate inductance is 250 nH and the approximate resistance is 0,4 Ω.

A high impedance oscilloscope probe with an input admittance equivalent to a parallel capacitance C_p < 14 pF and a parallel resistance R_p > 9 kΩ at 13,56 MHz shall be used to measure the (open circuit) voltage induced in the coil. The resonance frequency of the calibration coil and connecting leads shall be above 60 MHz.

NOTE 3 A parasitic capacitance of the probe assembly of less than 35 pF normally ensures for the whole set a resonant frequency greater than 60 MHz.

The open circuit calibration factor for this coil is 0,32 V (rms) per A/m (rms) [Equivalent to 900 mV (peak-to-peak) per A/m (rms)].

NOTE 4 The high impedance oscilloscope probe ground connection should be as short as possible, less than 20 mm or coaxial connection.

5.3 Test PCD assembly

The test PCD assembly shall consist of a 150 mm diameter test PCD antenna and two parallel sense coils: sense coil a and sense coil b. The test set-up is shown in Figure 2. The sense coils shall be connected such that the signal from one coil is in opposite phase to the other. The 10 Ω potentiometer P1 serves to fine adjust the balance point when the sense coils are not loaded by a PICC or any magnetically coupled circuit. The capacitive load of the probe including its parasitic capacitance shall be less than 14 pF.

NOTE 1 The capacitance of the connections and of the oscilloscope probe should be kept to a minimum for reproducibility.

NOTE 2 In order to avoid any unintended misalignment in case of an unsymmetrical set-up the tuning range of the potentiometer P1 is only 10 Ω. If the set-up cannot be compensated by the 10 Ω potentiometer P1 the overall symmetry of the set-up should be checked.

NOTE 3 The high impedance oscilloscope probe ground connection should be as short as possible, less than 20 mm or coaxial connection.

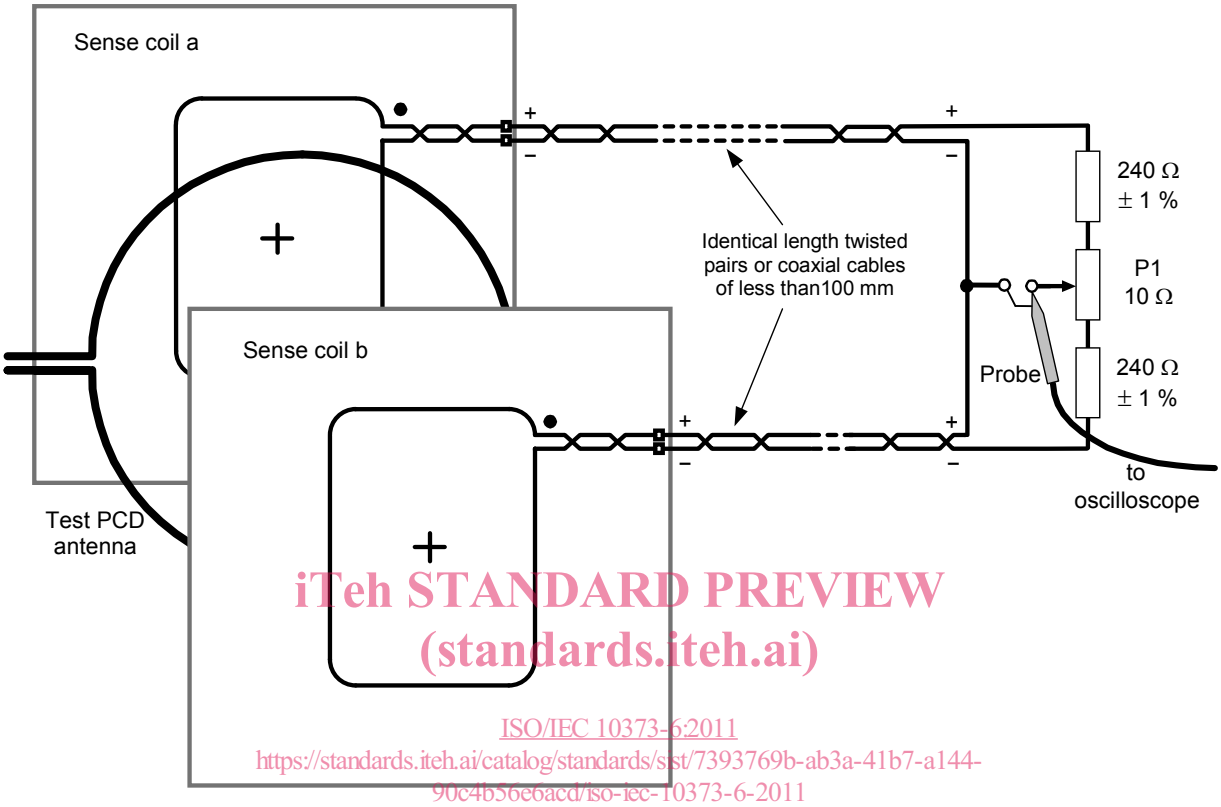

Figure 2 — Test set-up (principle)

5.3.1 Test PCD antenna

The test PCD antenna shall have a diameter of 150 mm and its construction shall conform to the drawings in Annex A.

The matching of the test PCD antenna should be accomplished by using an impedance analyzer or a network analyzer or a LCR meter. If either an impedance analyzer or a network analyzer or a LCR meter is not available, then the matching may be accomplished with the procedure given in Annex B.

5.3.2 Sense coils

The size of the sense coils shall be 100 mm × 70 mm with corner radius 10 mm. The sense coil construction shall conform to the drawings in Annex C.

5.3.3 Assembly of Test PCD

The sense coils and test PCD antenna shall be assembled parallel and with the sense and antenna coils coaxial and such that the distance between the active conductors is 37,5 mm as shown in Figure 3. The dimensional tolerance shall be better than ± 0,5 mm. The distance between the coil in the DUT and the calibration coil shall be equal with respect to the coil of the test PCD antenna.

NOTE These distances are chosen to represent the typical operating distance of the PICC.

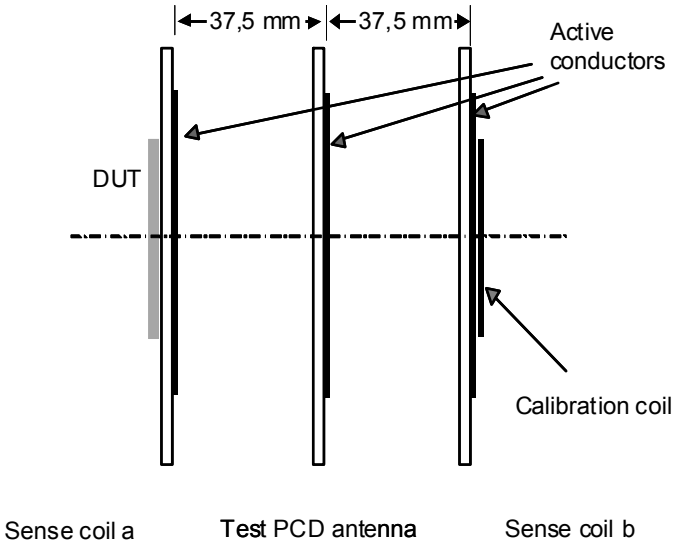

Figure 3 — Test PCD assembly

5.4 Reference PICC

A Reference PICC is defined to test the ability of a PCD to:

— generate a field strength of at least H_{min} and not exceeding H_{max};

— transfer power to a PICC;

— transmit a modulated signal to a PICC;

— receive a load modulation signal from the PICC;

in its operating volume.

5.4.1 Dimensions of the Reference PICC

The Reference PICC shall consist of an area containing the coils which has the height and width defined in ISO/IEC 7810:2003 for ID-1 type. An area external to this, containing the circuitry which emulates the required PICC functions, shall be appended in such a way as to allow insertion into the test set-ups and so as to cause no interference to the tests. The dimensions shall be as in Figure 4.

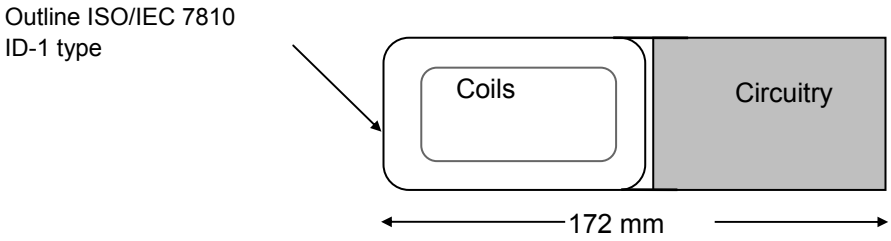

Figure 4 — Reference PICC dimensions