INTERNATIONAL STANDARD

ISO/IEC 15457-1

Second edition
2008-03-01

Identification cards — Thin flexible cards —

Part 1: Physical characteristics

Cartes d'identification — Cartes flexibles fines —

Partie 1: Caractéristiques physiques

Reference number
ISO/IEC 15457-1:2008(E)

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Foreword

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

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

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

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

ISO/IEC 15457-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and personal identification*.

This second edition cancels and replaces the first edition (ISO/IEC 15457-1:2001), which has been technically revised.

ISO/IEC 15457 consists of the following parts, under the general title *Identification cards — Thin flexible cards*:

— *Part 1: Physical characteristics*

— *Part 2: Magnetic recording technique*

— *Part 3: Test methods*

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Identification cards — Thin flexible cards —

Part 1: Physical characteristics

1 Scope

Thin flexible cards (TFC), the subject of ISO/IEC 15457, are used to automate the controls for access to goods or services such as mass transit, highway toll systems, car parks, vouchers, stored value, etc.

For these applications, data can be written and/or read by machines using various recording techniques such as magnetic stripe, optical character recognition (OCR), bar code, contactless, etc.

This part of ISO/IEC 15457 specifies the physical characteristics of thin flexible cards at two points in the card life cycle:

1. at the point of loading into the card issuing equipment;

2. at the point of issue to the public.

It takes into consideration both human and machine aspects and states the minimum requirements.

The principal card sizes are identified and the characteristics and dimensions are specified.

Guidance concerning the storage and use of cards under various environmental conditions is given.

NOTE ID-1 cards, specified in ISO/IEC 7810, do not come within this scope.

2 Normative references

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

ISO 1831, *Printing specifications for optical character recognition*

ISO 1924-2, *Paper and board — Determination of tensile properties — Part 2: Constant rate of elongation method (20 mm/min)*

ISO 2144, *Paper, board and pulps — Determination of residue (ash) on ignition at 900 °C*

ISO 2471, *Paper and board — Determination of opacity (paper backing) — Diffuse reflectance method*

ISO 5626, *Paper — Determination of folding endurance*

ISO 5627, *Paper and board — Determination of smoothness (Bekk method)*

ISO 5629, *Paper and board — Determination of bending stiffness — Resonance method*

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ISO 6383-2, *Plastics — Film and sheeting — Determination of tear resistance — Part 2: Elmendorf method*

ISO 8570, *Plastics — Film and sheeting — Determination of cold-crack temperature*

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

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

ISO/IEC 15457-2, *Identification cards — Thin flexible cards — Part 2: Magnetic recording technique*

ISO/IEC 15457-3, *Identification cards — Thin flexible cards — Part 3: Test methods*

3 Terms and definitions

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

3.1
back face
face of the card opposite the front

3.2
finished card
card at the point of issue to the public

3.3
front face
reference face of the card (which normally bears printed information relating to its origin and ownership)

3.4
height
dimension parallel to the shortest edge of the card

3.5
print contrast signal
PCS
print contrast of a machine readable printed mark, defined as:

$$PCS = \frac{R_w - R_p}{R_w}$$

where

R_p is the reflectance of the printed mark, measured in accordance with ISO 1831 for the B 900 spectral band;

R_W is the reflectance of the background surrounding the printed mark, measured in accordance with ISO 1831 for the B 900 spectral band.

3.6
recording technique
technique, such as magnetic, contactless or optical encoding etc., used to store data on the card

3.7
reference edges
datum edges for dimensioning and orientation, having a fixed relationship to the front of the card

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3.8
regular card
card without thermal sensitive coating

3.9
tactile identifier
feature used to determine the orientation of the card

3.10
thermal card
card with thermal sensitive coating

3.11
width
dimension parallel to the longest edge of the card

3.12
wood free
(of paper) 100% chemical pulp, containing no ground wood

3.13
normal use
use as an identification card involving equipment processes appropriate to the card technology and storage as a personal document between equipment processes

3.14
twist
off-axis curl resulting in the four corners of the card not being co-planar

3.15
sizing and pen writing factor
capacity of a paper for receiving lines of aqueous ink (pen ink) without smudging or going through the paper

3.16
join or splice
link made between two lengths of continuous conjoined cards (e.g. to eliminate one or more defective contactless cards)

3.17
Limited Use Card
LUC
card conforming to ISO/IEC 15457-1 that is equipped for contactless applications

4 General characteristics

4.1 Introduction

Three card formats are recognized, and classified as follows to correspond with other existing schemes of classification:

— TFC.0, size 66 mm x 30 mm;

— TFC.1, size 85 mm x 54 mm normal Thickness (see Table 1);

— Special TFC.1, size 85 mm x 54 mm with increased thickness (see Table 1);

— TFC.5, size 187 mm or 203 mm x 83 mm.

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For each format of card, the geometrical and topographical characteristics are specified separately in the relevant clause of this part of the standard. The remaining physical characteristics, which are common to all sizes, are specified in this clause.

Magnetic stripe and track characteristics are specified in ISO/IEC 15457-2.

Contactless characteristics are specified in ISO/IEC 10536, ISO/IEC 14443 or ISO/IEC 15693.

All clauses in all parts of ISO/IEC 15457 apply to finished cards or to the reels/packs from which such cards are taken. Certain clauses however concern the characteristics of the card throughout its life.

As a matter of convenience and practicality, certain tests can be carried out on unfinished cards where it can be demonstrated that no significant change in that characteristic can arise during subsequent processing.

4.2 Materials

Materials for TFCs of various thicknesses are defined in Annexes A, B and C, as shown in Table 1.

Table 1 — Permitted materials v TFC size

Permitted materials	TFC.0[1]	TFC.1	Special TFC.1	TFC.5
Paper	A270	A178, A250, A270,	A 290-680	A178
Composite	B270	B250,	B250, B360, B400-680	not specified
Plastic	C270	C250, C270	C250, C270, C290-680	not specified
NOTE Table entries refer to the nominal thickness of the material and the annex in which it's specification is given, e.g. A178 refers to 178 micron material from Annex A.				

4.3 Finishing

Thin flexible cards are finished in a variety of ways, in accordance with the requirements of the system in which they are to be used. They may be

— printed or pre-printed except in areas used by recording techniques and machine functions (e.g. magnetic stripes, positioning marks, where used);

— equipped for one or more recording techniques (e.g. magnetic stripes, optical bar codes, contactless).

Thin flexible cards shall not be embossed.

Regardless of any of these finishing processes, the finished cards shall continue to conform to the requirements of this standard.

4.4 Quality of TFC products

All cards, however presented, shall be generally free from minor defects which could interfere with the performance of TFCs or which detract from their visual appearance, such as joins, excessive dust, cutting debris, folds, tears, creases and thick spots.

[1] Note that TFC.0 materials are not necessarily the same as TFC.1 materials of the same thickness.

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Due to characteristics of product, stripe of contactless cards when presented in reel or in fan-fold can have join defined in section 8.4.

4.5 Reference edges

Any specification for a thin flexible card conforming to this standard shall nominate a reference face (the front) and two reference edges, having the relationship shown in Figure 1, such that all features of the finished card can be located within the same frame of reference.

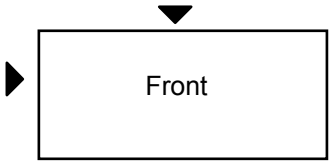


Figure 1 — Relationship between card front and reference edges

It is preferred that the front of the card should be that which is designated to carry the major printed identification information (e.g. system logo or name) and that human readable information on the front shall be upright when the card is held with one of the two reference edges at the top.

Once identified, these same reference edges shall be used exclusively and consistently when locating all features specified in this and the other applicable parts of ISO/IEC 15457.

4.6 Card life

4.6.1 Before issue

Cards stored in their original packing, under conditions specified in 4.7.2, shall remain in conformance with this standard for at least be one year.

Cards stored in operational devices (e.g. issuing machines), under the conditions specified in 4.7.3, shall remain in conformance with this standard for at least two months.

4.6.2 After issue

Finished cards stored under the conditions specified in 4.7.2, without further use, shall remain in conformance with this standard at least one year.

NOTE Paper materials specified in Annex A may be expected to withstand up to 50 transaction cycles, composite materials specified in Annex B may be expected to withstand up to 500 transaction cycles; plastic materials specified in Annex C may be expected to withstand up to 2 500 transaction cycles. The actual lifetimes achieved will of course be affected by many external factors.

Cards shall resist deterioration from exposure to light and other environmental factors encountered in normal use.

Where abnormally demanding conditions of use are likely to affect life expectancy, these shall be taken into account when selecting suitable card materials and methods of manufacture.

4.7 Environmental conditions

4.7.1 Testing environment

Each of the characteristics specified in this standard shall be measured under the environmental conditions specified in ISO/IEC 15457-3. For most characteristics, these conditions are 23 °C and 50 % relative humidity.

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NOTE Under different conditions, certain characteristics will change significantly, including dimensions (width, height, thickness), weight, flatness and many of the physical parameters listed in Tables A.1, B.1 and C.1. At the extremes of the operating environment (see 4.7.3), these changes can be substantial, and should be taken into account in the design of TFC handling devices.

4.7.2 Storage environment and packaging

Thin flexible cards shall be stored under the conditions specified in Table 2.

Table 2 — Storage conditions

Card type	Temperature °C	Relative humidity %
Regular cards	0 to 50	30 to 65
Thermal cards	0 to 40	30 to 65

The purpose of the packaging is to protect cards from physical damage and to reduce the rate of humidity variation. As a consequence:

— cards shall be kept in their original packaging for as long as is practical;

— boxes shall be stored on a flat surface, respecting "top" and "bottom" indications;

— boxes shall not show any apparent distortion or other damage.

The packaging may be defined by the user but shall enable the above conditions to be met.

4.7.3 Operating environment

Sudden changes in environmental conditions can cause card distortion. Packages containing cards shall therefore be approximately in equilibrium with surrounding conditions before they are opened.

Cards shall remain in conformance with Table 4, retain their structural integrity and remain usable within the range of ambient conditions specified in Table 3.

Table 3 — Operating conditions v Card type

Card type	Temperature[1] °C	Relative humidity %
Standard cards	-35 to 50	15 to 85
Special TFC 1 cards	- 20 to 50	15 to 85

[1] In some applications, the temperature range can be limited by the cold crack temperature (see Annex C).

5 Outline geometry

Table 4 shows, for each TFC format, the values of the quantities specified in Clause 5.

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Table 4 — Quantity values for outline geometry

dimensions in millimetres except where indicated otherwise

		TFC size		
Quantity	**Quantity symbol**	**0**	**1 & Special TFC.1**	**5**
Width	*W*	66,0 +1,0/-0,5	85,6 +1,0/-0,5	203,20 ± 0,38[1] 187,33 ± 0,38[2]
Height under testing conditions (see 4.7.1)	*H*	30,0±0,1	53,98±0,2	82,55 ± 0,18
Height variation under operating conditions (see Table 3)	*H*	29,8 to 30,3	53,6 to 54,5	82,10 to 83,25
Corners	α (Figures 2, 3, 4)	90°±1°	90°±1°	90°±1°
	R (Figure 4)	3,20±0,05	3,20±0,05	6,35±0,05
	a (Figures 3, 4)	3,20±0,10	3,20±0,10	6,35±0,10
	b (Figures 4)	not specified	3,2±0,5	not specified
	β (Figure 3)	not specified	45°±1°	not specified
Edge straightness		±0,05	±0,05	±0,05
Mismatch (barb)	*C*	0,1	0,1	0,1
Discontinuity	*D*	0,1	0,1	0,1

1 TFC.5 with stub.
2 TFC.5 without stub.

5.1 Dimensions

Dimensions shall be as shown in Table 4 for the selected card format.

5.2 Corners

Corners shall be rectangular, beveled or rounded, as shown in Table 4.

The parameters of corner geometry for which values are given in Table 4 are shown in Figure 2, Figure 3 and Figure 4.

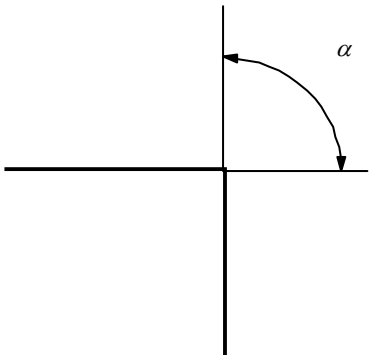


Figure 2 — Rectangular corner

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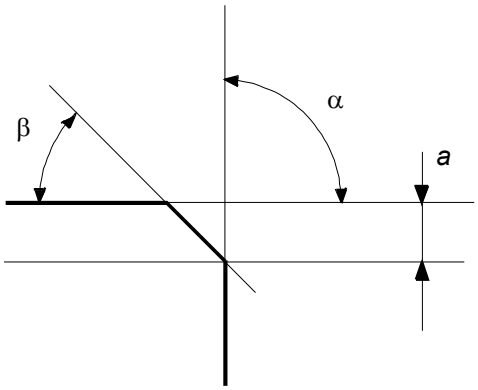


Figure 3 — Beveled corner

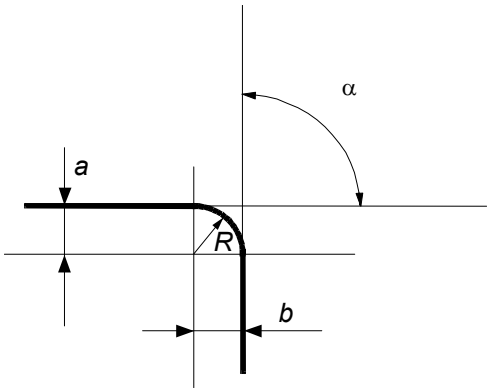


Figure 4 — Rounded corner

5.3 Edges

Each card edge and corner bevel (as applicable to the card format) shall be straight to within the value given in Table 4 except, in the case of a rounded corner, within a corner arc.

Any mismatch (barb) between a rounded corner and either of its adjacent sides shall be limited to the value of maximum displacement given in Table 4 of the side from the parallel tangent on the corner arc.

Discontinuities in any rounded corner (cut-ins, fibre clusters, single fibres – see Figure 5) shall be limited to the value of maximum deviation given in Table 4 from a smooth corner arc of the same radius.

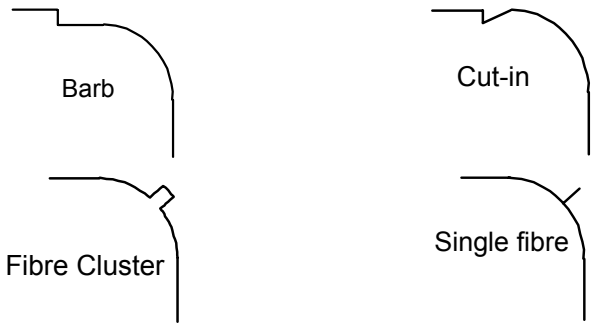


Figure 5 — Edge defects illustrated on rounded corner example

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6 Presentation

Table 5 shows, for each TFC format, the permitted methods of presentation and the values of the quantities specified in Clause 6.

Table 5 — Quantity values for presentation

dimensions are in millimetres except where otherwise specified

		TFC size			
Quantity	**Quantity symbol or remark**	**0**	**1**	**Special TFC.1**	**5**
Single card:		allowed	Allowed	allowed	allowed
overall flatness		≤ 2	≤ 2	Class 1(1) ≤ 2 Class 2(2) ≤ 5	≤ 6,35
transverse curl		≤ 1	≤ 1	Class 1 ≤ 1 Class 2 ≤ 3,5	≤ 3,04
twist		≤ 1	≤ 1	Class 1 ≤ 1 Class 2 ≤ 2,5	≤ 6,35
separation force					
no fold	perforation line A	not specified	not specified	not specified	300±40 N
no fold	perforation line C	not specified	not specified	not specified	200±40 N
5 folds	perforation line A	not specified	not specified	not specified	≥ 60 N
5 folds	perforation line C	not specified	not specified	not specified	≥ 40 N
Fan-fold(5):		not specified	allowed	Allowed	allowed
separation force					
no fold	perforation line	not specified	80±15 N	Type 1(3): 80±15 N Type 2(4): 280±40 N	not specified
	Bridge	not specified	80±15 N	Type 1: 80±15 N Type 2: 280±40 N	not specified
1 fold	perforation line	not specified	not specified	not specified	80±20 N
	Bridge	not specified	not specified	not specified	not specified
5 folds	perforation line	not specified	≥ 20N	≥ 20N	≥ 20 N
	Bridge	not specified	≥ 40 N	≥ 40 N	not specified

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Reel[5]:		allowed	allowed	allowed	allowed
width	Wr	< 32	< 56	< 56	not specified
diameter	D_o	≤ 280	≤ 280	≤ 280	not specified
end cut angle	α	90°±1°	90°±1°	90°±1°	not specified
Plastic hub:					
External diameter	D	80±0,5	80±0,5	106±0,5	not specified
Internal diameter	D_i	70±0,1	70±0,1	70±0,1	not specified
width	W_h	30±0,2	54±0,2	54±0,2	not specified
Paper hub:					
External diameter	D	80±1	80±1	not specified	not specified
Internal diameter	D_i	70±1	70±1	not specified	not specified
width	W_h	30 +0,5/-1,0	54 +0,5/-1,0	not specified	not specified

Notes:

(1) Class 1 shall be used in distribution systems that require normal TFC.1 flatness.

(2) Class 2 shall be used in distribution systems capable of handling a degree of flatness outside the normal TFC.1 limits; manual distribution systems for example.

(3) Type 1 separation force values shall be used in distribution systems that require normal TFC.1 burst strength to separate two consecutive cards;

(4) Type 2 separation force values shall be used in distribution processes that do not employ traction to separate two consecutive cards.

(5) Reels and fan-fold packs of TFCs shall not contain any splices or joins (except in the special case of contactless TFCs – see Clause 8).

6.1 Single card

6.1.1 Overall flatness

The maximum perpendicular distance which can be measured from any point on the concave surface of the card to a plane defined by any three corners of the card, shall be as shown in Table 5.

6.1.2 Transverse curl

The maximum perpendicular distance which can be measured from any point on either of the short edges to a line defined by the two adjacent corners, shall be as shown in Table 5.

6.1.3 Twist

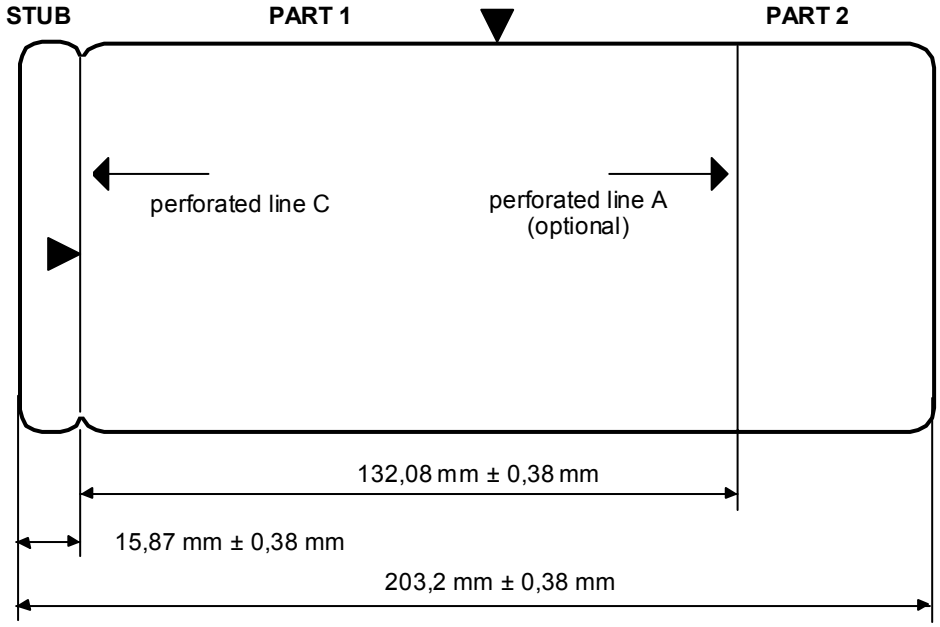
The maximum perpendicular distance that can be measured from any corner to the plane defined by the other three corners shall be as shown in Table 5.

6.1.4 Perforations

Perforation lines within the outline of the single card are permitted only for TFC.5, which may be divided into parts by the perforated lines shown in Figure 6, Figure 7 and Figure 8.

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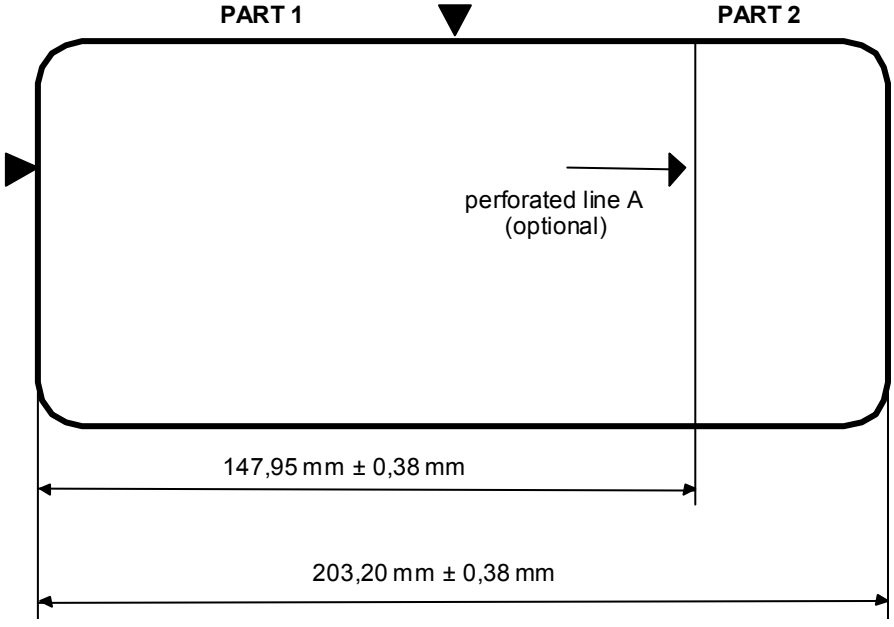
Any text or design printed on either side of the card shall be upright when the longest reference edge is uppermost.



NOTE 1 The purpose of the stub is to hold cards into a binder when issued. In use the card is detached from the stub to expose a new edge along perforation line C. This perforated line is therefore designated as the reference edge and datum for all subsequent card processing.

NOTE 2 The dimensions of the card are specified in the manner shown to avoid the effects of cumulative tolerances.

Figure 6 — Card with stub (default)

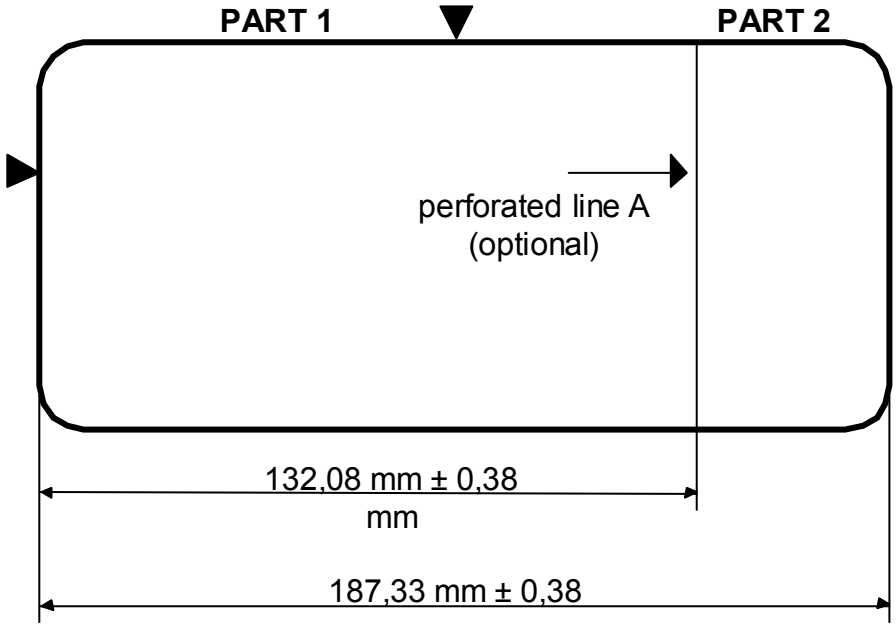


NOTE The dimensions of the card are specified in the manner shown to avoid the effects of cumulative tolerances.

Figure 7 — Long card without stub (first variant)

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NOTE The dimensions of the card are specified in the manner shown to avoid the effects of cumulative tolerances.

Figure 8 — Short card without stub (second variant)

Perforated lines A and C, where present, shall enable users and/or card handling devices to separate the various parts of the card. The force required for separation shall be as shown in Table 5.

All perforations shall be made from the back of the card and shall not produce any increase in thickness or local distortion of the card in excess of 15 μm.

The perforations shall be symmetrical with respect to the longitudinal centre line of the card and a fully attached portion shall be left at each end of each perforated line to prevent premature separation of the card parts.

6.2 Fan-fold pack

Fan-fold presentation may be used for TFC.1 and TFC.5.

A fan-folded pack shall comprise a continuous strip of material with perforated lines, bridges or both delimiting the width of each card.

6.2.1 Fan-fold card presentation

All perforation lines joining adjacent cards in a fan-fold pack shall be symmetrical with respect to the longitudinal centre line of the card.

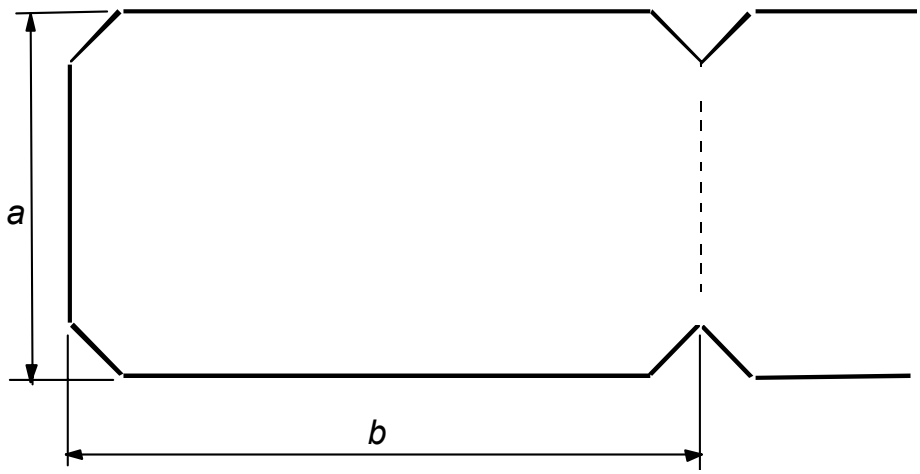
All perforations shall be made from the back of the card and shall not produce any increase in thickness or local distortion of the card before folding in excess of 15 μm.

No part of any card shall adhere to, or leave an impression on, the adjacent cards in a pack.

6.2.1.1 Fan-fold TFC.1

The perforated line card shall be as shown in Figure 9. A fully attached portion shall be left at each end of the perforated line to prevent premature separation of the cards.

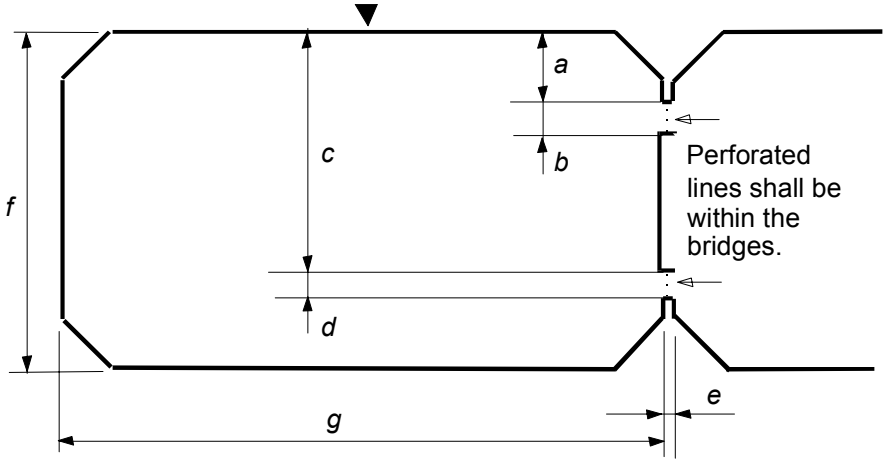
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a = 53,98 mm; *b* = 85,60 mm

Figure 9 — Perforated line card using bevelled card as an example

The bridge joined card, with or without a perforated line shall be as shown in Figure 10.



a = 9,00 mm ± 0,25 mm; *b* = 4,00 mm ± 0,25 mm; *c* = 40,98 mm ± 0,25 mm

d = 4,00 mm ± 0,25 mm; *e* = 1,1 mm ± 0,2 mm; *f* = 53,98 mm; *g* = 85,60 mm

Figure 10 — Bridge joined card using bevelled card as an example

6.2.1.2 Fan-fold TFC.5

The positions of the optional perforated lines A and C, and the fan-fold perforation B, shall be as shown in Figure 11. Perforation B shall have a fully cut portion of at least 2 mm at each end.

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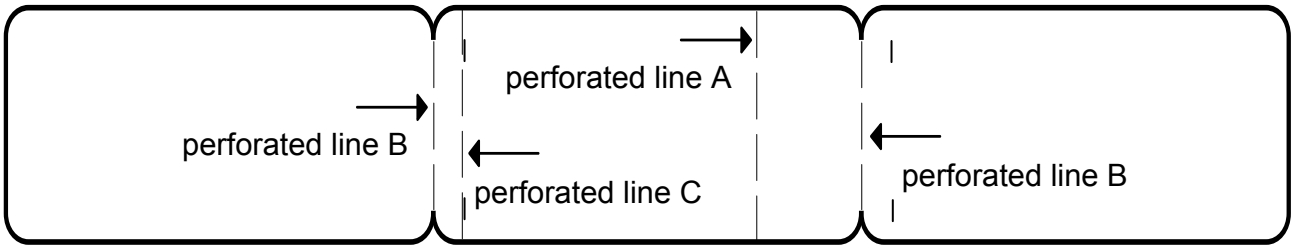


Figure 11 — Perforated lines on fan-fold TFC.5

6.2.2 Fan-fold pack presentation

6.2.2.1 Fan-fold TFC.1

Cards shall be folded, with any number of cards per fold, and with the reference edges oriented such that the shorter (heightwise) reference edge is the leading edge for feeding the cards into the equipment, as shown in Figure 12.

NOTE The resultant orientation of a lateral magnetic stripe, if present, will be as shown.

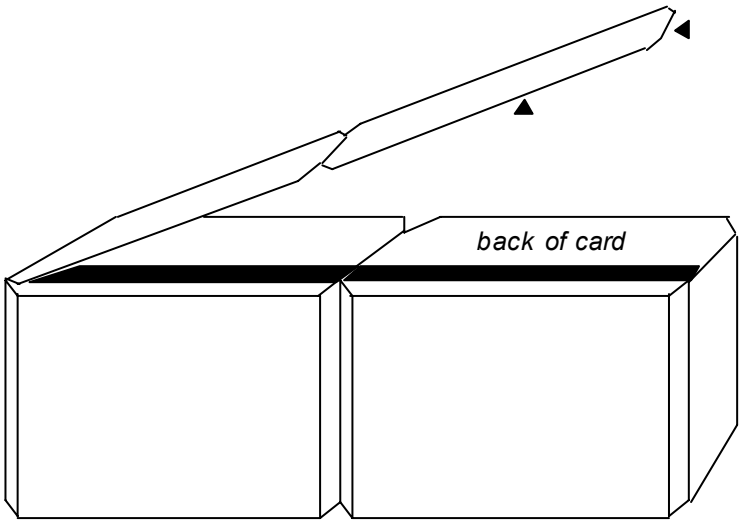


Figure 12 — Fan-folded presentation using two cards per fold as an example

6.2.2.2 Fan-fold TFC.5

Cards shall be folded, with any number of cards on each fold, and with the reference edges oriented such that the shorter (widthwise) reference edge is the leading edge for feeding the cards into the equipment, as shown in Figure 13.

NOTE The resultant orientation of a magnetic stripe, if present, will be as shown.

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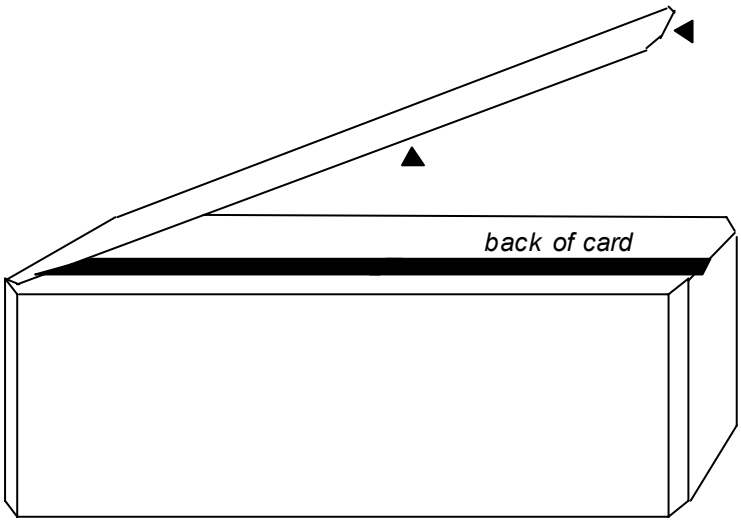


Figure 13 — Fan-fold card presentation

6.2.3 Card flatness

Each card in the pack shall meet the flatness requirements given in Table 5 for single cards of the same format.

6.2.4 Separation force

Perforated lines and bridge joins shall enable users and card issuing devices to separate the cards easily. The type of join permitted for each format and the force to separate two adjacent cards are shown in Table 5.

6.3 Reel

The reel shall be composed of a continuous strip of TFC material wound on a plastic or cardboard hub having the dimensions shown in Table 5.

6.3.1 Reel dimensions

The reel shall have a maximum external diameter shown in Table 5. It shall pass freely between two parallel flat plates spaced apart by the maximum width of the reel given in Table 5. The sides of the reel shall be smooth.

The internal diameter of the reel is determined by the hub used, as shown in Table 5.

The dimensions referred to are illustrated in Figure 14.

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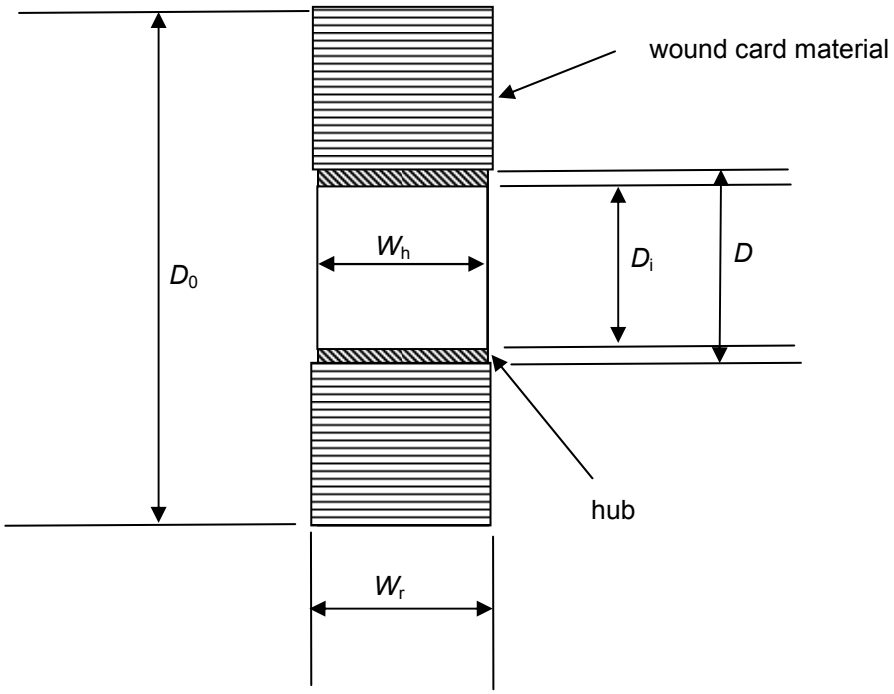


Figure 14 — Reel winding dimensions

6.3.2 Reel winding

The back of the cards shall be on the internal face of the turns. Specific application may not require such request. In that case it will be specified.

No part of any card shall adhere to, or leave an impression on, the adjacent cards in a reel.

Reels held in a horizontal plane, supported only at their edges, for 24 h shall not show a deflection from flatness of greater than 5 mm.

The outer end of the reel shall be cut at 90° ± 1° to the edges of the TFC material strip; it shall be secured with a temporary system which can be removed without causing damage to the material support or any other feature, including the magnetic stripe, if present.

7 Positioning features

When positioning features are required for an application, they shall either be punched holes or printed marks conforming to the following.

NOTE The presence of a positioning feature allows the reference edges to be identified uniquely.

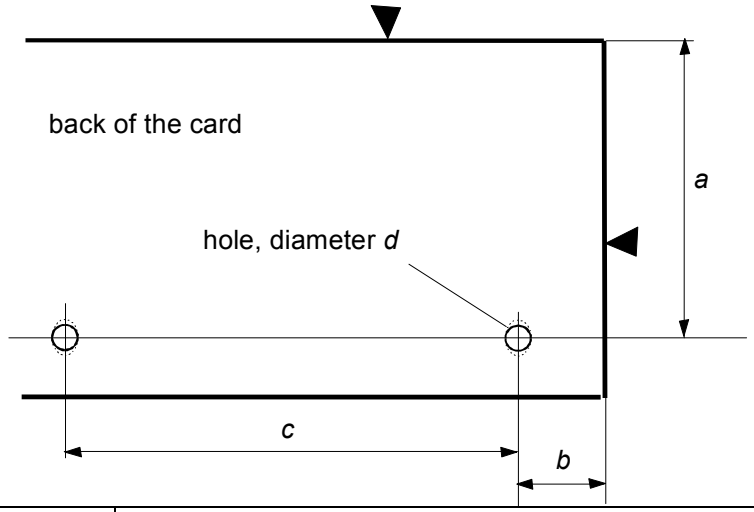
7.1 Punched positioning hole

NOTE It is not allowed to have holes when contactless application are taken into account.

Punched positioning holes are defined only for TFC.1.

If such a feature is required to identify the position and orientation of cards during manufacture, issuing and processing, its dimensions and position shall be as shown in Figure 15.

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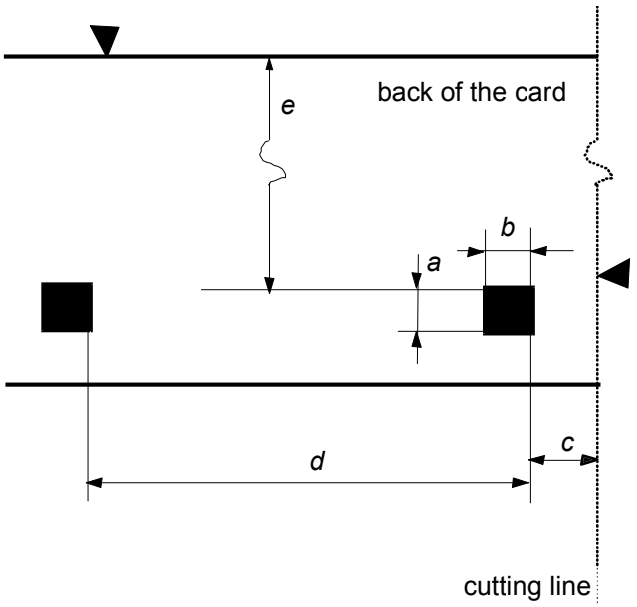
Quantity	Value (mm)	Notes
A	48,70 ± 0,25	
B	7,10 ± 0,25	*b* = 7,1 ± 1,0 for cards cut from reels.
C	85,6 ± 0,3	Applicable only to cards presented in reel form.
D	3,2 ± 0,1	The height of the hole may be elongated to a major diameter of 4,2 ± 0,1 to compensate for the hygroexpansivity of paper.

Figure 15 — Geometry of punched positioning hole

7.2 Printed positioning mark

Printed positioning marks are defined only for TFC.1.

The mark shall be on the back of the card. The dimensions and position shall be in accordance with Figure 16.



a = 5,0 mm ± 0,3 mm; *b* = 5,0 mm ± 0,3 mm; *c* = 5,5 mm ± 1,0 mm; *d* = 85,6 ± 0,3 mm;
e = 46,20 mm ± 0,25 mm

NOTE Applicable only to cards presented in reel form.

Figure 16 — Geometry of the positioning mark

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7.2.1.1 Printing zone reservation

A continuous zone shall be left unprinted on the back of the card to print the positioning marks. The height of the zone shall not be less than the height of the positioning mark.

7.2.1.2 Optical properties (contrast)

When measured in accordance with the methods specified in ISO 1831 for the B900 spectral band, the optical contrast between the mark and the printing zone reservation shall be as specified in Table 6.

Table 6 — Optical properties of positioning mark

Optical property	Value
R_w	≥ 70%
PCS	≥ 0,71

8 Characteristics specific to contactless TFCs

The requirements contained within this clause are entirely specific to contactless TFCs, including Low Usage Cards (LUC), and shall not be applied to any TFC that is not a contactless card. Furthermore, in the case of contactless TFCs only, where any specific requirement stated in this clause conflicts with one or more of the general TFC requirements stated elsewhere in this document then the specific requirement contained in this clause shall be applied.

8.1 Local overthickness due to the presence of the chip

The local increase in thickness of the card, relative to the nominal card thickness (see Figure 17), due to the presence of the chip shall be ≤ 200 µm.

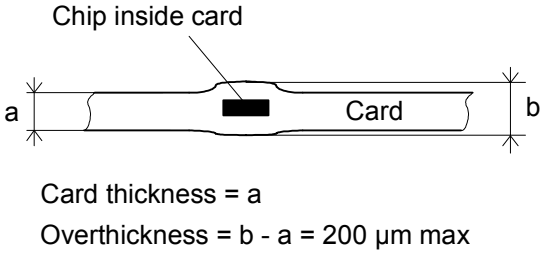


Figure 17 — Card overthickness due to presence of chip

8.2 Antenna location in Special TFC.1 cards

8.2.1 Cards in reel presentation

For cards in a reel presentation, the antenna shall be located within the area shown in Figure 18.

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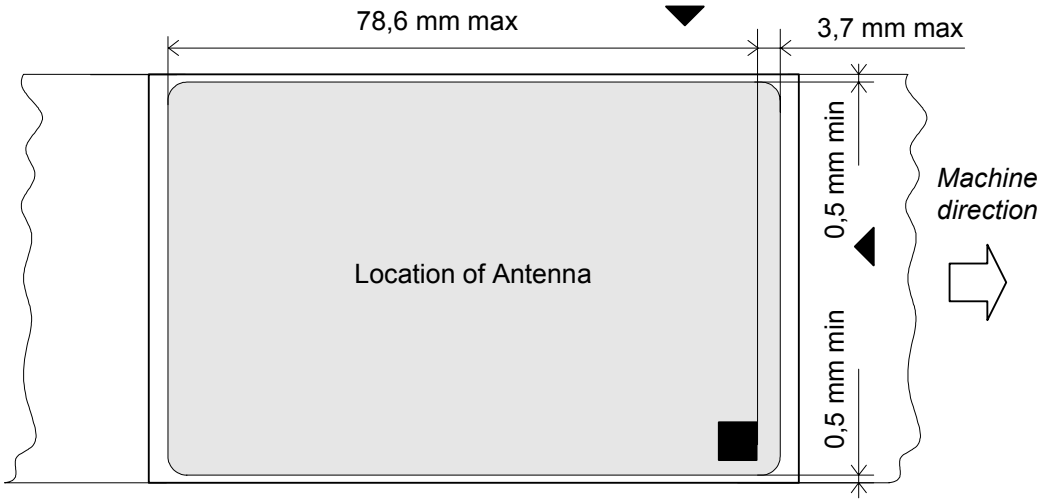


Figure 18 — Available area for antenna location (reel presentation)

8.2.2 Cards in fan-fold presentation

For cards in a fan-fold presentation, the antenna shall be located within the area shown in Figure 19.

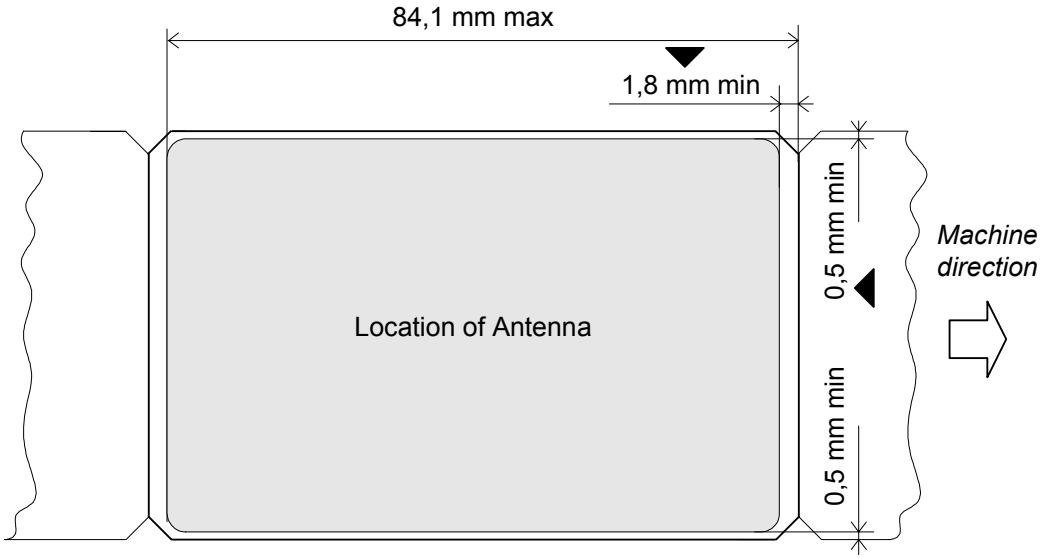


Figure 19 — Available area for antenna location (fan-fold presentation)

8.3 Location of chip and forbidden area for thermal printing

Any thermal printing of the card shall avoid the areas shown as "forbidden" in Figure 20.

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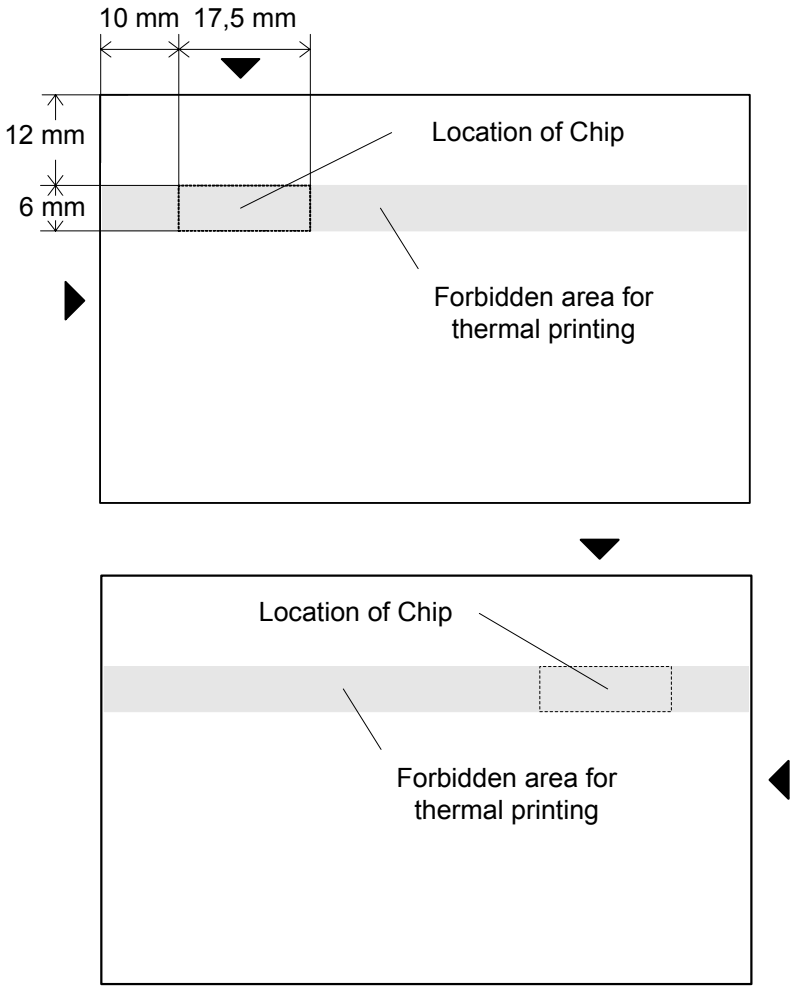


Figure 20 — Areas not available for thermal printing

8.4 Joins and splices

8.4.1 General

Where joins or splices are required to eliminate a section of reel or fanfold card stock, they shall conform to the following general requirements:

— Joins and splices shall not detach from the spliced card in normal processing and handling (to be agreed between supplier and customer);

— The thickness of any join or splice shall be less than 100 µm each side;

— The card stock either side of any join or splice shall be parallel within an angle of 0,5°;

— The card in which the join or splice is located shall continue to conform to the following requirements of this standard for Special TFC.1 cards:

  — card height requirements;

  — frictional characteristics requirements;

  — printed positioning mark requirements

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NOTE 1 It is recommended that the splice should be applied to both faces of the card.

NOTE 2 Knowledge of the tear characteristics of the splice or join is essential

NOTE 3 In case of cards with a thermal coating, a special joining or splicing material with a thermal layer can be used.

NOTE 4 A contactless card with a join or splice will automatically be considered defective.

8.4.2 Joins and splices in cards in reel presentation

Joins or splices in cards in reel presentation shall conform to Figure 21.

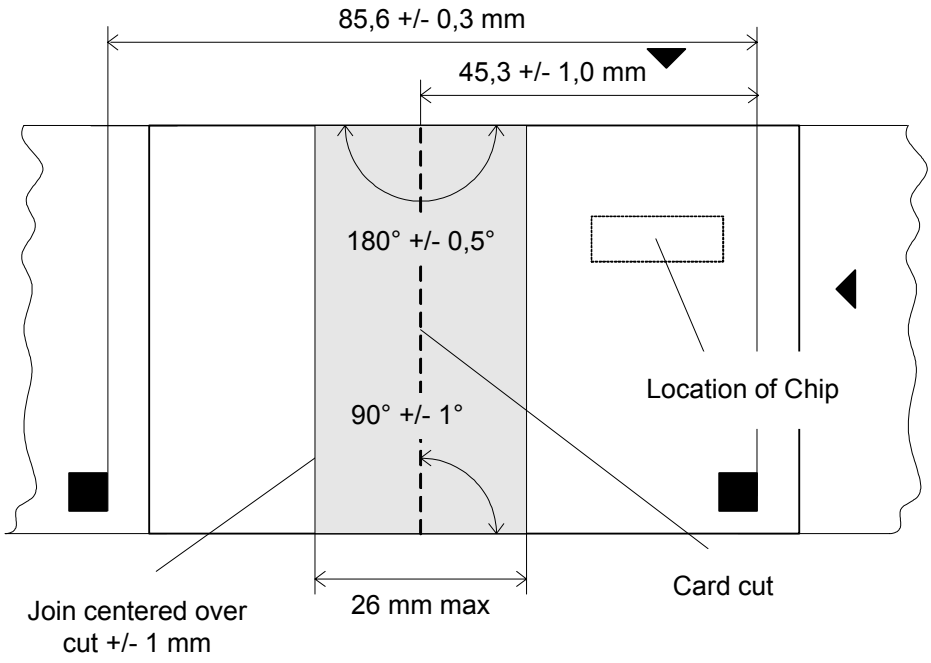


Figure 21 — Join or splice for a reel presentation (seen from Limited Use Card backside)

NOTE A beveled join may be used for specific applications.

8.4.3 Joins and splices in cards in fan-fold presentation

Joins or splices in cards in reel presentation shall conform to Figure 22.

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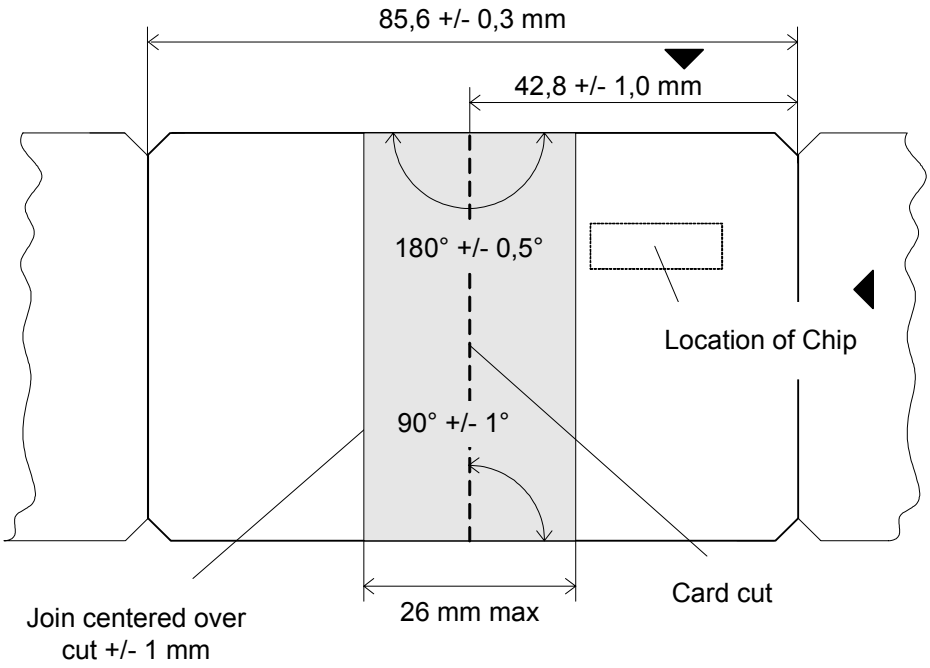


Figure 22 — Join or splice for a fan-fold (seen from Limited Use Card backside)

NOTE A beveled join may be used for specific applications.

8.5 Ultra-violet light

The card shall continue to operate as intended under exposure to ultra-violet light levels greater than those encountered in ordinary daylight at sea-level.

8.6 X-rays

The card shall continue to operate as intended after exposure of either face to medium-energy X-radiation, with energy in the range of 70 keV to 140 keV, of a cumulative dose of 0,1 Gy per year.

NOTE This corresponds to approximately twice the maximum acceptable dose to which humans may be exposed annually.

8.7 Dynamic bending stress

The card shall continue to operate as intended after testing in accordance with the test methods described in ISO/IEC 10373-1 where the maximum deflections about the short and long cards axes are h_{wA} = 20 mm and h_{wB} = 10 mm.

8.8 Dynamic torsional stress

The card shall continue to operate as intended after testing in accordance with the test methods described in ISO/IEC 10373-1 where the maximum angle of rotation is α = 15°.

8.9 Static electricity

The card shall continue to operate as intended after testing in accordance with the test methods described in ISO/IEC 10373-6 (referring to IEC 61000-4-2:1995), where the test voltage is 6 kV.

8.10 Operating temperature

The card shall operate as intended over an ambient temperature range of 0 °C to 50 °C.

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Annex A
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Paper TFC material characteristics

This annex specifies the material characteristics of paper TFCs.

A.1 Paper TFC.0

A.1.1 Regular paper TFC.0

Regular paper TFC.0 shall be constructed from a single layer of wood free paper. The characteristics of the base material shall be as given in Table A.1.

Table A.1 — Material characteristics of paper TFC.0

Characteristic	Values for 270 μm card	Control methods
Thickness	(270 ± 20) μm	ISO/IEC 15457-3
Stiffness (Resonance method): machine direction	(11 ± 1,5) mN·m	ISO 5629
Folding endurance (Schopper/Lhomargy method):	Log(n)	ISO 5626
machine direction cross direction	≥ 3,08 ≥ 2,78	
Tensile strength:		ISO 1924-2
machine direction cross direction	≥ 13 kN/m ≥ 5 kN/m	
Ash content	≤ 8 %	ISO 2144
Hygroexpansivity:		ISO 8226-2
machine direction cross direction	≤ 0,25 % ≤ 0,65 %	
Smoothness (Bekk method) (both faces)	40 to 100 s	ISO 5627
Coefficient of friction		
paper/stainless steel (machine and cross directions)	0,23 ± 0,05	ISO/IEC 15457-3
Opacity (700-1000 nm)	≥ 1,00	ISO/IEC 15457-3
Opacity (paper backing)	≥ 90 %	ISO 2471

A.1.2 Specific paper TFC.0 exceptions

For some applications, the material characteristics may deviate from those given in Table A.1.

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A.1.2.1 Thermal paper TFC.0

The requirements of Table A.1 are modified as follows :

— ash content : not applicable.

— — smoothness of front face (Bekk method) : 400 – 1 100 s.

A.1.3 Optional additional paper TFC.0 specifications

Some applications may use some or all of the requirements shown in Table A.2.

Table A.2 — Optional additional specifications for paper TFC.0

Characteristic	Values for 270 μm card	Control methods
Reflectance factor (R_W for B900 spectral band)	≥ 70 %	ISO 1831
Air permeance (Bendtsen method)	≤ 1,8 μm/Pa·s	ISO 5636-3
Sizing and pen writing factor	≥ 3	ISO/IEC 15457-3

A.2 Paper TFC.1

A.2.1 Regular paper TFC.1

Regular paper TFC.1 shall be constructed from a single layer of wood free paper. The characteristics of the base material shall be as given in Table A.3.

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Table A.3 — Material characteristics of paper TFC.1

Characteristic	Values for 178 μm card	Values for 250 μm card	Values for 270 μm card	Values for 290 to 680 μm Cards	Control methods
Thickness	(178 ±20) μm	(250 ± 20) μm	(270 ± 20) μm	Thickness = X ± 40 μm	ISO/IEC 15457-3
Stiffness (Taber method) machine direction	≥ 40,6 mN	≥ 71,1 mN	≥ 77,1 mN	≥ 77,1 mN	ISO 2493
Folding endurance (Schopper/Lhomargy method)	$Log_{10}(n)$	$Log_{10}(n)$	$Log_{10}(n)$	$Log_{10}(n)$	ISO 5626
machine direction cross direction	≥ 3 ≥ 2,40	≥ 3,08 ≥ 2,78	≥ 3,08 ≥ 2,78	≥ 3,08 ≥ 2,78	
Smoothness (Bekk method) (both faces)	40 to 100 s	40 to 100 s	40 to 100 s	40 to 100 s	ISO 5627
Coefficient of friction - select at least one of the following according to application requirements:					
a) paper/stainless steel (machine and cross directions)	0,23 ± 0,05	0,23 ± 0,05	0,23 ± 0,05	0,23 ± 0,05	ISO/IEC 15457-3
b) de-stacking	0,30 to 0,45	0,30 to 0,45	0,30 to 0,45	0,30 to 0,45	ISO/IEC 15457-3
Tear resistance (machine and cross directions)	≥ 000 mN	≥ 1 000 mN	≥ 1 000 mN	≥ 1 000 mN	ISO 6383-2
Opacity (700-1000 nm)	≥0,72	≥ 1,00	≥1,00	≥1,00	ISO/IEC 15457-3
Opacity (paper backing)	≥ 90 %	≥ 90 %	≥ 90 %	≥ 90 %	ISO 2471

A.2.2 Specific paper TFC.1 exceptions

For some applications, the material characteristics may deviate from those given in Table A.3.

A.2.2.1 Thermal paper TFC.1

The requirements of Table A.3 are modified as follows :

— smoothness of front face (Bekk method) : 400 – 1 100 s.

A.2.3 Optional additional paper TFC.1 specifications

Some applications may use some or all of the requirements shown in Table A.4.

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Table A.4 — Optional additional specifications for paper TFC.1

Characteristic	Values for 178 μm card	Values for 250 μm card	Values for 270 μm card	Control methods
Reflectance factor (R_W for B900 spectral band)	≥ 70 %	≥ 70 %	≥ 70 %	ISO 1831
Air permeance (Bendtsen method)	≤ 0,62 μm/Pa·s	≤ 1,8 μm/Pa·s	≤ 1,8 μm/Pa·s	ISO 5636-3
Sizing and pen writing factor	≥ 3	≥ 3	≥ 3	ISO/IEC 15457-3

A.3 Paper TFC.5

A.3.1 Regular paper TFC.5

Regular paper TFC.5 shall be constructed from a single layer of wood free paper. The finished cards shall conform to the material characteristics given in Table A.5.

Table A.5 — Material characteristics of paper TFC.5

Characteristic	Values for 178 μm card	Control methods
Thickness	(178 ±20) μm	ISO/IEC 15457-3
Stiffness (Taber method) machine direction	40,6 mN	ISO 2493
Folding endurance (Schopper/Lhomargy method) machine direction cross direction	$Log_{10}(n)$ ≥ 3 ≥ 2,40	ISO 5626
Smoothness (Bekk method) (both faces)	40 to 100 s	ISO 5627
Coefficient of friction - select at least one of the following according to application requirements: a) paper/stainless steel (machine and cross directions) b) de-stacking	 0,23 ± 0,05 0,30 – 0,45	 ISO/IEC 15457-3 ISO/IEC 15457-3
Tear resistance (machine and cross directions)	1000 mN	ISO 6383-2
Opacity (700-1000 nm)	0,72	ISO/IEC 15457-3
Opacity (paper backing)	≥ 90 %	ISO 2471

A.3.2 Specific paper TFC.5 exceptions

For some applications, the material characteristics may deviate from those given in Table A.5.

NOTE TFC.5 differs in details only from the card format (ATB) used in international air transportation.

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A.3.2.1 Thermal paper TFC.5

The requirements of Table A.5 are modified as follows:

— thickness: 185 μm ± 13 μm;

— smoothness of front face (Bekk method): 400 – 1 100 s.

A.3.3 Optional additional paper TFC.5 specifications

Some applications may use some or all of the requirements shown in Table A.6.

Table A.6 — Optional additional specifications for paper TFC.5

Characteristic	Values for 178 μm card	Control methods
Reflectance factor (R_W for B900 spectral band)	≥ 70 %	ISO 1831
Air permeance (Bendtsen method)	≤ 0,62 μm/Pa·s	ISO 5636-3
Sizing and pen writing factor	≥ 3	ISO/IEC 15457-3

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Annex B
(normative)

Composite TFC material characteristics

This annex specifies the material characteristics of composite TFCs.

B.1 Composite TFC.0

B.1.1 Regular composite TFC.0

Regular composite TFC.0 shall be constructed from at least two layers of different material, at least one of which is paper. The finished cards shall conform to the material characteristics given in Table B.1.

Table B.1 — Material characteristics of composite TFC.0

Characteristic	Values for 270 μm card	Control methods
Thickness	(270 ± 20) μm	ISO/IEC 15457-3
Stiffness (Resonance method) machine direction	(8,5 ± 1) mN·m	ISO 5629
Smoothness (Bekk method) (both faces)	40 to 100 s	ISO 5627
Tear resistance machine and cross directions	≥ 2 000 mN	ISO 6383-2
Delamination resistance	≥ 550 kPa	ISO/IEC 15457-3
Coefficient of friction paper/stainless steel (machine and cross directions)	0,23 ± 0,05	ISO/IEC 15457-3
Opacity (700-1000 nm)	≥ 1	ISO/IEC 15457-3
Opacity (paper backing)	≥ 90 %	ISO 2471

B.1.2 Specific composite TFC.0 exceptions

For some applications, the material characteristics may differ from those given in Table B.1.

B.1.2.1 Thermal composite TFC.0

The requirements of Table A.3 are modified as follows:

— smoothness of front face (Bekk method): 400 – 1 100 s.

B.1.3 Optional additional composite TFC.0 specifications

Some applications may use some or all of the requirements shown in Table B.2.

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Table B.2 — Optional additional specifications for composite TFC.0

Reflectance factor (R_W for B900 spectral band)	≥ 70 %	ISO 1831
Sizing and pen writing factor	≥ 3	ISO/IEC 15457-3

B.2 Composite TFC.1

B.2.1 Regular composite TFC.1

Regular composite TFC.1 shall be constructed from at least two layers of material, at least one of which is paper. The finished cards shall conform to the material characteristics given in Table B.3.

Table B.3 — Material characteristics of composite TFC.1

Characteristic	Values for 250 μm card	Values for 360 μm card	Values for 400 to 680 μm Cards	Control methods
Thickness	(250 ± 25) μm	(360 ± 40) μm	Thickness = X ± 50 μm	ISO/IEC 15457-3
Stiffness (Taber method) machine direction	≥71,1 mN	≥71,1 mN	≥71,1 mN	ISO 2493
Smoothness (Bekk method) (both faces)	≥ 45 s	≥ 45 s*	≥ 45 s*	ISO 5627
Tear resistance machine and cross directions	≥ 2 000 mN	≥ 2 000 mN	≥ 2 000 mN	ISO 6383-2
Delamination resistance	≥ 550 kPa	≥ 300 kPa	≥ 300 kPa	ISO/IEC 15457-3
Coefficient of friction - select at least one of the following according to application requirements:				
a) paper/stainless steel (machine and cross directions)	0,23 ± 0,05	0,23 ± 0,05	0,23 ± 0,05	ISO/IEC 15457-3
b) de-stacking	0,30 – 0,45	0,30 – 0,45	0,30 – 0,45	ISO/IEC 15457-3
Opacity (700-1000 nm)	≥1	≥1	≥1	ISO/IEC 15457-3
Opacity (paper backing)	≥ 90 %	≥ 90 %	≥ 90 %	ISO 2471

* Due to specific use, this characteristic is not necessarily requested

B.2.2 Specific composite TFC.1 exceptions

For some applications, the material characteristics may differ from those given in Table B.3.

B.2.2.1 Thermal composite TFC.1

The requirements of Table B.3 are modified as follows:

— smoothness of front face (Bekk method): 400 – 1 100 s.

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B.2.3 Optional additional composite TFC.1 specifications

Some applications may use some or all of the requirements shown in Table B.4.

Table B.4 — Optional additional specifications for composite TFC.1

Reflectance factor (R_w for B900 spectral band)	≥ 70 %	ISO 1831
Sizing and pen writing factor	≥ 3	ISO/IEC 15457-3

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Annex C
(normative)

Plastic TFC material characteristics

This annex specifies the material characteristics of plastic cards. Such cards shall be made solely from one or more layers of plastic.

C.1 Plastic TFC.0

C.1.1 Regular plastic TFC.0

The finished cards shall conform to the material characteristics given in Table C.1.

Table C.1 — Material characteristics of plastic TFC.0

Characteristic	Values for 270 μm card	Control methods
Thickness	(270 ± 20) μm	ISO/IEC 15457-3
Stiffness (Resonance method) machine direction	(4,5 ± 1,0) mN·m	ISO 5629
Smoothness (Bekk method) (both faces)	40 to 100 s	ISO 5627
Tear resistance (Elmendorf method)	≥ 2 500 mN	ISO 6383-2
Coefficient of friction - select at least one of the following according to application requirements:		
a) paper/stainless steel (machine and cross directions)	0,23 ± 0,05	ISO/IEC 15457-3
b) de-stacking	0,30 – 0,45	ISO/IEC 15457-3
Reflectance factor (R_w for B900 spectral band)	≥ 70 %	ISO 1831
Sizing and pen writing factor	≥ 3	ISO/IEC 15457-3
Cold crack temperature machine and cross directions	≤ –35°C	ISO 8570
Opacity (700-1000 nm)	≥ 1,00	ISO/IEC 15457-3
Opacity (paper backing)	≥ 90 %	ISO 2471

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C.2 Plastic TFC.1

C.2.1 Regular plastic TFC.1

The finished cards shall conform to the material characteristics given in Table C.3.

Table C.2 — Material characteristics of plastic TFC.1

Characteristic	Values for 250 μm card	Values for 270 μm card	Values for 290 to 680 μm Cards	Control methods
Thickness	(250 ± 20) μm	(270 ± 20) μm	Thickness = X ± 50 μm	ISO/IEC 15457-3
Stiffness (Taber method) machine direction	≥ 71,1 mN	≥ 77,14 mN	≥ 77,14 mN	ISO 2493
Smoothness (Bekk method) (both faces)	≥ 45 s	≥ 45 s	≥ 45 s*	ISO 5627
Tear resistance (Elmendorf method)	≥ 2 500 mN	≥ 2 500 mN	≥ 2 500 mN	ISO 6383-2
Coefficient of friction - select at least one of the following according to application requirements:				
a) paper/stainless steel (machine and cross directions)	0,23 ± 0,05	0,23 ± 0,05	0,23 ± 0,05	ISO/IEC 15457-3
b) de-stacking	0,30 – 0,45	0,30 – 0,45	0,30 – 0,45	ISO/IEC 15457-3
Opacity (700-1000 nm)	≥ 1,00	≥ 1,00	≥ 1,00	ISO/IEC 15457-3
Opacity (paper backing)	≥ 90 %	≥ 90 %	≥ 90 %	ISO 2471

* Due to specific use, this characteristic in not necessarily requested

C.2.2 Optional additional plastic TFC.1 specifications

Some applications may use some or all of the requirements shown in Table C.4.

Table C.3 — Optional additional specifications for plastic TFC.1

Reflectance factor (R_w for B900 spectral band)	≥ 70 %	≥ 70 %	ISO 1831
Sizing and pen writing factor	≥ 3	≥ 3	ISO/IEC 15457-3
Cold crack temperature machine and cross directions	≤ –35°C	≤ –35°C	ISO 8570

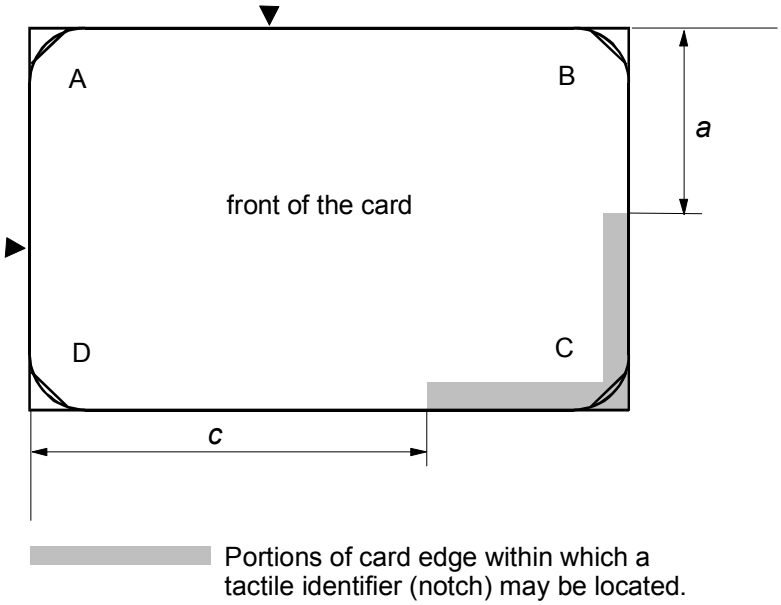
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Annex D
(informative)

Recommended location of TFC.1 tactile identifiers

In cases where it is necessary to provide a tactile identifier to indicate a particular TFC.1 card orientation, it is recommended that it be located at corner C, or on one of the adjacent non-reference edges of the card, within the limits defined in Figure D.1.



Nominal dimensions: *a* = 27 mm; *c* = 57 mm

NOTE Care should be taken to ensure that the location of the tactile identifier does not compromise any other operational feature of the card.

Figure D.1 — Permitted locations for the tactile identifier

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