INTERNATIONAL STANDARD

ISO/IEC 18745-1

Second edition
2018-07

Test methods for machine readable travel documents (MRTD) and associated devices —

Part 1: Physical test methods for passport books (durability)

Méthodes d'essais pour documents de voyage lisibles par machine et dispositifs associés —

Partie 1: Méthodes d'essais physiques pour livrets de passeport (durabilité)

Reference number
ISO/IEC 18745-1:2018(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by 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 18745-1:2014), which has been technically revised.

The main changes compared to the previous edition are as follows:

— test definitions have been detailed;

— instructions to evaluate test results have been clarified;

— the definition of the foam to be used in 8.6.4 book bend stress method has been changed to enhance the accessibility to the foam needed;

— test sequences have been updated to create more realistic test results;

— references have been updated.

A list of all the parts in the ISO/IEC 18745 series can be found on the ISO website.

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.

Introduction

0.1 General

ICAO Doc 9303 provides the basic functional specification for Machine Readable Travel Documents (MRTDs) and, together with the Supplement, which is published from time to time, describes all relevant properties of MRTDs. Machine Readable Passports (MRPs) are a subset of all MRTDs. The publication of Part 1 of the 6th edition of Doc 9303 introduces the contactless integrated circuit to the MRP. Such a passport containing a contactless integrated circuit is commonly referred to as an e-Passport.

This document provides a set of instructions for the evaluation of MRPs which may incorporate contactless integrated circuits. This document is a companion to ICAO Doc 9303. It specifies the minimum criteria to be achieved in order to meet ICAO's expectations for durability of fully personalized MRPs. Therefore, by its existence, and endorsement by ICAO, this document implicitly defines additional requirements for passports above and beyond ICAO Doc 9303. Some of the tests described herein are also intended to serve as an instrument for the assessment of the ageing behaviour of the MRP and its components.

This document updates and replaces the document "ICAO Technical Report – Durability Of Machine Readable Passports" published by ICAO (International Civil Aviation Organization).

0.2 Future considerations

Where technologies or combinations of technologies are to be applied in an MRP, which are not covered by the test methods described below, it is recommended to define such test methods based on available methods described in ISO/IEC standards or any other accepted standards from other international standard organizations in cooperation with the suppliers of such technologies.

Today, there is no stable state of the art regarding the correlation between stress and ageing, neither for previously existing nor for oncoming types of MRPs. The tests that can be described at the present stage may contribute to improving such knowledge but need to be considered preliminary. It is important to notice that ultimately, reliable and predictably useful correlations can only be achieved by continuously comparing the ageing behaviour of documents in real use to the predictions made. Such predictions are based on assumptions that, in particular if novel and unusual technologies and components are used, they are in many cases unproven and preliminary in nature.

It is one of the aims of this document to help in the task of establishing sound correlations. This is done by providing tools for executing tests with comparable results for a multitude of acting parties. Comparable results are a prerequisite to encourage the execution of field surveys in quality related research and their use for a continuous improvement not only of this document but also of the quality of MRPs on a global basis.

0.3 Other uses for this document

The tests defined in this document may also be appropriate for other forms of MRTDs, however, they may require modification before use.

Where applicable, tests may be used to evaluate characteristics of non-personalized MRPs or materials used to make MRPs.

Type evaluation is usually a one-time exercise in the life cycle of a specific type of document. However the same test procedures may be useful for the proper definition of quality assurance procedures during the regular production of MRTDs. In the framework of the contractual relationship between a manufacturer and its customer(s) it is common practice to establish an expected quality level for the MRTDs in the delivery contract, and also to specify acceptance criteria for individual deliveries in executing the contract. On the other hand, it is good practice to leave it with the manufacturer to decide on the production quality measures to assure this quality level.

This document has been carefully designed to provide the user with a set of tools for evaluating MRPs, whether it be prototype evaluation, delivery acceptance or any other purpose.

Test methods for machine readable travel documents (MRTD) and associated devices —

Part 1: Physical test methods for passport books (durability)

1 Scope

This document provides a set of instructions for evaluation of MRPs which may incorporate contactless integrated circuits. This evaluation is an instrument to establish the ability in principle of a specific type of document to fulfil the requirements of use. It supplies a structured approach to evaluate MRPs by:

— defining reproducible stress methods to submit the document(s) under evaluation to specific stress or environmental conditions;

— defining reproducible evaluation methods to measure numerical values for specific document properties;

— defining test sequences that specify the order in which stress methods and evaluation methods are to be performed;

— defining test plans to link specific user requirements to test sequences and related parameters.

It specifies the minimum criteria to be achieved in order to meet ICAO's expectations for durability of fully personalized MRPs.

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 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 105-B02, *Textiles — Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon arc fading lamp test*

ISO 105-E04, *Textiles — Tests for colour fastness — Part E04: Colour fastness to perspiration*

ISO 2439:2008, *Flexible cellular polymeric materials — Determination of hardness (indentation technique)*

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

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO/IEC 10373-1:2006, *Identification cards — Test methods — Part 1: General characteristics*

ISO 12757-2, *Ball point pens and refills — Part 2: Documentary use (DOC)*

ISO/IEC 18745-2:2016, *Information technology — Test methods for machine readable travel documents (MRTD) and associated devices — Part 2: Test methods for the contactless interface*

ASTM E 832-81*(Reapproved 2003), Standard Specification for Laboratory Filter Papers*

3 Terms and definitions

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

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

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

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

3.1
chip sheet
sheet containing a chip

3.2
constant
fixed values that can be given to parameters (within methods) when defining a sequence or test plan

3.3
evaluation method
method to measure numerical values for specific document properties

3.4
evaluation result
all numerical values related to document properties measured upon performing a test sequence

3.5
method
instruction or set of instructions defining equipment and related tools and materials in an experimental setup, including general advice on their use in a specific test procedure

3.6
page
any single side of an individual sheet of the MRP

3.7
parameter
variable quantity within a test procedure that is not part of the instructions describing the procedure; in particular, experimental parameters that need to be controlled during the test sequence but whose values and/or tolerances are not explicitly defined in a specific stress or evaluation method or sequence

3.8
sheet
any structure having a free edge and an opposite edge attached to the spine making up the MRP including covers, datapage, visa pages, observation pages and chip sheet

Note 1 to entry: Each sheet has two pages.

3.9
stress method
experimental setup and procedure that may or may not deteriorate or destroy the document under examination

3.10
test instruction
distinct piece of information required within the framework of test execution

3.11
test plan
list of test sequences and their specific test parameters and expected evaluation results

3.12
test procedure
set of instructions to be followed in order to obtain a test result

3.13
test sequence
test procedure that comprises a number of different methods in a defined order of execution

3.14
type evaluation
type approval
process of testing a design (type of documents produced while using a common material and component basis and the same manufacturing processes, including same production quality assurance process) to ensure it is compliant-in-principle with the specifications

4 Abbreviated terms

IC Integrated Circuit

ICAO International Civil Aviation Organization

MRP Machine Readable Passport

MRTD Machine Readable Travel Document

MRZ machine-readable zone

NSS Neutral Salt Spray

PCD Proximity Coupling Device

PIC Proximity Integrated Circuit

NOTE ICAO 9303 uses CIC (contactless integrated circuit) and PIC interchangeably.

RH relative humidity

VIZ Visual Inspection Zone

5 Methodology

The systemic approach used in this document provides three structural levels to define a complete test specification for MRPs.

The first level deals with methods to exert defined stresses to documents and to evaluate the results of such stresses. The second level deals with predefined sequences of stresses and related evaluations using the methods defined in level 1. The third level specifies the lists of test sequences and the individual quantities of test specimens to be subject to each sequence. The purpose is to include in such lists all sequences that are considered necessary to achieve type approval for a specific type of MRP with specific lifetime and usage expectations. This is referred to as a test plan.

This approach provides flexibility in creating individual test plans appropriate for varying user requirements and MRP specifications without increasing the variety of basic testing methods beyond a strict minimum. It also allows the use of a parameterized method description; parameters, which may be explicitly specified on the sequence and/or test, plan level.

In this way this document provides the entire toolset for prototype evaluation of MRPs.

Table 1 — Hierarchical approach for test methodology

Level	Subject	Description	Degree of variance	Clause
1	Stress methods	The purpose is to submit the document(s) under evaluation to specific stress or environmental conditions in a well-defined experimental setup that ensures reproducibility.	Parameters	Clause 8
1	Evaluation methods	The purpose is to measure numerical values for specific document properties using well-defined and reproducible experimental setups that may or may not deteriorate or destroy the document under examination.	Parameters	Clause 9
2	Test sequences	Sequence of use of the above methods in performing a complete test.	Constants and Parameters	Clause 10
3	Test plans	Scenarios which link the user requirements to specific test sequences and related parameters used for the tests on the one hand and to specific test results on the other.	Constants	Clause 11

Each sequence is composed of stress methods and evaluation methods executed in a specific order. A test plan is composed of one or more individual sequence(s) that is linked to a specific set of documents and user requirements. See Figure 1.

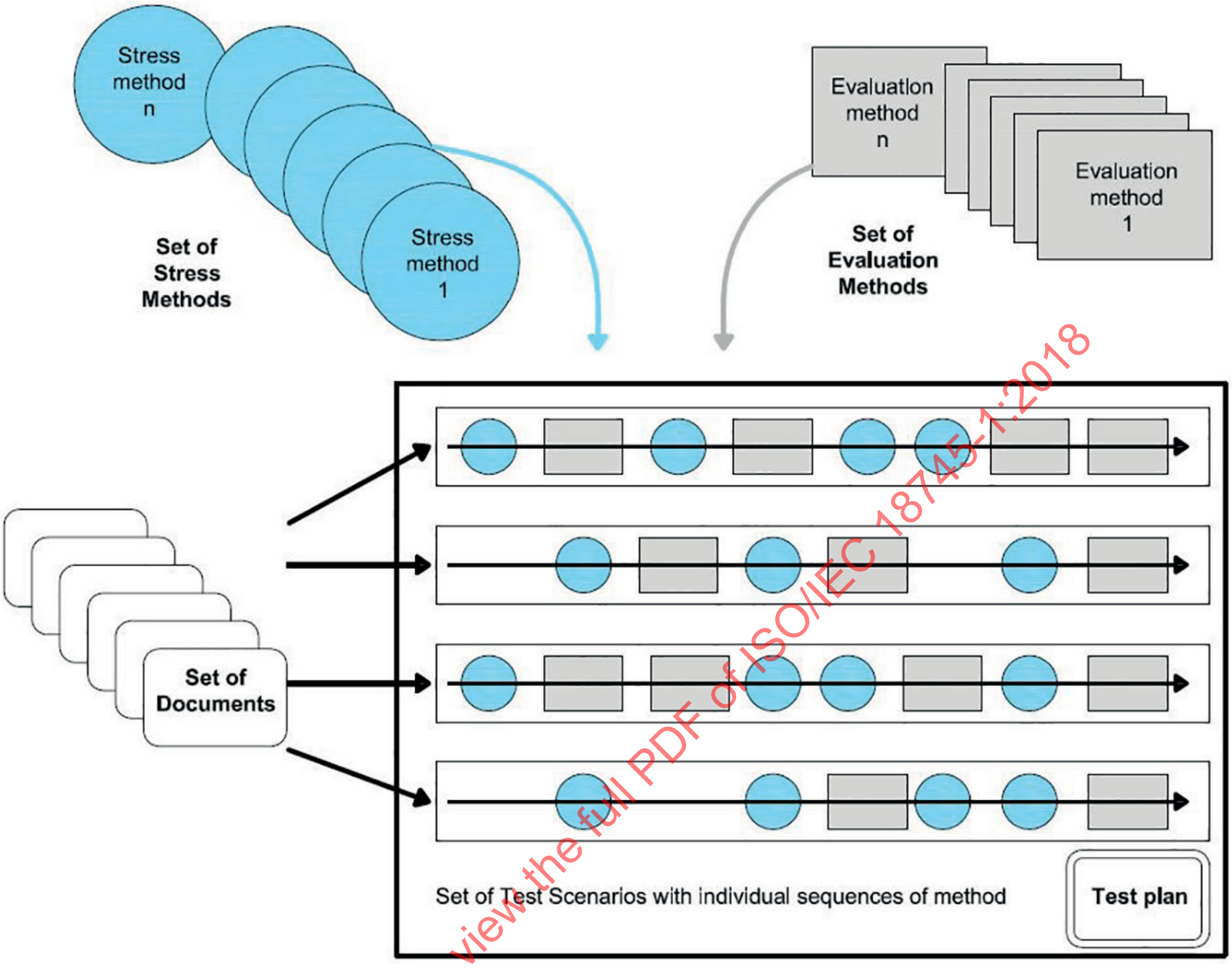

Figure 1 — Relationship between methods, sequences and test plans

6 Guidance to the tester

6.1 Number of samples

References are given to a single MRP. However, multiple MRP samples may be tested simultaneously depending on the size and construction of the test apparatus.

6.2 Preparation

Test samples shall be either finished MRPs or be prepared from finished MRPs having passed the entire production process including visual personalization with a dataset considered typical for the specific type of passport. Initialisation and personalization of the chip may be done in an arbitrary way as long as the chip is able to support the necessary tests within the intended test sequence.

MRPs shall be conditioned in accordance with 7.1.

Test pieces shall, as necessary, be prepared from the test samples in the particular form required by the test apparatus used.

6.3 Sampling

For testing samples may be taken from the base material before MRP manufacture if it can be demonstrated that no significant change in the property to be tested can arise during subsequent processing. The samples used to prepare a set of test pieces shall be taken from the same batch of MRP base materials.

6.4 Storage

Any test samples or test pieces retained for reference shall be stored under the environmental conditions specified in 7.1.

All such samples shall be clearly cross-referenced to the test report and any relevant supplementary documentation.

7 Common method information

7.1 Default environment

Unless otherwise specified, testing shall take place in an environment having a default temperature of 23 °C ± 3 °C and 40 % RH to 60 % RH.

7.2 Climatic conditions

Climatic conditions defined in the test methods are the conditions within the chamber. The resulting temperature in the MRP is not specified or defined in the methods.

7.3 Tolerances

Unless otherwise specified, a tolerance of ±5 % shall be applied to the quantity values given in this document.

7.4 Default MRP holder

A structure for holding the MRP while maximizing air space around the MRP during testing shall have the general construction as shown in Figure 2. There are no size or quantity limitations for the holder rack, any number of MRP positions may be used. For the wire and the square rod use a non-corrosive material.

Dimensions in millimetres

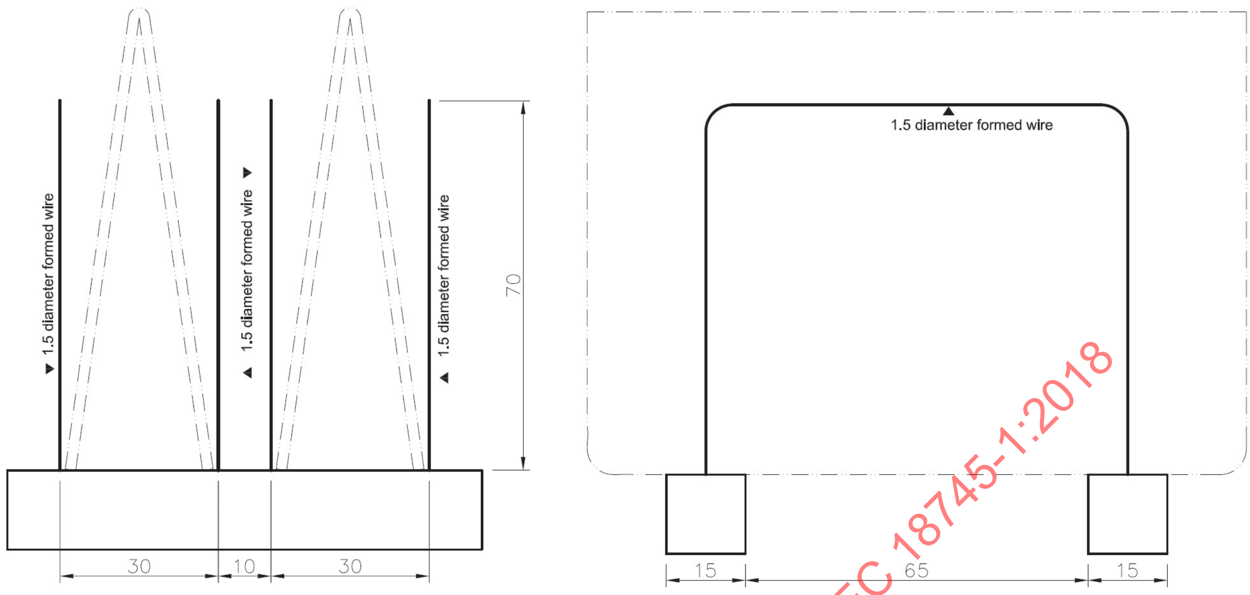

Figure 2 — MRP rack

8 Stress methods

Stress methods are designed to apply reproducible stresses to the travel document. Methods that describe how to measure the effect of these stresses are given in Clause 9.

The fundamental philosophy behind all stress methods is to define conditions that mimic real daily use (as much as possible). In cases where the correlation between real life and the stress method is tenuous, every attempt has been made to define conditions that produce similar rates of deterioration.

8.1 Conditioning stress method

8.1.1 General

The MRPs to be tested shall be conditioned to the test environment as described below.

8.1.2 Input Parameters

t = time of conditioning. If t is not specified, assume 24 h.

8.1.3 Apparatus

8.1.3.1 Default MRP holder.

8.1.4 Method

— Remove MRP from any box and protective packaging.

— Place MRP in default MRP holder with spine up. MRP shall not be forced open but may open on its own. Minimum spacing between MRP and any other MRP shall be 10 mm in all directions.

— Expose MRP to a temperature of 23 °C ± 3 °C and 40 % RH to 60 % RH for at least time t.

8.2 Thermal cycling stress method

8.2.1 General

This stress method subjects the MRP to cycling between two temperature extremes. This stress simulates the thermal shock the MRP could experience due to thermal expansion and contraction of each MRP component. The test is conducted over a short period of time for each stress cycle.

8.2.2 Input parameters

n = number of cycles.

8.2.3 Apparatus

8.2.3.1 Two temperature controlled chambers, where applicable, a single fast-response temperature controlled chamber may be used in place of a second test chamber.

8.2.3.2 Default MRP holder.

8.2.4 Method

— Control of relative humidity in the temperature chambers is not required for this test but the test chamber should be located in a test environment as defined in 7.1.

— Place in a temperature controlled chamber at a temperature of 77 °C ± 3 °C for 15 min.

— Transfer the MRP in the default MRP holder to a second temperature controlled chamber held at a temperature of −32 °C ± 3 °C in less than 60 s (a transfer time of 15 s is recommended). The position of the MRP in the holder should not be modified during the transfer process.

— Subject the MRP to a temperature of −32 °C ± 3 °C for 15 min.

— Repeat the process for n cycles as depicted in Figure 3. Allow chamber to regain test conditions.

— At the end of the cycling process remove MRP and return to the default environment. Leave MRP in holder and condition according to 7.1.

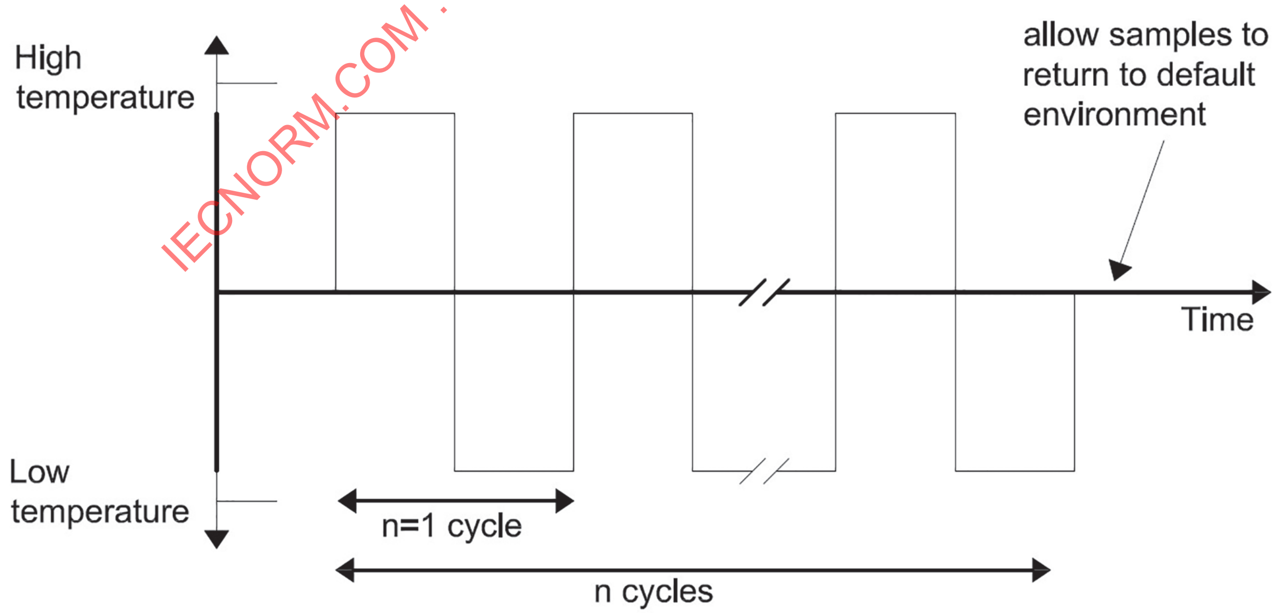

Figure 3 — Thermal cycling

8.3 Storage temperature stress method

8.3.1 General

This stress method applies high or low temperature and humidity to the document for specified amounts of time. This stress simulates a document's exposure to various storage conditions. The purpose of the test is to demonstrate the resistance of MRP construction to such conditions in principle.

The test refers to temperature stability defined in ICAO Doc 9303, 7th Edition, Part 3.

8.3.2 Input parameters

T = temperature at which the passport is stored.

H = relative humidity for storage.

8.3.3 Apparatus

8.3.3.1 Climate controlled chamber.

8.3.3.2 Default MRP holder.

8.3.4 Method

— Place MRP in a climate controlled chamber at temperature T ± 3 °C and H ± 5 % RH for 168 h.

— Remove MRP.

— Evaluate within 30 min after completion.

8.4 Operational climate stress method

8.4.1 General

This stress method applies high or low temperature and humidity to the document for specified amounts of time. This stress simulates a document's exposure to various climatic conditions. The purpose of the test is to demonstrate the resistance of MRP construction to such conditions in principle.

The test refers to temperature stability defined in ICAO Doc 9303, 7th Edition, Part 3.

8.4.2 Input Parameters

T = temperature at which the passport is expected to operate.

H = humidity at which the passport is expected to operate.

8.4.3 Apparatus

8.4.3.1 Climate controlled chamber.

8.4.3.2 Default MRP holder.

8.4.4 Method

— Place MRP in a climate controlled chamber at temperature T ± 3 °C for 1 h.

— Remove the MRP from the climate chamber, evaluate and note the used method in the test report and return the MRP to chamber for test completion.

— Evaluate within 30 s.

8.5 Impact stress method

8.5.1 General

This stress method applies a certain forced impact to the sample to simulate stamping of the document at a border control point.

8.5.2 Input parameters

S = sheet to be affected by impact. As only visa pages will be impacted, sheet S may not be impacted directly.

The stamping test shall be conducted on the first visa page in a passport that overlays the IC page, when the passport book is opened for stamping.

8.5.3 Output parameters

None.

8.5.4 Apparatus

8.5.4.1 Stamp

The face of the stamp is a flat solid surface, steel or equivalent, with a diameter 29 mm.

Concentric circles are etched into the surface. The profile of the grooves is rectangular, with a minimum groove depth 0,3 mm. The width of the grooves is 1 mm ± 0,1 mm, and the nominal distance between grooves is 1,5 mm. See Figures 4 and 5.

The nominal diameter of the central circular groove is 1 mm.

The accumulated tolerance of groove distances is ±0,5 mm.

Dimensions in millimetres

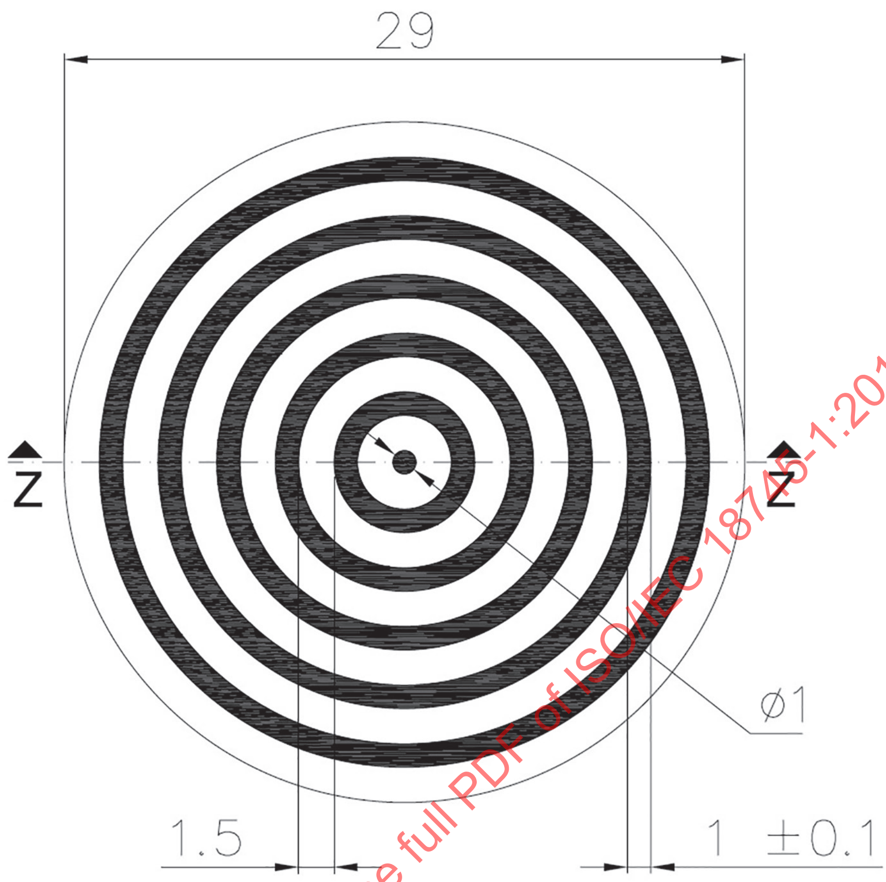

Figure 4 — Impact pattern resulting from specified stamp

Dimensions in millimetres

Figure 5 — Stamp geometry

8.5.4.2 Stamp construction

— The stamp/weight shall be constructed as a single-piece stamp of mass M.

— Flat surface made of steel at least 12 mm thick with a 2 mm surface material.

— The surface material shall have a Shore D value of 50.

— Suitable guiding for stamp to maintain stamping face parallel to MRP surface at the point of impact.

— Holder for retaining pages of the MRP against the flat surface during testing.

8.5.4.3 Description of stamp parameters

H = nominal height (mm) from which an impact stamp is dropped onto the document or weight is dropped onto the stamp, thereby defining an impact velocity according to the formula for acceleration of inert bodies under earth gravitation.

H shall be between 0,05 m and 0,20 m.

M = weight (kg) of the impact stamp.

D = displacement between two impacts.

The product P = H·M shall have a value of 0,02 kg·m.

If the apparatus is composed of a stamp that is impacted by a separate weight, the weight shall have mass M, and be dropped from a height H above the stamp. The mass of the stamp is not considered.

8.5.5 Method

— Locate the sheet S.

— Locate the nearest visa page that could require stamping and turn this over on top of the sheet under test. Depending on location, there can be several sheets between the sheet S and the nearest visa page.

— Open MRP to 180°and place on a flat hard surface so the outer cover is directly against the flat surface.

— Drop impact stamp of mass M from a height H at each of the locations as shown in Figure 6. Move from first to last location progressing from left to right and from top to bottom.

— If there are visa pages that could require stamping on the opposite side of the sheet under test, repeat the above process on the other side, but using a different MRP.

— Evaluate within 30 min after completion.

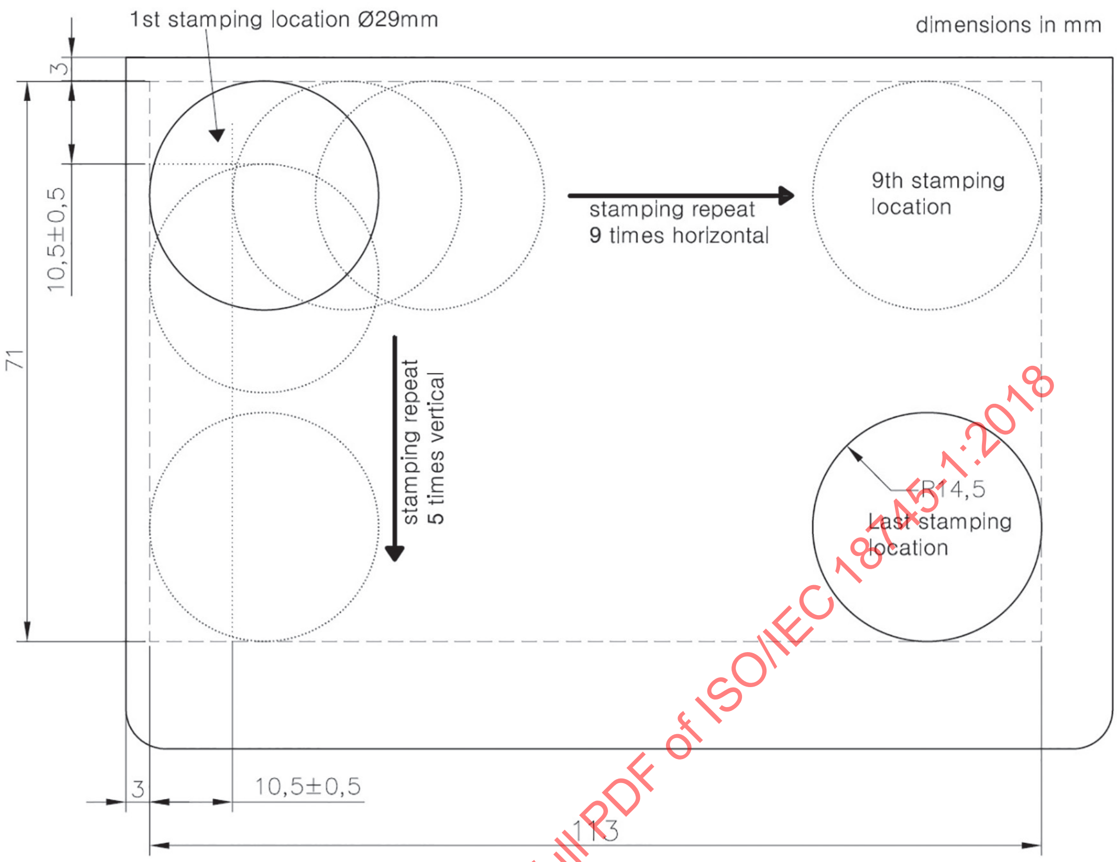

Figure 6 — Impact stamp locations

8.5.6 Alternate method

If the fragile area is obvious it is acceptable to limit drops to this area.

8.6 Book bend stress method (back pocket)

8.6.1 General

This test simulates the stresses of sitting on an MRP. This method applies a force to the MRP and forces it to bend around a curved surface. The resulting stresses acting on the MRP are a combination of compression and bending stresses.

8.6.2 Input parameters

n = number of cycles to apply force.

8.6.3 Output parameters

None.

8.6.4 Apparatus

8.6.4.1 Test apparatus, to load the MRP in a manner consistent with Figure 7 below.

8.6.4.2 **Anvil**, of non-elastic material with spherical impact area of radius r = 150 mm.

— Diameter of anvil: ≥ 95 mm × 125 mm.

8.6.4.3 **Cushion of foam**, having a density of 30 g/l to 55 g/l and a hardness of 150 N to 265 N as defined in ISO 2439 method A. The minimum thickness of the cushion is 100 mm. The minimum dimension, in any direction, of the cushion surface on which the sample is placed shall be larger than 200 mm and shall be larger than the anvil.

8.6.4.4 Alternatively, an **air cushion,** inflated to a pressure of 5 kPa to 20 kPa may be used. The chosen value also depends on the geometry of the anvil.

The test results do not depend on the exact properties of the cushion as long as:

a) its resistance to the force exerted by the sample under the anvil is sufficient to support the sample so that the force is not deviated from the sample (i.e. the activated anvil shall not touch the cushion directly as long as the bending of the sample is not entirely following the anvil shape);

b) its elasticity is sufficient to follow the anvil shape without irregular deformations;

c) its resistance to the exerted pressure is not subject to local deviations or irregularities.

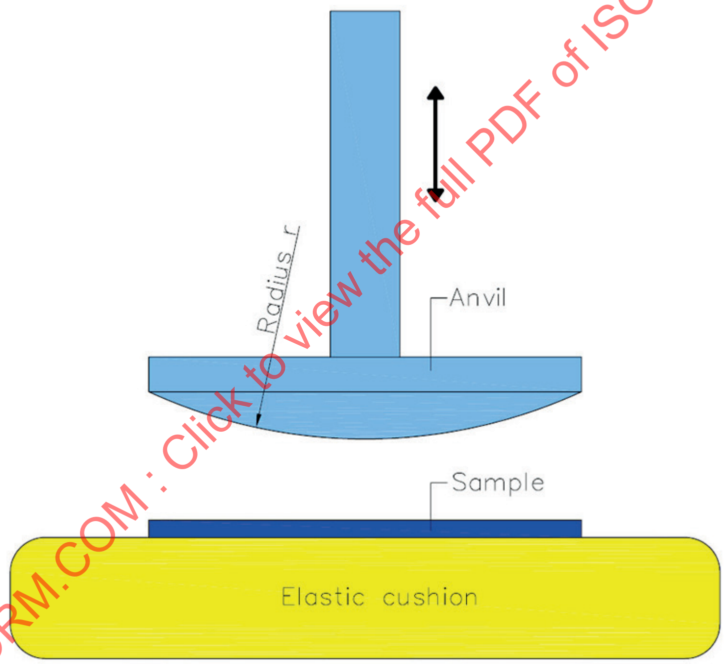

Figure 7 — Schematic of the test apparatus to load the MRP in the back pocket bending method

8.6.5 Method

— Place and centre the MRP with respect to the cushion and the spherical anvil. Start with front cover (hot stamped).

— Secure the MRP on the test machine so that the centred placement can be maintained during testing. A flexible support pocket constructed from fabric such as denim may be used.

— Press the spherical anvil into the MRP and cushion support to a maximum force of 350 N. Maintain the applied force of 350 N for 5 s ± 1 s.

— Lift the spherical anvil so that it does not touch the MRP or cushion. Repeat the loading and unloading process for a total of n times.

— Turn the MRP over and repeat the loading and unloading process n times.

8.7 Dynamic bend stress method

8.7.1 General

The purpose of this test is to determine the bending fatigue resistance of the booklet construction to fully reversed loading. This method differs from the back pocket stress method by avoiding directly applied pressure. This method accelerates fatigue due to imposed bending, especially in the area of the antenna and associated connections if present.

8.7.2 Input parameters

n = number of bending cycles with the MRP.

O = orientation of book in the bender.

8.7.3 Output parameters

None.

8.7.4 Apparatus

8.7.4.1 Dynamic flexion machine, as illustrated in Figure 8.

Dimensions in millimetres

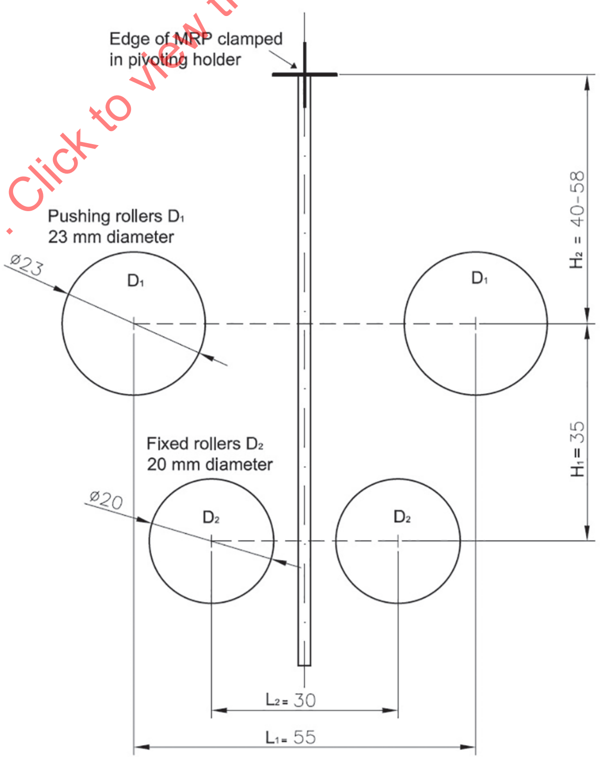

Figure 8 — Apparatus to impose cyclic motion

— The pushing rollers shall be set to ensure that the centreline deflection of the MRP is equal on each segment of the stroke.

— The distance H_2 between the clamped edge of the MRP and the pushing rollers on centre is adjustable between 40 mm and 58 mm.

— Pushing rollers and fixed rollers are separated by 35 mm (H_1) on centre.

— Pushing rollers have an outer diameter D_1 of 23 mm and are separated by 55 mm (L_1) on centre.

— Fixed rotating rollers are separated by a distance of 30 mm (L_2) on centre and have an outer diameter D_2 of 20 mm.

8.7.5 Calibration of movement method

— Use different samples for vertical and horizontal calibration. To reduce dispersion effects from one sample to the other, it is recommended that three samples are used for each orientation to get an average value.

— Taking into account the specified orientation, O, the MRP shall be clamped at one extremity and allowed to freely move at the opposite edge.

— H_2 should be adjusted depending on the orientation of the book.

Orientation (O)	H_2
Spine clamped	40 mm
Top clamped	58 mm

— Move the pushing rollers so that they just push the passport up against the fixed rollers without bending the passport, as illustrated in Figure 9. The amount of roller movement is b0 and is called the initial position.

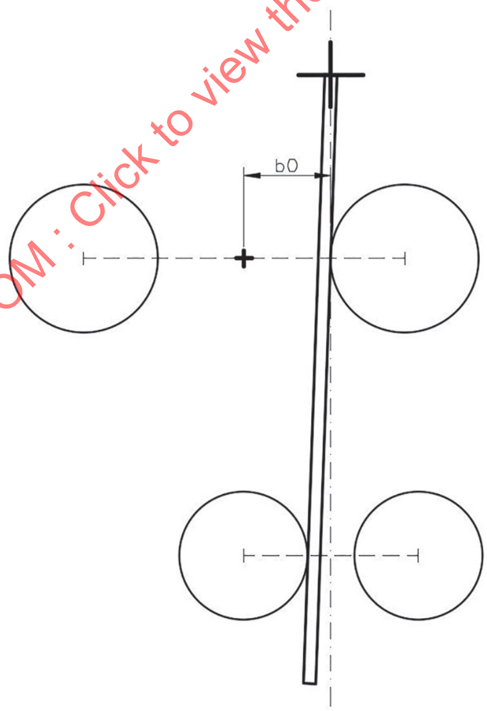

Figure 9 — Initial position of pushing rollers

— Allow the pushing rollers to move freely, however set the maximum travel of the pushing rollers to b0 + 20 mm.

— Apply smoothly a force of 40 N in the direction of the bold arrow in Figure 10 for 1 min.

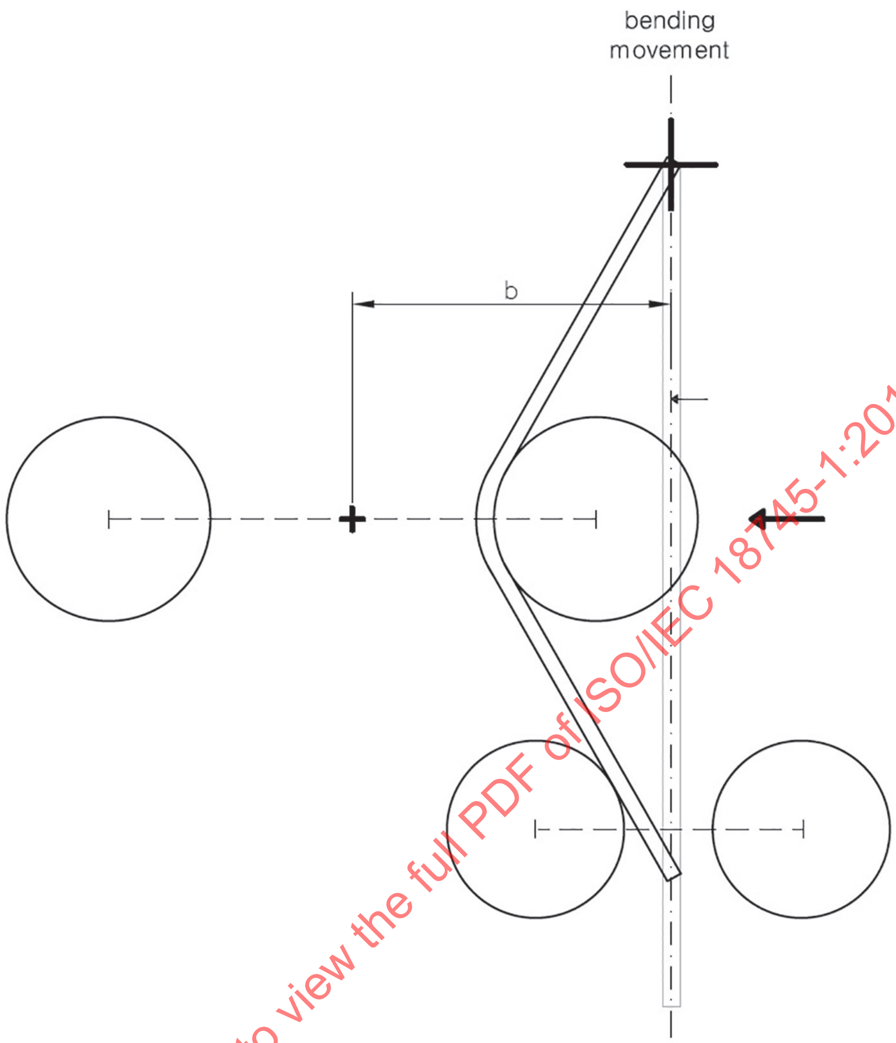

Figure 10 — Bending movement

— Measure the amount of travel of the pushing rollers. If the maximum travel is reached with a force of less than 40 N then the travel to be used for the test is b = b0 + 20 mm; otherwise measure the amount of travel of the pushing rollers, b, as shown in the figure above.

— Remove 40 N load.

— Use separate passports for calibration and for testing.

NOTE Alternate equipment can be used for calibration.

8.7.6 Method

— Set the travel of the pushing rollers to ±b as measured above.

— Flex the book n times at 0,5 Hz. One cycle is a one deflection in each direction.

8.8 Torsion stress method

8.8.1 General

The purpose of this test is to determine adverse mechanical or functional effects in the MRP arising from torsional fatigue. This method differs from the back pocket stress method by applying only torsional stresses to the MRP.

8.8.2 Input parameters

n = number of torsion cycles.

8.8.3 Output parameters

None.

8.8.4 Apparatus

The test apparatus shall impose torsional motion in a manner consistent with Figure 11 shown below.

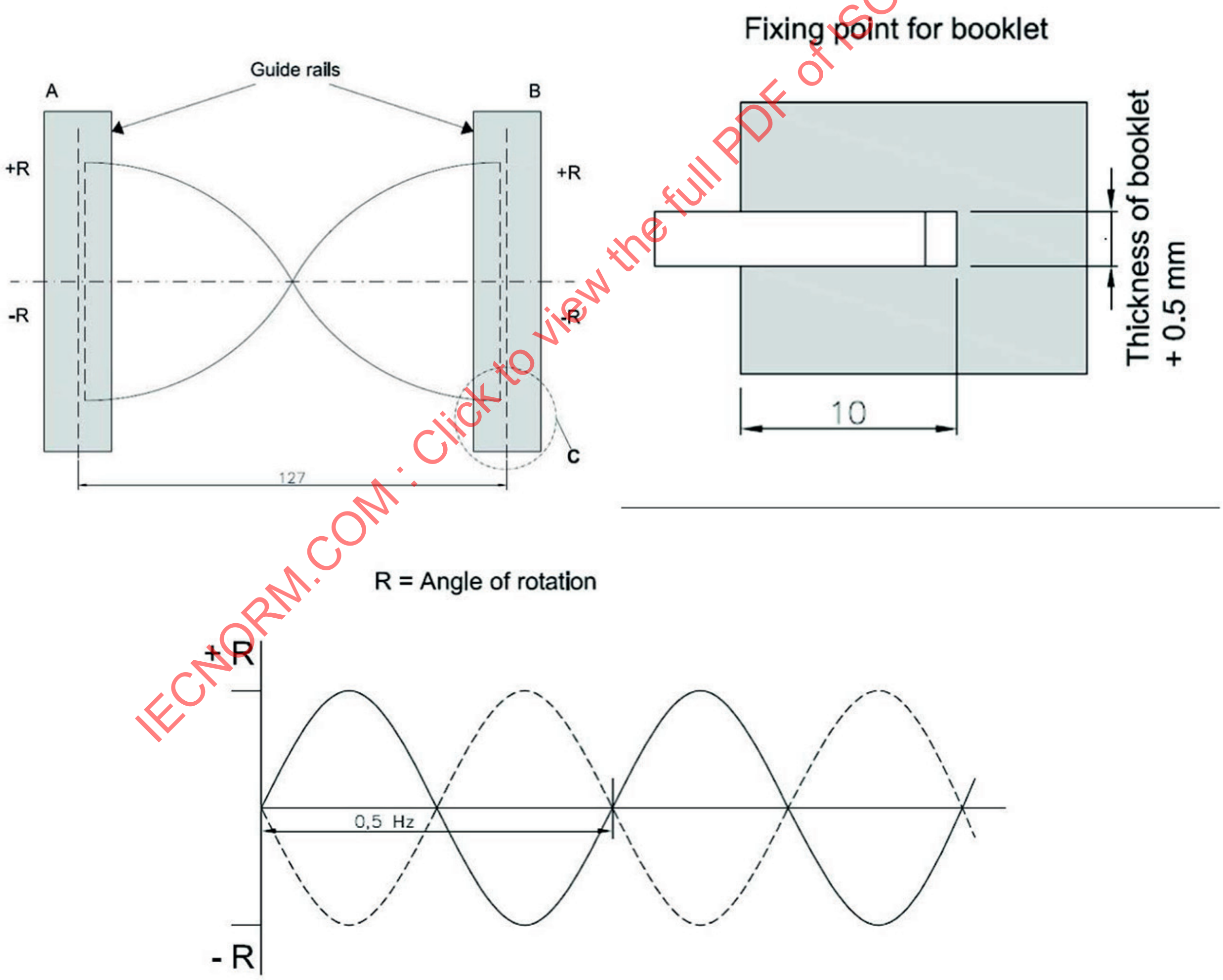

Figure 11 — Schematic of the apparatus and the associated motion for torsion

8.8.5 Calibration

— Adjust separation of guide rails to thickness of book plus a maximum of 0,5 mm.

— Place MRP in test apparatus.

— Set maximum travel of holders to 15°.

— Measure amount of travel and reset maximum travel, R, of holder to amount measured.

NOTE Alternate equipment can be used for calibration.

8.8.6 Method

— Place MRP in test apparatus.

— One cycle consists of the following continuous steps (movement is not stopped at the 0 position except at that start and end of the test):

  — Start from a point where both holder A and holder B are at angle 0;

  — Rotate holder A to angle +R, while simultaneously rotating holder B to angle –R;

  — Rotate holder A to angle –R, while simultaneously rotating holder B to angle +R;

  — Rotate holder A to angle 0, while simultaneously rotating holder B to angle 0.

— Operate the test apparatus at a speed of 0,5 Hz for n cycles.

— Note that equipment with only one rotating holder may be used. In that case rotate the holder from –2R to +2R angle.

8.9 Sheet turning stress method

8.9.1 General

The purpose of the test is to determine the folding resistance of a sheet of an MRP at the spine.

8.9.2 Input parameters

P = sheet under test.

n = number of cycles.

8.9.3 Output parameters

None.

8.9.4 Apparatus

8.9.4.1 Fixture, for clamping the fixed sheet or MRP.

8.9.4.2 Arm, for rotation of sheet or MRP.

8.9.4.3 Device, to apply force to sheet or MRP being tested.

NOTE No constraints are placed on machine design, including which clamp is fixed, which clamp moves, and which clamp the force is applied to.

The apparatus should prevent bending of the booklet in any other place than the axis of the booklet spine and that the distance between the rotation axis (spine) and the clamp should be not greater than 10 mm.

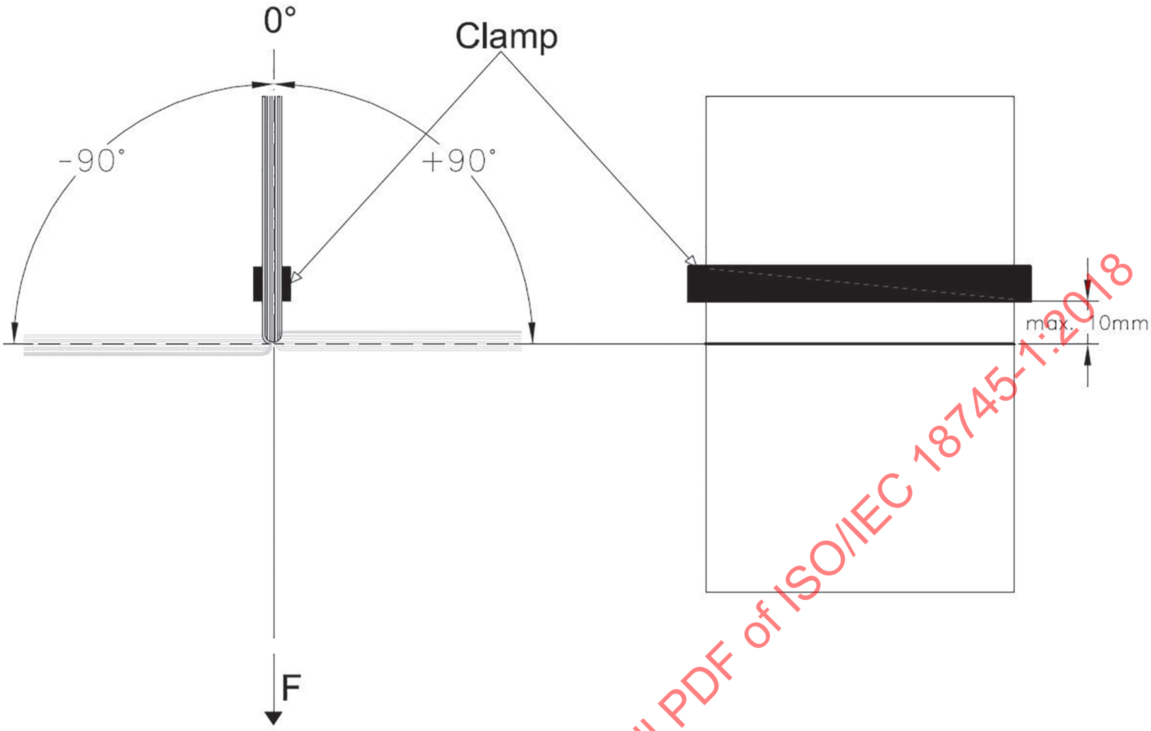

Figure 12 — Sheet clamping illustration

8.9.5 Method

The entire book except the sheet to be tested is folded back and held in a clamp. The sheet to be tested is held in another clamp allowing for the rotation of the sheet or MRP under test around the spine between the defined angle positions. See Figure 13.

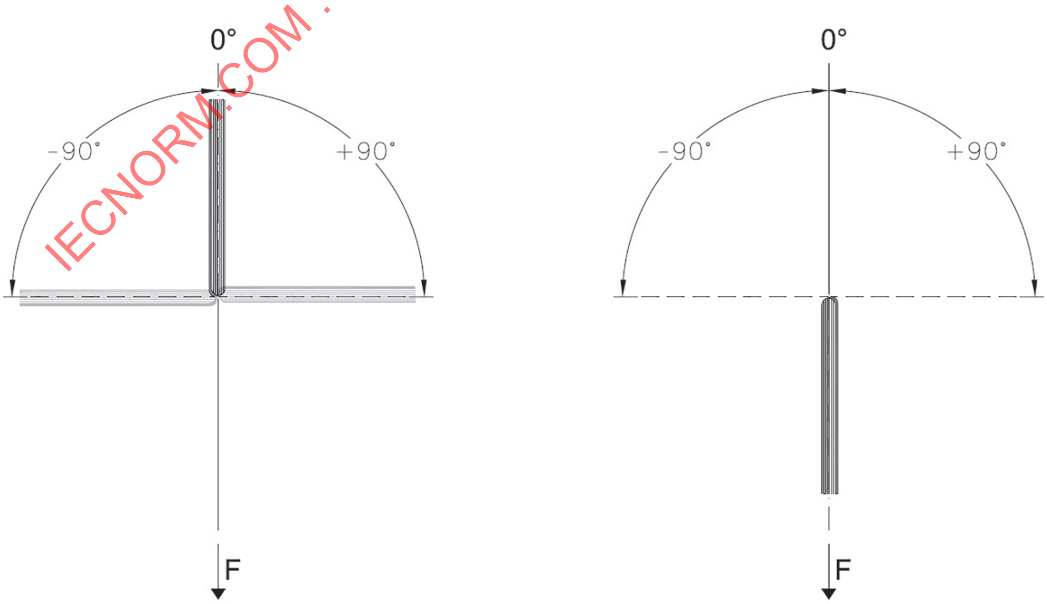

Figure 13 — Sheet bending illustration

8.9.6 Bending parameters

— Bending frequency: f = 0,5 Hz.

— Bending angle: a = ±90°.

— Tensile force: F= 12,5 N ± 5 % (force applied to full length of sheet).

8.10 Sheet pull stress method

8.10.1 General

The purpose of the test is to assess the tearing resistance of the booklet pages and the sewing part during the usage of an MRP.

8.10.2 Input parameters

P = sheet under test.

8.10.3 Output parameters

S = minimum tearing strength in N.

8.10.4 Apparatus

8.10.4.1 Clamp, to hold the MRP in a fixed position, minimum width of clamping area 130 mm.

8.10.4.2 Movable clamp, for pulling on the page under test, minimum width of clamping area 130 mm.

See Figure 14.

8.10.5 Method

— Cut the opposite sheet of the one under test. The cutting distance from the spine should be of 10 mm.

— Place all the other sheets including cover in the fixed clamp of the apparatus.

— The fixed clamp shall be set at a distance from the spine so that it does not clamp any portion of the sheet under test.

— Apply a force of at least 62,5 N at a maximum velocity of 5 mm/s. Test may be continued until the sheet is torn off.

Dimensions in millimetres

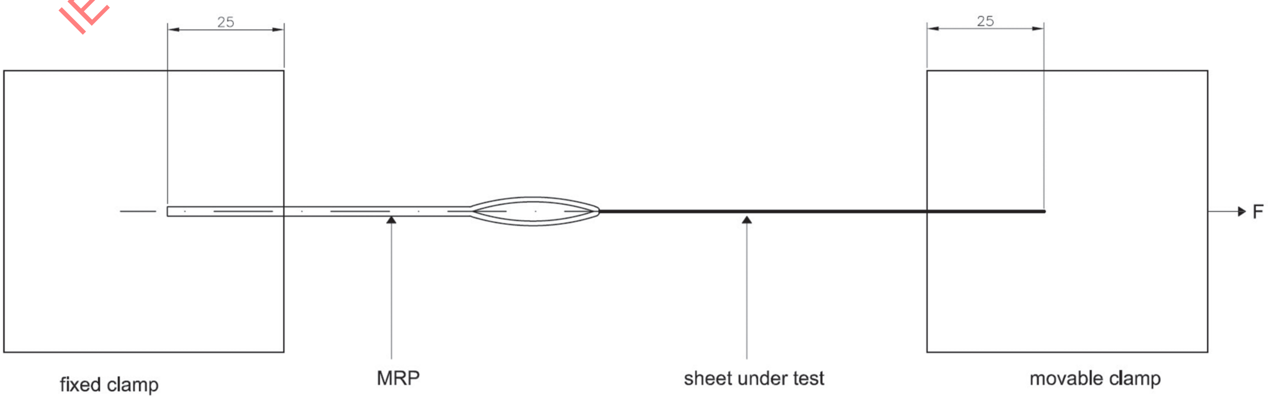

Figure 14 — Sheet pull apparatus

The clamps should not damage the paper.

8.11 Abrasion stress method

8.11.1 General

The purpose of this test is to determine the effect of a specified mechanical abrasion to the passport data page of a document conforming to ICAO. The main purpose is to test the MRZ but the test may also be used for the VIZ of the passport as defined by ICAO Doc 9303, 7th Edition, Part 3. In order to perform this test, the datapage shall be personalized.

8.11.2 Input parameters

n = number of test cycles (double strokes).

P = sheet under test.

8.11.3 Output parameters

None.

8.11.4 Apparatus

8.11.4.1 Test load, L = 14 000 (1 ± 5 %) N/m^2.

Diameter of test load D = 15 mm (the test load shall cover MRZ).

Test speed v = between 2,5 cm/s and 7,5 cm/s.

— The abrasive material to be used shall be the material of the facing page. The abrasive material has to be attached to the test load without protruding beyond the edge of the passport.

— Test load movement: The abrasion axis is parallel to the MRZ of the MRP. The amplitude of the test load movement shall cover at least 20 mm. Test equipment may move/rotate the test load during the test between cycles.

See Figure 15.

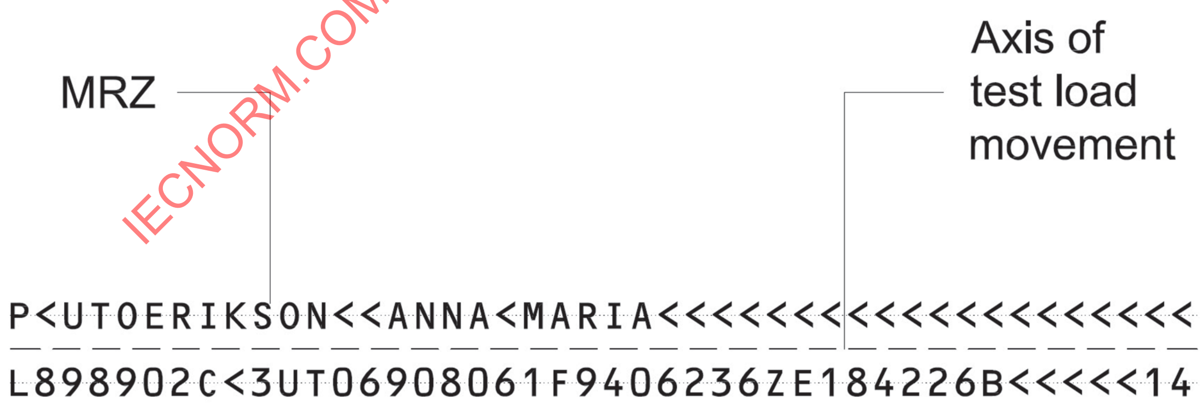

Figure 15 — Illustration of the abrasion test

8.11.5 Method

- Fix the passport data page on a level rigid plate (i.e. sample carrier of the test equipment). Apply the test load and start the apparatus at the specified speed and amplitude for the specified number of test cycles.
- Alternative equipment may be used as long as it provides equivalent results.

8.12 Pen stress method

8.12.1 General

The purpose of the test is to simulate writing over the PIC with a ball point pen simulating manual entries on visa pages. It is felt that depending on the construction of the passport, a pen might damage components of the passport (PIC, visa paper sheets).

The page to be written on shall be one that is normally written on and shall provide maximum stress to the chip (if present). In the case where it is possible to write on pages on both sides of the chip sheet, separate MRPs should be evaluated.

This method may not be suitable when devices like rivets are used, i.e. the pen may become damaged or stuck if features protrude from the page under test.

8.12.2 Input parameters

n = number of cycles.

P = page to test.

8.12.3 Output parameters

None.

8.12.4 Apparatus

8.12.4.1 Pen, with ball point of diameter 0,7 mm in accordance with ISO 12757-2.

8.12.4.2 Pen positioning apparatus, capable of pen movement in X and Y direction over the area shown in Figure 16. Pen shall be held at an angle of 90° to the page under test.

8.12.5 Method

- Choose a page P to write on. It shall be a page that is normally written on and shall provide maximum stress to the chip. In the case where it is possible to write on pages on both sides of the chip page, both sides will be tested.
- Clamp MRP in suitable holding fixture so pages do not move during testing.
- Apply a force to pen of 2,5 N downward toward pages under test.
- Apply a series of strokes, each in the form of a double line (movement back and forth along the same straight line and across the dimension of the sample) and at a nominal distance of 1,5 mm between lines.

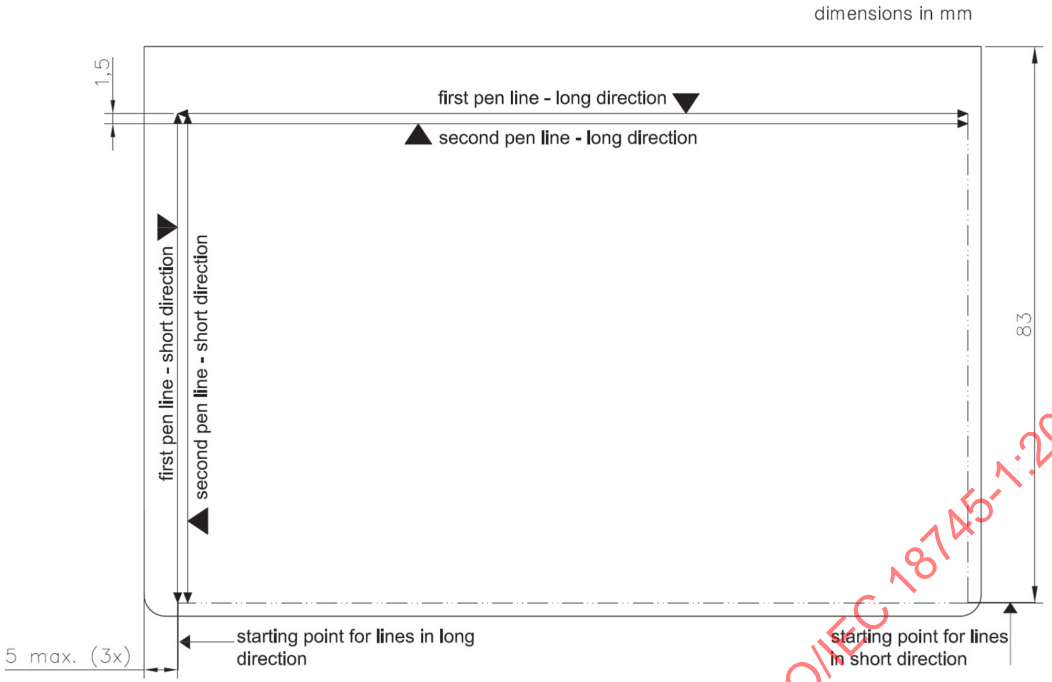

Figure 16 — Pen stress test area

— Move pen with a maximum speed of 150 mm/s from left to right and back again on the same line as shown in Figure 16 for lines in the long direction.

— When the pen has returned to the starting point, move to the next line as shown. It is not necessary to lift the pen when moving from one line location to the next.

— After completing the last line in the long direction, begin to make lines in the short direction.

— Move pen with a maximum speed of 150 mm/s from bottom to top and back again on the same line as shown in Figure 16 for lines in the short direction.

— When the pen has returned to the starting point, move to the next line as shown. It is not necessary to lift the pen when moving from one line location to the next.

— Replace pen as soon as ink is exhausted, lines shall not be made with no ink.

— Outer margin of 5 mm from the edge of the page under test may be disregarded. This margin may be used to stabilize the page under test by e.g. clamping or taping it to the support.

— The surface coverage may be reached in a single run or by consecutive runs covering sub-areas of the page under test.

— Repeat the sequence n times.

— If critical areas are obvious, the pen test may be performed only over those areas.

8.13 Resistance to chemicals stress method

8.13.1 General

The purpose of this test is to determine any adverse effects of a range of chemical contaminants on an MRP test sample. It is possible that the document may not be useable for travel after this test, but it is expected that the book shall be identifiable as belonging to the bearer.

Certain security features incorporated into MRPs are designed to react to reagents in order to show that tampering has taken place. The action of these security features under the influence of the reagents shall not constitute a failure.

8.13.2 Input parameters

None.

8.13.3 Output parameters

None.

8.13.4 Apparatus

8.13.4.1 Salt mist equipment, shall be in accordance with ISO 9227, NSS condition, particularly for:

— default MRP holder;

— component protection;

— spray cabinet size;

— heater and temperature control;

— spraying device;

— collecting devices.

8.13.5 Short term contamination test

8.13.5.1 Short term reagents (list provided here for information only, defined in ISO/IEC 10373-1)

8.13.5.1.1 5 % by mass aqueous solution of sodium chloride, ($NaCl$, 98 % minimum assay).

8.13.5.1.2 5 % by mass aqueous solution of acetic acid, (CH_3COOH, 99 % minimum assay).

8.13.5.1.3 5 % by mass aqueous solution of sodium carbonate, (Na_2CO_3, 99 % minimum assay).

8.13.5.1.4 60 % by mass aqueous solution of ethyl alcohol, (CH_3CH_2OH, 93 % minimum assay).

8.13.5.1.5 10 % by mass aqueous solution of sucrose ($C_{12}H_{22}O_{11}$, 98 % minimum assay).

8.13.5.1.6 Fuel B, (according to ISO 1817).

8.13.5.1.7 50 % by mass aqueous solution of ethylene glycol, ($HOCH_2CH_2OH$, 98 % minimum assay).

NOTE As fuel B is a toxic product, ISO/IEC/JTC 1/SC 17 is currently working on replacing it in the similar test applicable to ID1 cards. As soon as ISO/IEC/JTC 1/SC 17 agrees on an updated version of the test, it will be reflected in this document.

8.13.5.2 Short term contamination method

— Use solutions as defined in ISO/IEC 10373-1.

— Use a different sample MRP for each solution.

— Prior to immersion in the test solution, fan the pages of the MRP such that the sheets of the MRP are exposed.

— Standing the MRP upright (spine is in a vertical orientation), submerge the MRP for 60 s in one of the solutions listed above. The solutions shall be kept at a temperature between 20 °C and 25 °C.

— Remove MRP from solution and place it in default MRP holder for 24 h at default temperature and humidity conditions. For those samples immersed in organic solvents (including fuel), this procedure should be performed within the confines of a fume hood.

— MRP should be evaluated after 24 h (see 9.2).

8.13.6 Long term contamination test

8.13.6.1 Long term reagents (list provided here for information only, defined in ISO/IEC 10373-1)

8.13.6.1.1 Salt mist.

8.13.6.1.2 Artificial perspiration, (both solutions shall be prepared in accordance with ISO 105-E04): (i) alkaline solution; (ii) acid solution.

8.13.6.2 Method for salt mist

— Use neutral solution as defined in ISO/IEC 10373-1.

— Use a different sample MRP for each test.

— Expose the sample to salt mist for 24 h while mounted in a cabinet in accordance with ISO 9227.

— Remove MRP from solution and place in default MRP holder for 24 h at default temperature and humidity conditions.

8.13.6.3 Method for synthetic perspiration

— The filter paper shall be in accordance with ASTM E 832. Any Type I filter paper for qualitative analysis may be selected.

— Soak filter paper in the artificial perspiration solution. Allow excess liquid to drain for 10 s minimum, then place it on a flat non-absorbent surface (glass plate) to stabilize for 1 min.

— Wrap the sample MRP in wetted filter paper of adequate size to enclose the booklet entirely and place this in a sealed plastic bag in an environment kept between 20 °C and 25 °C. The plastic bag shall be placed between flat plates with a 5 kg weight positioned on top.

— Leave the sample in this environment for 24 h.

— Remove MRP from solution and place in default MRP holder for 24 h at default temperature and humidity conditions.

8.14 Artificial daylight exposure stress method

8.14.1 General

This test is derived from ISO 105-B02 and exposes the sample to illumination from an artificial light source that represents natural daylight in the visible and near UV (UV A) spectral region. The aim of this test is to assess the resistance of the MRP to fading.

NOTE The blue wool reference numbers refer to those preferred in Europe (1-8) and not those preferred in the US (L2-L9).

This method is difficult to apply to ordinary security printing backgrounds due to the fine structure of the linework.

8.14.2 Input parameters

P = page to expose.

S = blue wool scale to measure exposure.

8.14.3 Output parameters

None.

8.14.4 Apparatus

8.14.4.1 Xenon arc exposure device, conforming to ISO 105-B02.

8.14.5 Method

- Cut a sample from the MRP to required size for the test machine and place an opaque cover over a portion of the sample (for comparison purposes).
- Prepare the appropriate blue wool reference in the same way. Strips cut from the blue wool references 1 to S shall be used.
- Place samples together with the blue wool reference set in the accelerated daylight test apparatus and expose to artificial daylight according ISO 105-B02 until the exposed part of the blue wool reference S has faded to the equivalent of grey scale 4 (ISO 105-A02).
- The exposure conditions (ISO 105-B02) normal shall be used.
- The conditions of viewing and illumination in assessing colour fastness should be according to ISO 105-A01.
- For direct comparison of security printed features or for heat or moisture sensitive printed substrates a separate unexposed MRP shall be used for comparison purposes. This MRP should be comparable with the test sample.

8.15 X-ray stress method

8.15.1 General

The purpose of this test is to determine any adverse effects to the MRP by x-ray levels that might be encountered during border control screening. The MRP shall comply with the requirement in ISO/IEC 7810 when tested in accordance with ISO/IEC 10373-1.

It is permissible to perform the test at chip level and use the test certificates supplied by the chip manufacturer.

8.15.2 Input parameter

None.

8.15.3 Output parameter

None.

8.15.4 Apparatus

Use apparatus defined by ISO/IEC 10373-1 for x-rays.

8.15.5 Method

Follow the procedure in ISO/IEC 7810 for x-ray testing (substitute MRP for card, wherever it appears in the procedure in ISO/IEC 7810).

9 Evaluation methods

Evaluation methods are instructions describing how to measure specific attributes of the passport. Wherever applicable, the output of the evaluation method should be a numerical value that can be compared against a pass/fail criterion.

9.1 Functional PIC evaluation method

9.1.1 General

This method evaluates the function of the PIC. The method determines that the chip is still functioning and that it operates within normal and reasonable conditions. There is always a trade-off between the execution time of this method and the completeness of the test.

If the MRP does not contain a chip, this evaluation method returns a pass result.

9.1.2 Input parameters

None.

9.1.3 Output parameters

R = pass/fail.

9.1.4 Apparatus

9.1.4.1 Commercial PCD.

9.1.5 Method

— Evaluate within 30 min after completion.

— Evaluate the PIC according to ISO/IEC 18745-2:2016, 5.6.

9.2 Physical damage evaluation method

9.2.1 General

The intent of this method is to verify that the passport is (still) suitable for use as a travel document. To pass the evaluation method, the document shall be intact and shall still be machine readable. Some security features may be degraded or altered; however, the evaluation of these features may be subjective and specific to individual passports and are therefore outside the scope of this method.

Extremes of temperature as well as the exposure to certain chemicals may affect various security features, especially inks. Changes in these features shall not be considered a failure unless they render the document unrecognisable as belonging to the bearer or could cause strong suspicion to the authorities of a counterfeit or forgery.

9.2.2 Input parameters

None.

9.2.3 Output parameters

R = pass/fail.

9.2.4 Apparatus

None.

9.2.5 Method

Physical damage and related acceptability levels are best evaluated by comparing the sample(s) under test to a set of evaluation samples that is considered to be just at the limit of acceptability. However, the following limits should be placed on an MRP for it to be useable.

- The picture shall be recognizable.
- Written information shall be legible, with no missing letters or words.
- The MRZ shall be machine readable.
- The MRP shall be intact – no pages shall be separated.
- Opening the MRP to the datapage (180°) shall not incur any further damage.
- Opening the MRP to a visa page (180°) shall not incur any further damage.
- The PIC containing part (cover, data page, special visa page) does not allow direct access to the chip or the antenna.
- No part of the datapage shall be missing.
- For datapages, more than 90 % of the binding shall be intact.
- For other pages, more than 90 % of the binding shall be intact.
- At least 50 % of the hot-stamp on the cover shall be intact.
- Any holes in any sheets shall be less than 2 mm in diameter.
- Areas of delamination along the edges shall be less than 3 mm deep, and 3 mm in length. Delaminations within the sheet shall be less than 3 mm in length.

9.3 Peel strength evaluation method

9.3.1 General

The purpose of this test is to measure the peel strength between different layers used in passport constructions according to ISO/IEC 10373-1:2006, 5.3.

If the sheet to be evaluated is composed of multiple layers, the peel strength evaluation should be conducted on all layers. A separate document should be used for each layer so that a consistent number of strips will be cut from the sheet.

9.3.2 Input parameters

P = sheet to perform test on.

9.3.3 Output parameters

F = strength (N/cm).

9.3.4 Apparatus

Use apparatus defined in ISO/IEC 10373-1:2006, 5.3. References to "card" shall mean "sheet" for this test. If a stabilizing plate is required, a suitable size would be 95 mm × 130 mm.

9.3.5 Method

— Remove the sheet to be tested from the MRP.

— Follow the method for peel strength measurements for all accessible layers as outlined in ISO/IEC 10373-1: 2006, 5.3, except for pre-conditioning and the direction and quantity of sample sections.

— Following Figure 17, cut the sample, or score through the accessible layer, to produce sections of width 10,0 mm ± 0,2 mm. The top reference edge is the edge closest to the spine.

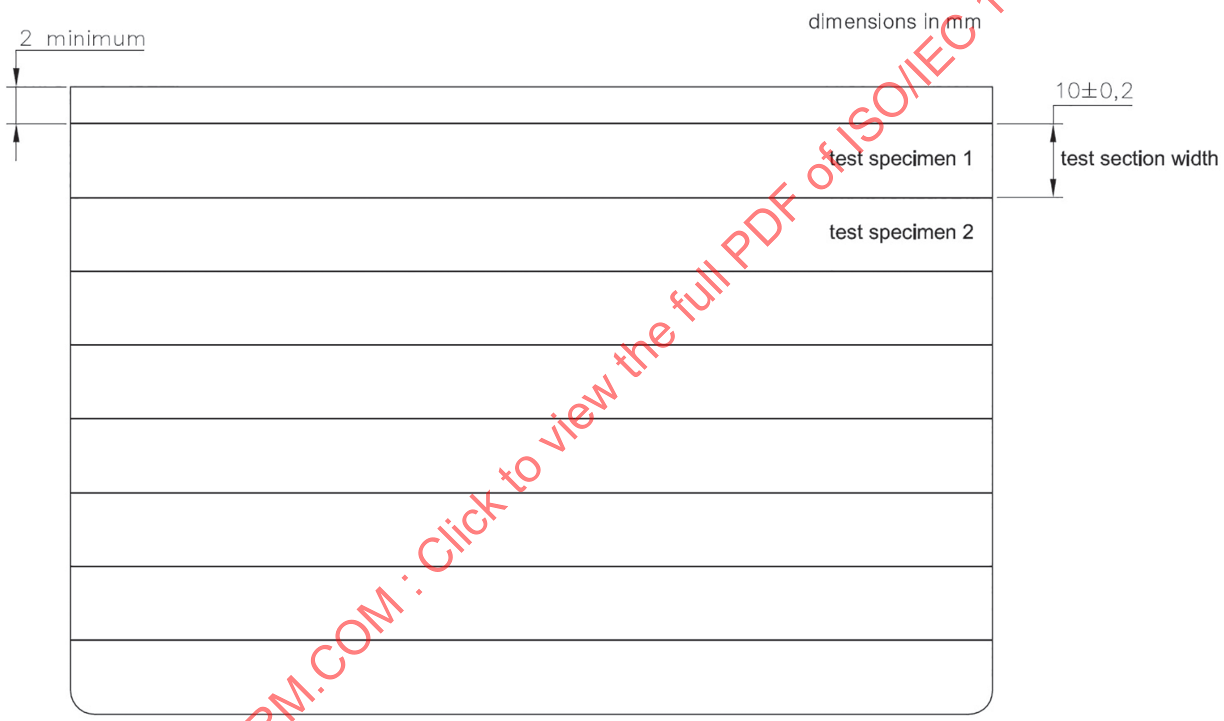

Figure 17 — Peel strength sample preparation

9.4 Colour fastness evaluation method

9.4.1 General

This evaluation method determines the change in appearance of the sample following exposure to artificial daylight. This evaluation method relies on the sample being subjected to 8.14.

9.4.2 Input parameters

P = page to evaluate.

9.4.3 Output parameters

R = pass/fail.

9.4.4 Apparatus

9.4.4.1 Equipment using D65 light source, according to ISO 105-B02.

9.4.5 Method

— Colour fastness evaluation derived from ISO 105-B02.

— The evaluation procedure is as follows.

  — Visually evaluate fading or colour changes. For this purpose samples shall be illuminated by a D65 light source.

  — Compare the contrast between exposed and unexposed sample with the contrast of grey scale 4.

  — If the sample contrast is higher, then the test result is fail. If the sample contrast is less or equal, then the test result is pass.

9.5 Datapage and cover warpage evaluation method

9.5.1 General

The purpose of this test is to measure the extent of warpage in the MRP. The amount of warping in an MRP is important to ensure contactless IC and MRZ readability.

9.5.2 Input parameters

None.

9.5.3 Output parameters

W = warpage (mm).

9.5.4 Apparatus

9.5.4.1 Level, rigid and smooth surface, e.g. glass plate or granite surface.

9.5.4.2 Flattening plate, weighing 200 g, measuring 88 mm by 125 mm and having a uniform density and height.

9.5.4.3 Height gauge, or similar measuring device with a minimum precision of 0,1 mm.

9.5.4.4 Micrometer, with a flat anvil and spindle whose diameter is within the range 3 mm to 8 mm, having a minimum precision of 0,1 mm. The micrometer pressure shall be 100 kPa to 400 kPa.

9.5.5 Method

— Identify the cover page closest to the datapage.

— Open the MRP and place only the datapage and cover on the level rigid surface as shown in Figure 18.

— Apply and centre the 200 g flattening plate directly on top of the pages. Align the long edge of the flattening plate with the edge of the rigid surface.

— At each corner, measure the total combined thickness of the pages and flattening plate shown in Figure 18, using a height gauge without applying any additional force.

Dimensions in millimetres

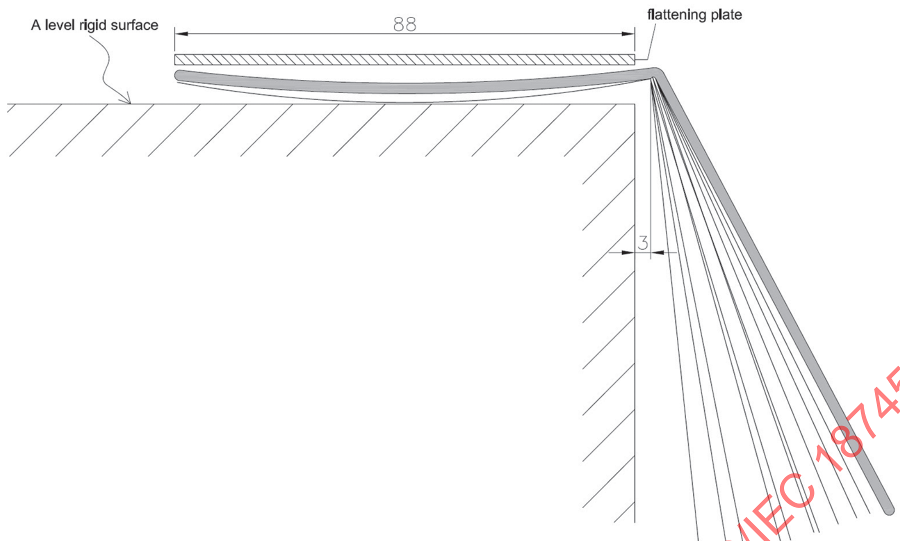

Figure 18 — Datapage and cover warpage measuring arrangement

— Using a micrometer measure the thickness of the flattening plate at each corner and subtract this from the corresponding total thickness. Record the resulting values as A_1 for corner one, A_2 for corner two etc. (see Figure 19 for corner labelling).

— Using a micrometer measure the combined thickness of the cover and datapage at each of the four corners, excluding the area 3 mm from the spine. Record these values as B_1 for corner one, B_2 for corner two etc.

— Calculate the warpage for the four corners: $A_1 - B_1$ for corner one, $A_2 - B_2$ for corner two etc. and report the largest warpage as W.

Figure 19 — Convention for corner numbering (cover page closest to the data page)

9.6 Book warpage evaluation method

9.6.1 General

The purpose of this test is to measure the extent of warpage in the MRP. The amount of warping in the MRP is important to ensure contactless IC and MRZ readability. This method is similar to the datapage and cover warpage evaluation method but measures the amount of warpage with the MRP in the closed position.

9.6.2 Input parameters

None.

9.6.3 Output parameters

W = warpage (mm).

9.6.4 Apparatus

9.6.4.1 Level, rigid and smooth surface, (e.g. glass plate or granite surface).

9.6.4.2 Flattening plate, weighing 200 g, measuring 88 mm by 125 mm and having a uniform density and height.

9.6.4.3 Micrometer, with a flat anvil and spindle whose diameter is within the range 3 mm to 8 mm, having a minimum precision of 0,1 mm. The micrometer pressure shall be 100 kPa to 400 kPa.

9.6.4.4 10 kg weight.

9.6.5 Method

— Identify the four corners of the MRP cover page.

— Place the closed MRP on a level rigid surface as shown in Figure 20.

— Apply and centre the 200 g flattening plate directly on top of the MRP cover.

— At each corner, measure the total combined thickness of the MRP and flattening plate shown in Figure 20, using a height gauge without applying any additional force.

— Using a micrometer measure the thickness of the flattening plate at each corner and subtract this from the corresponding total thickness. Record the resulting values as A_1 for corner one, A_2 for corner two etc. (see Figure 19 for corner labelling).

— Eliminate any warpage by placing a 10 kg weight on top of the flattening plate. Using a height gauge measure the combined thickness of the MRP and flattening plate at each of the four corners. Calculate the thickness of the flat MRP as previously. Record these values as B_1 for corner one, B_2 for corner two etc.

— Calculate the warpage for the four corners: $A_1 - B_1$ for corner one, $A_2 - B_2$ for corner two etc. and report the largest warpage as W.

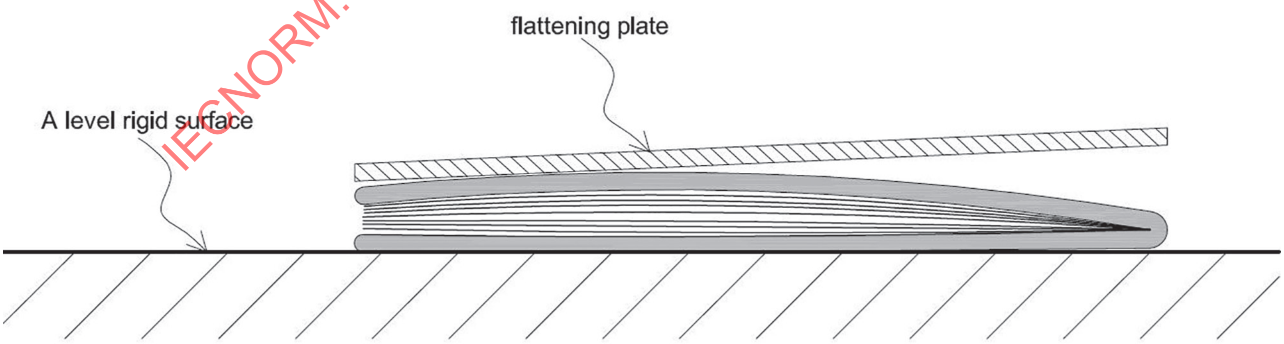

Figure 20 — Book warpage measuring arrangement

10 Test sequences

10.1 General

Sequences are defined to specify the order in which stress methods and evaluation methods shall be performed in order to execute a specific test.

10.2 Instructions for using the sequence table

The heading of a sequence table is reproduced below.

Table 2 — Heading of a sequence table

Step No.	Stress /eval.	Method	Parameters	Output parameters measured	Pass/fail criteria

This table defines the order of the methods to be performed. The content of each column is defined in Table 3 below.

The time space between each stress test and the time period between the end of the last test and the evaluation should not exceed 30 min.

Table 3 — Description of Table 2 columns

Step No.	The reference number for the step within the sequence. The order of the methods within the sequence table determines the order in which the methods are to be executed – not the step number.
Stress/eval.	Indicates whether the method is a stress method or an evaluation (eval.) method.
Method	The name of the method to be performed.
Parameters	Defines the values of the input parameters. Method parameters not assigned at the sequence level shall be assigned at the test plan level.
Output parameters	List of the output parameters of the method that will be used to determine the pass/fail criteria for the test.
Pass/fail criteria	Specifies the limits of the output parameter that will be considered a pass for the test sequence.

10.3 Sheet binding sequence

10.3.1 General

The purpose of this test sequence is to simulate normal book handling over its lifetime. Real-life stresses include opening and closing the book and manipulating data and visa pages.

10.3.2 Input parameters

n = number of sheet bend cycles.

P = sheet to test.

10.3.3 Output parameters

R = pass/fail.