International Standard

ISO/IEC 24789-1

Second edition
2024-01

Identification cards — Card service life —

Part 1: Application profiles and requirements

Cartes d'identification — Durée de vie des cartes —

Partie 1: Profils d'application et exigences

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and security devices for personal identification*.

This second edition cancels and replaces the first edition (ISO/IEC 24789-1:2012), which has been technically revised.

The main changes are as follows:

— Test parameters for most methods to be included in the test plan are determined from card functional elements, the number of uses per day and the expected lifetime in years.

— Test sequences in the test plan have been shortened, a maximum of three methods occur in a sequence now.

— Test parameter calculations are only based on the number of uses per day and the expected lifetime in years; the complex calculations of environmental, storage and reader factors have been removed.

A list of all parts in the ISO/IEC 24789 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

This document defines a methodology for determining a test plan to simulate a card's service life.

Such a test plan consists of a set of stress exposure methods, each simulating specific types of environmental or mechanical stresses. Most of the stress exposure methods are followed by one or more evaluation methods to determine to which extent the card has survived exposure to the stress exposure method, while a few have the evaluation embedded in the stress test method.

Although the equipment and parts of the procedures of certain ISO/IEC 10373-1 test methods are referenced for employment in the simulation of aging or usage in the ISO/IEC 24789 series, such references are clearly distinguished from the normal use of ISO/IEC 10373-1. In normal use, these ISO/IEC 10373-1 test methods are applied to determine conformity to ISO/IEC 7810 and do not explicitly address application-specific requirements for card service life.

Test methodologies employed by various card industry experts are included in this document. They are based upon field experience for specific applications and card functional elements. While it is believed that the field experiences can be generally applied, there is limited field/laboratory correlation data to confirm this.

Prior to publication of this document, industry experts were given the opportunity to test cards used successfully in various applications for conformity to this document. There were no instances of participating card industry experts reporting successfully implemented functional elements failing the criteria in this document.

While this document attempts to accurately predict card service life, it is possible that some card constructions can be in conformity with this document while having field issues. It is also possible that some card constructions will not be in conformity with this document while having adequate field performance. In either of these cases, the reader of this document is advised to contact their country's national standards body (see the Foreword) and share this information so that future editions of this document can be revised accordingly.

NOTE For the convenience of certain users, non-SI equivalents are given for some quantity values where these are in common use in the ID card industry. These equivalents appear in parentheses and are for information only.

Identification cards — Card service life —

Part 1:
Application profiles and requirements

1 Scope

This document comprises a methodology for determining a test plan to simulate a card's service life. The methodology defines two parameters of card service life: the expected card service life in years and the average number of uses per day.

This document and ISO/IEC 24789-2, together along with ISO/IEC 10373-1 describe the evaluation methods to be used and their criteria.

This document was originally developed for ID-1 cards conforming to ISO/IEC 7810 but can be useful in whole or in part for other types and form factors.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Identification cards — Physical characteristics*

ISO/IEC 10373-1, *Cards and security devices for personal identification — Test methods — Part 1: General characteristics*

ISO/IEC 24789-2, *Identification cards — Card service life — Part 2: Methods of evaluation*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 7810, ISO/IEC 10373-1, ISO/IEC 24789-2 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
card service life
period for which a card retains the set of characteristics specified for its application under the conditions of use specified for that application from the time it is issued to the card holder

3.1.2
application profile
set of parameters that, in total, defines the conditions of use specified for an application

3.1.3
integrated circuit module width
ICM width
maximum dimension of an ICM's exposed surface, measured parallel to a long edge of the card

3.1.4
integrated circuit module height
ICM height
maximum dimension of an ICM's exposed surface, measured parallel to a short edge of the card

3.1.5
rounded
process of replacing a number with another number in which the last digits have been adjusted up or down

3.1.6
rounded-up
process of replacing a number with another number in which the replacement number is chosen to be either an exact multiple of a convenient test variable or the next higher multiple of the test variable

3.1.7
visual personalization
information on a card that is visible by eye with ambient and specialized lighting, including protective and security coatings applied on top of the personalized card

3.1.8
card, independent of personalization
card, with or without personalization

3.1.9
patch
cut film, smaller than the ID-1 card face that is applied over parts of the card surface

3.2 Abbreviated terms

ICM integrated circuit(s) module

PICC proximity integrated circuit card

RH relative humidity

VICC vicinity integrated circuit card

4 Determination of the card application profile

4.1 General

During its service life a card is exposed to a broad range of influences that can degrade and weaken the card until it is finally no longer fit for purpose.

Examples for such influences are:

— heat and humidity, for example causing breakdown of material within the card;

— temperature changes, for example causing separation of previously well adhering components inside the card;

— bending, for example causing breakdown of the card material, or causing mechanical failure of an electrical connection inside the card;

— friction, for example causing text written on the card's surface to become illegible.

Various test methods have been developed to simulate the impact of certain influences onto the card, such as:

— temperature and humidity storage test, to simulate the impact of heat and humidity;

— temperature cycling to simulate the impact of temperature changes;

— dynamic bending stress test, to simulate the impact of a certain type of bending applied to the card;

— surface wear tests, to simulate the effects of friction on the card's surface.

Additional informative methods have been documented in the informative Annex A, but are not required to be included in the test plan.

This document provides a systematic approach to determine a test plan containing a range of test methods and the related test parameters.

The following necessary indicators shall be determined:

— the functional elements the card contains;

— the application profile variables (according to 4.2).

By applying the rules defined in this document, a test plan based on the above indicators is determined.

4.2 Determining application profile variable values

The usage frequency and the card lifetime in the field have a strong impact on the cumulative stresses the card will have to withstand. These parameters dictate testing and requirements for determining conformity to this document. The values for the two variables shall be determined as follows:

— A, the expected card service life in years (whole number, at least 1);

— U, the average number of uses per day (greater than 0).

To reduce the number of combinations of U values resulting in slightly different test plans, the use of one of the values in Table 1 for U is recommended.

Table 1 — Recommended values for U

Recommended values for U (uses per day)							
0,05	0,1	0,2	0,5	1	2	5	10

4.3 Converting classes as defined in 24789-1:2012 (the previous edition of this document) into application profile coefficients as defined in this document

Table 2 gives approximate values for the age coefficient A and the usage coefficient U as they are used in this version of ISO/IEC 24789-1, relative to aging class and usage class values as they were used in 24789-1:2012.

Table 2 is not an exact mathematical correlation, but an estimated equivalence. The user of this document should not assume that A and U derived from Table 2 are automatically representative for their application.

Table 2 — Approximate correlation of ISO/IEC 24789-1:2012 (the previous edition of this document) classes to this document

Aging		Usage	
ISO/IEC 24789-1:2012 (the previous edition of this document)	This document	ISO/IEC 24789-1:2012 (the previous edition of this document)	This document
Aging class	A, the expected card service life in years (at least 1)	Usage class	U, the average number of uses per day (greater than 0)
0	1	A	0,1
1	4	B	0,5
2	7	C	2
3	10	D	10

5 Inputs to card life requirements

5.1 General

Card industry experts believe that card service life testing and requirements must be based upon three key factors: functional elements on cards, expected card life and card use frequency.

5.2 Card functional elements

Card functional elements dictate what test methods need to be performed on cards. The testing can be individual test methods, or a series of tests performed sequentially.

5.3 Expected card life

The time a card is expected to be functional after issuance is an obvious factor in determining card service life. In the case of this document, the expected card life will be used to determine how many times a test sequence is performed before running conformity testing. It can also be used to determine either performance metrics or exposure severity of individual test methods, or both.

5.4 Card use frequency

Card use frequency is used to determine test method variables, such as accelerated aging test exposure times, number of dynamic bendings and other test parameters.

6 Card tests

6.1 General

Cards shall be evaluated for conformity by running test methods that are required for the chosen card functional elements as per Clause 8 Card testing and requirements. The test methods can be stand-alone, single iteration sequential or multiple iteration sequential test methods.

6.2 Stand-alone test methods

Stand-alone test methods shall be run on cards using tests from ISO/IEC 10373-1 and ISO/IEC 24789-2. Variable test parameters shall be used when determined by this document. These parameters are based upon the expected card life and card use frequency.

6.3 Single iteration sequential test methods

Single iteration sequential test methods shall be run using a series of tests from either ISO/IEC 10373-1 or ISO/IEC 24789-2, or both. Variable test parameters can be included in the test conditions and will be a function of either expected card life or card use frequency, or both. The test sequence shall be run once.

The sequential test method tables are structured such that the testing is done sequentially from top to bottom of the tables using the parameters listed.

6.4 Multiple iteration sequential test methods

Multiple iteration sequential test methods shall be run using a series of tests from either ISO/IEC 10373-1 or ISO/IEC 24789-2, or both. Variable test parameters can be included in the test conditions and will be a function of either expected card life or card use frequency, or both.

The number test sequence iterations (i) that shall be run will be based upon expected card life, A (years). In the case where the test sequences are repeated the following applies:

Number of Iterations, i = 1 + A/3, rounded to the nearest whole number. The number of test iterations shall be 1 minimum and 4 maximum.

Table 3 — Number of test sequence iterations vs expected card life

Expected card life (years)	Number of test sequence iterations, i
1	1
2 to 4	2
5 to 7	3
8 and greater	4

The sequential test method tables are structured such that the testing is done sequentially from top to bottom of the tables using the parameters listed. If the number of test sequence iterations is greater than 1, then the sequential tests are performed again until the number of sequence iterations is equal to the calculated value.

7 Card functional elements supported by this document

7.1 Visual personalization

7.1.1 General

Information applied to cards using various technologies shall be durable enough so that all the information is functional for the intended card use during its life.

7.1.2 Surface printing

Cardholder data can be applied by surface printing. Surface printing also includes layers added after personalization to improve either durability or security, or both.

Surface printing includes, but is not limited to, dye diffusion thermal transfer, resin thermal transfer and ink jet. The printing can be applied directly to either the card surface or by transferring a printed media to the card surface, or both.

Protective and security layers on top of the personalization include, but are not limited to, heat transfer films, ink jet coatings or patch laminates. These elements can include security features designed to dissuade efforts to either modify card information or to counterfeit the cards, or both.

7.1.3 Raised surfaces

Cardholder data can be added to cards by technologies that cause the personalization to be from 0,26 mm to 0,48 mm above the adjacent card surface. Personalization resulting in raised surfaces include, but are not limited to, embossing (with or without topping foil), tactile identification mark (TIM) and human readable or machine-readable raised characters as given in ISO/IEC 7811-1.

7.1.4 Laser marking

Cardholder data can be added to cards by laser marking. The data is typically embedded below the card surface. Laser marking can also cause minor tactile distortion of the card surface that is typically less than that for raised surfaces. If laser marking is greater than 0,26 mm above the adjacent surface, then the personalization shall be considered a raised surface and shall be tested as such.

7.2 Card, independent of personalization

7.2.1 General

The cards, independent of personalization can contain the following functional elements.

7.2.2 IC cards with contact interface

IC cards with contact interface are cards with a contact chip that is positioned and with the electrical functions given in the ISO/IEC 7816 series.

7.2.3 IC cards with PICC or VICC interface

IC cards with PICC or VICC interface are cards that have contactless chip and antenna positioned according to antenna class and uses of the electrical functions as given in the ISO/IEC 14443 series and the ISO/IEC 15693 series.

7.2.4 Cards with magnetic stripe

Cards with magnetic stripe are cards where cardholder data can be added via encoding of magnetic stripes.

8 Card testing and requirements

8.1 General

Card functional elements dictate what tests are to be performed for conformity to this document. Expected card life and card use frequency dictates the severity of the tests and the number of test sequences, when applicable.

Tables 4 to 18 have five columns:

— Standard: this column references the standard that contains the test method.

— Test conditions:

  — This column specifies the variable run conditions that are to be used when performing the test. Example conditions include, but are not limited to, temperature, humidity, exposure time and flex cycles.

  — When set as a function of A or U, minima and maxima are often stated in square brackets; for example [min 12 h; max 120 h]. In the case where the equation output is either less than the minimum or greater than the maximum, then the limit condition values shall be used.

  - When dynamic bending tests are required, the number of bending cycles calculated shall be for each of the four orientations in the test method. For example, if 500 bending cycles per orientation are required, each card shall be sequentially tested as per below:
    - 500 cycles around axis A, front of card up, followed by;
    - 500 cycles around axis A, front of card down, followed by;
    - 500 cycles around axis B, front of card up, followed by;
    - 500 cycles around axis B, front of card down.
- Evaluation methods: The test methods used to evaluate the cards after testing.
- Requirements for visual personalization: this column dictates the requirements for conformity to this document when personalization is being tested.
- Requirements for card, independent of personalization: this column dictates the requirements for conformity to this document when card properties not related to visual personalization are being tested.

Tables 4 to 18 also have additional row(s) where exclusions, restrictions and notes on the testing are listed.

8.2 Cards for testing

Whenever possible, the stand-alone tests and test sequences should be run on fully personalized cards with all intended-use functional elements present.

This document acknowledges that there will be cases where inclusion of all functional elements is not possible and allows testing to be done in these cases. In cases where functional elements are either missing or differ from the intended issuance, or both, the known differences shall be reported along with the test results.

It is recommended that all components needed for cardholder functional use are present for this testing, but this is not needed for conformity to this document. For those functional elements present, conformance requirements are listed and apply.

8.3 Card testing and requirements

8.3.1 General

Stand-alone tests are in Tables 4 to 13. Single iteration sequential test methods are in Tables 14 to 16. Multiple iteration sequential test methods are in Tables 17 to 18. All tests are required.

Each of the test scenario tables have cells that contain requirements for "visual personalization" and "card, independent of personalization". Any cells with "NOT APPLICABLE" indicate the testing is not required and no requirements exist.

When testing for visual personalization, test cards do not need other technology features if the remaining construction is equivalent to cards with the functional elements. IC chips, antennas, magnetic stripes, etc. can be in cards used for visual personalization testing, but are not required as these components are deemed to have little to no effect on test results.

Card, independent of personalization testing does not need other technology features if the remaining construction is equivalent to cards with all functional elements. Surface printing, laser marking, etc. can be in cards used for card, independent of personalization testing but are not required.

Cards including personalization shall be subjected to the test plans for both visual personalization and card, independent of personalization.

In all cases, known differences between the tested cards and the intended issuance construction shall be noted in the test report.

Where a test result from a more severe test plan is available, this test result may be used as evidence for conformity with a less severe test plan.

Examples of more severe test results:

— higher number of dynamic bending cycles;

— longer environmental exposure times;

— higher elevated (greater than default test environment) temperatures;

— higher elevated (greater than default test environment) humidity;

— lower (less than default test environment) humidity;

— higher number of abrasion cycles;

— larger number of sequential test iterations.

8.3.2 Stand-alone test methods

8.3.2.1 Temperature and humidity aging

Table 4 — Temperature and humidity aging — Test conditions and requirements

Standard	Test conditions	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 24789-2	T = 50 °C ± 3 °C RH = 90 % to 100 % Exposure time = A × 12 h, rounded-up to the nearest multiple of 24 h [min 24 h; max 120 h]	Visual (Clause 9)	Visual (Clause 9)	Visual (Clause 9)
		Card warpage (ISO/IEC 10373-1)	3,5 mm maximum [e]	2,5 mm maximum [d]
		Dimensions of cards (ISO/IEC 10373-1)	ISO/IEC 7810; Personalized card and returned card requirements	ISO/IEC 7810; Personalized card and returned card requirements
		Delamination – Cross cut tape test (ISO/IEC 24789-2) [a]	2 maximum	NOT APPLICABLE
		Peel Strength Patches covering graphical personalization (ISO/IEC 10373-1) [b]	0,25 N/mm minimum	NOT APPLICABLE
		Testably functional (ISO/IEC 10373-1)	NOT APPLICABLE	All functional elements shall remain testably functional
		Adhesion of ICM to Card Push Test (ISO/IEC 24789-2) [c]	NOT APPLICABLE	= 0,5 N/mm^2 × ICM Width × ICM Height [min 50 N] Rupture of the ICM at a force below the requirement value is also a compliant test result
		Peel strength Card body layers (ISO/IEC 10373-1)	NOT APPLICABLE	0,35 N/mm minimum
Restrictions	[a] Limited to cards having a continuous thin film coating applied (heat transfer film, ink jet varnish or other) on top of cards with minimum width and height of 25 mm × 25 mm. This requirement does not apply to patches or surface coatings smaller than the test grid, nor does it apply to personalization without the thin film coatings. [b] Limited to cards with patches covering visual personalization. [c] Limited to cards with contact IC. [d] Limited to cards without visual personalization. [e] Most cards will function without issue when warpage after this environmental exposure sequence is at the upper limit. While no known field issues have been reported, there is concern about use of such cards in insert readers. The user of this standard is advised to verify insert reader functionality when warpage after this test sequence exceeds 2,5 mm.			

8.3.2.2 Plasticized vinyl storage

Table 5 — Plasticized vinyl storage — Test conditions and requirements

Standard	Test conditions	Evaluation methods [a] (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 24789-2	Exposure time = A × 12 h, rounded-up to the nearest multiple of 24 h [min 24 h; max 120 h]	Visual (Clause 9)	Visual (Clause 9)	NOT APPLICABLE
Exclusion	Cards with raised surfaces are excluded from this test requirement as the raised surfaces prevents intimate contact with the vinyl sheets.			
[a] Evaluating robustness of the card against vinyl storage is an important aspect of evaluating the card's service life. It is therefore recommended to conduct this test on unembossed samples, instead of just skipping this test.				

8.3.2.3 Resistance to heat

Table 6 — Resistance to heat — Test conditions and requirements

Standard	Test conditions [a]	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 10373-1	User-defined maximum storage temperature [min 50 °C; max 85 °C]	ISO/IEC 10373-1	NOT APPLICABLE	10 mm maximum
Exclusion	The standard value for cards is 50 °C as defined in ISO/IEC 7810. If the user-defined maximum value is 50 °C, then ISO 7810 conformity eliminates the need for this test requirement as it is redundant testing.			
[a] Care shall be taken when selecting the maximum storage temperature as many card constructions cannot sustain higher temperatures.				

8.3.2.4 Magnetic stripe abrasion (Taber)

Table 7 — Magnetic stripe abrasion (Taber) — Test conditions and requirements

Standard	Test conditions	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 24789-2	Cycles = (50 × A) + (2 × A × U) [min 50, max 350] rounded to nearest 50 cycles	ISO/IEC 24789-2	NOT APPLICABLE	$U_A > 0{,}7 \times U_{A\ initial}$
Restrictions	Limited to cards having magnetic stripes.			

8.3.2.5 Surface abrasion (Taber)

Table 8 — Surface abrasion (Taber) — Test conditions and requirements

Standard	Test conditions	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 24789-2	Cycles = 4,5 × A × U rounded-up to nearest multiple of 10 [min 10; max 450]	ISO/IEC 24789-2	Visual (Clause 9)	Visual (Clause 9)
Exclusions	Cards with raised surfaces are excluded from this test requirement if the raised surfaces are located such that the Taber path cannot be routed to avoid them. Cards with patches are excluded from this test requirement as 450 cycles will not result in visual non-conformity. Card bodies without features applied over lamination overlays are excluded from this requirement as 450 Taber cycles will not result in visual non-conformity. Features applied after lamination that are not excluded include but are not limited to overprint varnishes, signature panels and hot stamp holograms.			

8.3.2.6 3-Wheel exposure

Table 9 — 3-wheel exposure — Test conditions and requirements

Standard	Test conditions	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 10373-1	Test shall be run with contact side up orientation only. No cycles shall be run with contact side down. Force = 8 N Cycles = 10 × A × U rounded to nearest multiple of 50 [min 100; max 300]	Testably functional (ISO/IEC 10373-1)	NOT APPLICABLE	All functional elements shall remain testably functional
Exclusions	Cards without contact interface are excluded from this test requirement.			

8.3.2.7 ID card flexure around Axis A

Table 10 — ID card flexure around Axis A — Test conditions and requirements

Standard	Test conditions	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 24789-2	Cycles = 500 × A × U rounded-up to nearest multiple of 1 000 [min 1 000; max 50 000]	Visual (Clause 9)	NOT APPLICABLE	Visual (Clause 9)
		Testably functional (ISO/IEC 10373-1)	NOT APPLICABLE	All functional elements shall remain testably functional
Exclusions	Cards with the following functional elements are excluded from the testing and requirements: ICC with contact interface, dual interface, raised surfaces, and ICM exposed on surface.			

8.3.2.8 ID card flexure around Axis B

Table 11 — ID card flexure around Axis B — Test conditions and requirements

Standard	Test conditions	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 24789-2	Cycles = 250 × A × U rounded-up to nearest multiple of 500 [min 500; max 25 000]	Visual (Clause 9)	NOT APPLICABLE	Visual (Clause 9)
		Testably functional (ISO/IEC 10373-1)	NOT APPLICABLE	All functional elements shall remain testably functional
Exclusions	Cards with the following functional elements are excluded from the testing and requirements: ICC with contact interface, dual interface, raised surfaces and ICM exposed on surface.			

8.3.2.9 Dynamic bending stress

Table 12 — Dynamic bending stress — Test conditions and requirements

Standard	Test conditions [a]	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 10373-1	Cycles per orientation = (125 × A × U) + 250 rounded to nearest multiple of 250 [min 250; max 1 000]	Visual (Clause 9)	Visual (Clause 9)	Visual (Clause 9)
		Testably functional (ISO/IEC 10373-1)	NOT APPLICABLE	All functional elements shall remain testably functional
[a] An upper limit of 1 000 cycles per card orientation is reasonable; conducting this test beyond 1 000 cycles has not been proven to result in card constructions being more reliable in the field.				

8.3.2.10 Adhesion of ICM to card — Wrapping test

Table 13 — Adhesion of ICM to card — Wrapping test — Test conditions and requirements

Standard	Test conditions	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 24789-2	Contacts facing up Wrapping cycles = 10	Visual check for ICM detachment	NOT APPLICABLE.	ICM shall remain attached
Restrictions	Test is only required for cards having an ICM exposed on the card surface.			

8.3.3 Single iteration sequential test methods

8.3.3.1 Temperature exposure with humidity variation

Table 14 — Temperature exposure with humidity variation — Test conditions and requirements

Standard	Test conditions	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 24789-2	All cards shall be exposed to both exposure methods 1st Exposure T = 50 °C ± 3 °C RH = 90 % to 100 % Exposure time = 60 h followed by 2nd Exposure T = 50 °C ± 3 °C RH = 20 % to 30 % Exposure time = 6 h	Visual (Clause 9)	Visual (Clause 9)	Visual (Clause 9)
		Card warpage (ISO/IEC 10373-1)	3,5 mm maximum [e]	2,5 mm maximum [d]
		Dimensions of cards (ISO/IEC10373-1)	ISO/IEC 7810; Personalized card and returned card requirements	ISO/IEC 7810; Personalized card and returned card requirements
		Delamination – Cross cut tape test (ISO/IEC 24789-2) [a]	2 maximum	NOT APPLICABLE
		Peel Strength Patches covering graphical personalization (ISO/IEC 10373-1) [b]	0,25 N/mm minimum	NOT APPLICABLE
		Testably functional (ISO/IEC 10373-1)	NOT APPLICABLE	All functional elements shall remain testably functional
		Adhesion of ICM to Card Push Test (ISO/IEC 24789-2) [c]	NOT APPLICABLE	= 0,5 N/mm^2 × ICM Width × ICM Height [min 50 N] Rupture of the ICM at a force below the requirement value is also a compliant test result
		Peel Strength Card body layers (ISO/IEC 10373-1)	NOT APPLICABLE	0,35 N/mm minimum
Restrictions	[a] Limited to cards having a continuous thin film coating applied (heat transfer film, ink jet varnish or other) on top of cards with minimum width and height of 25 mm × 25 mm. This requirement does not apply to patches or surface coatings smaller than the test grid, nor does it apply to personalization without the thin film coatings. [b] Limited to cards with patches covering visual personalization. [c] Limited to cards with contact IC. [d] Limited to cards without visual personalization. [e] Most cards will function without issue when warpage after this environmental exposure sequence is at the upper limit. While no known field issues have been reported, there is concern about use of such cards in insert readers. The user of this standard is advised to verify insert reader functionality when warpage after this test sequence exceeds 2,5 mm.			

8.3.3.2 Exposure to artificial perspiration

Table 15 — Exposure to artificial perspiration — Test conditions and requirements

Standard	Test conditions	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 10373-1	All cards shall be exposed to both exposure methods 1st Exposure Alkaline Exposure time = 24 h followed by 2nd Exposure Acidic Exposure time = 24 h	Visual (Clause 9)	Visual (Clause 9)	Visual (Clause 9)
		Card warpage (ISO/IEC 10373-1)	2,5 mm maximum	2,5 mm maximum
		Dimensions of cards (ISO/IEC10373-1)	ISO/IEC 7810; Personalized card and returned card requirements	ISO/IEC 7810; Personalized card and returned card requirements
		Delamination – Cross cut tape test (ISO/IEC 24789-2) [a]	2 maximum	NOT APPLICABLE
		Peel Strength Patches covering graphical personalization (ISO/IEC 10373-1) [b]	0,25 N/mm minimum	NOT APPLICABLE
		Testably functional (ISO/IEC 10373-1)	NOT APPLICABLE	All functional elements shall remain testably functional
		Adhesion of ICM to card push test (ISO/IEC 24789-2) [c]	NOT APPLICABLE	= 0,5 N/mm^2 × ICM Width x ICM Height [min 50 N] Rupture of the ICM at a force below the requirement value is also a compliant test result
		Peel strength Card body layers (ISO/IEC 10373-1)	NOT APPLICABLE	0,35 N/mm minimum
Restrictions	[a] Limited to cards having a continuous thin film coating applied (heat transfer film, ink jet varnish or other) on top of cards with minimum width and height of 25 mm × 25 mm. This requirement does not apply to patches or surface coatings smaller than the test grid, nor does it apply to personalization without the thin film coatings. [b] Limited to cards with patches covering visual personalization. [c] Limited to cards with contact IC.			

8.3.3.3 Temperature exposure with humidity variation followed by dynamic bending stress

Table 16 — Temperature exposure with humidity variation followed by dynamic bending stress — Test conditions and requirements

Standard	Test conditions	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 24789-2	1st Exposure T = 50 °C ± 3 °C RH = 90 % to 100 % Exposure time = 60 h	Visual (Clause 9)	Visual (Clause 9)	Visual (Clause 9)
ISO/IEC 24789-2	2nd Exposure T = 50 °C ± 3 °C RH = 20 % to 30 % Exposure time = 6 h			
ISO/IEC 24789-2	3rd Exposure Conditioning at default environment Time = [min 16 h; max 72 h]			
ISO/IEC 10373-1	4th Exposure Dynamic Bending Stress Cycles per Orientation = (125 × A × U) + 250 rounded to nearest multiple of 250 [min 250, max 1 250]	Testably functional (ISO/IEC 10373-1)	NOT APPLICABLE	All functional elements shall remain testably functional
ISO/IEC 24789-2	5th Exposure Conditioning at default environment Time = [min 16 h; max 72 h]			
Cards are submitted to all five test condition exposures before running the evaluation methods for compliance to this document. The user of this document may run the evaluation methods between exposures, but these evaluations are not required for compliance testing.				

8.3.4 Multiple iteration sequential test methods

8.3.4.1 General

The following test sequences shall be performed using the test methods and parameters defined in Tables 17 to 18. The number of test sequence iterations (to be designated by "i") to be performed will be based upon expected service life as per 6.4.

Evaluation methods shall be completed after the final test iteration to determine conformity to this document.

8.3.4.2 Temperature and humidity aging alternating with dynamic bending stress

Table 17 — Temperature and humidity aging alternating with dynamic bending stress — Test conditions and requirements

Standard	Test conditions for each test sequence iteration	Evaluation methods (reference document)	Requirements applicable to:	
			Visual personalization	Card, independent of personalization
ISO/IEC 24789-2	1st Exposure T = 50 °C ± 3 °C RH = 90 % to 100 % Exposure time = (A × 12 h) / i rounded to the nearest multiple of 3 h [min 3 h, max 30 h]	Visual (Clause 9)	Visual (Clause 9)	Visual (Clause 9)
ISO/IEC 24789-2	2nd Exposure Conditioning at default environment Time = [min 16 h; max 72 h]	Testably functional (ISO/IEC 10373-1)	NOT APPLICABLE	All functional elements shall remain testably functional
ISO/IEC 24789-2	3rd Exposure Dynamic Bending Stress Cycles per orientation = ((125 × A × U) +250) / i rounded to nearest multiple of 100 [min 100, max 1 200 / i]			
ISO/IEC 24789-2	4th Exposure Conditioning at default environment Time = [min 16 h; max 72 h]			
Cards are submitted to all five test condition exposures before running the evaluation methods for compliance to this document. The user of this document may run the evaluation methods between exposures, but these evaluations are not required for compliance testing.				