
**Identification cards — Recording
technique —**

Part 2:
Magnetic stripe: Low coercivity

*Cartes d'identification — Technique d'enregistrement —
Partie 2: Bandeau magnétique: Faible coercivité*

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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.

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 ISO/IEC JTC 1, *Information technology*, SC 17, *Cards and personal identification*.

This fifth edition cancels and replaces the fourth edition (ISO/IEC 7811-2:2014), which has been technically revised.

Major changes from the previous edition are as follows:

- wherever possible, the same definitions, criteria and test methods are used in ISO/IEC 7811-2 and ISO/IEC 7811-6;
- the primary standard cards held by Q-Card are used to calibrate the manufacture of secondary reference cards. Other primary standard cards held by PTB and Card Testing International (CTI) are used as backup to replace cards held by Q-Card as they wear out;
- the supplier of secondary reference cards has changed from PTB to Q-Card;
- during revision, some figure and table numbers may have changed and might not be the same between the two standards.

Notes in this document are only used for giving additional information intended to assist in the understanding or use of the document. They do not contain provisions or requirements to which it is necessary to conform in order to claim compliance with this document.

A list of all the parts in the ISO/IEC 7811 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.

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Identification cards — Recording technique —

Part 2: Magnetic stripe: Low coercivity

1 Scope

ISO/IEC 7811 defines the characteristics for identification cards as defined in [Clause 4](#) of this document and the use of such cards for international interchange.

This document specifies requirements for a low coercivity magnetic stripe (including any protective overlay) on an identification card, the encoding technique and coded character sets. It takes into consideration both human and machine aspects and states minimum requirements.

Coercivity influences many of the quantities specified in this document but is not itself specified.

ISO/IEC 7811 provides criteria to which cards are to perform. No consideration is given within ISO/IEC 7811 to the amount of use, if any, experienced by the card prior to test. Failure to conform to specified criteria is negotiated between the involved parties.

ISO/IEC 10373-2 specifies the test procedures used to check cards against the parameters specified in this document.

NOTE Numeric values in the SI and/or Imperial measurement system in this document may have been rounded off and are consistent with, but not exactly equal to each other. Using either system is correct but intermixing or reconvertng values can result in errors. The original design was made using the Imperial measurement system.

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 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

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

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

ISO/IEC 10373-2, *Identification cards — Test methods — Part 2: Cards with magnetic stripes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 7810 and the following 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 <http://www.iso.org/obp>

**3.1
primary standard**

set of reference cards established by the Physikalisch-Technische Bundesanstalt (PTB) and maintained by PTB, Q-Card, and Card Testing International secretariat that represent the values of U_R and I_R designated RM7811-2

**3.2
secondary standard**

reference card designated RM7811-2 that is related to the primary standard as stated in the calibration certificate supplied with each card

Note 1 to entry: Secondary standards can be ordered from Q-Card, 301 Reagan Street, Sunbury, PA 17801, USA. The source of secondary standards will be maintained at least until 2018.

**3.3
unused un-encoded card**

card possessing all the components required for its intended purpose, which has not been subjected to any personalization or testing operation, and which has been stored in a clean environment with no more than 48 h exposure to daylight and at temperatures between 5 °C and 30 °C and humidity between 10 % and 90 % without experiencing thermal shock

**3.4
unused encoded card**

card according to 3.3 that has only been encoded with all the data (magnetic, embossing, electronic, etc.) required for its intended purpose

**3.5
returned card**

card according to 3.4 after it has been issued to the card holder and returned for the purpose of testing

**3.6
flux transition**

location of the greatest rate of change with distance of the magnetisation

**3.7
reference current**

I_R
minimum recorded current amplitude under the given test conditions that causes, on the reference card, a readback signal amplitude equal to 80 % of the reference signal amplitude U_R , at a density of 8 flux transitions per millimetre (200 flux transitions per inch) as shown in [Figure 6](#)

**3.8
reference flux level**

F_R
flux level in the test head that corresponds to the reference current I_R

**3.9
test recording currents**

two recording currents defined by:

I_{\min} = recording current corresponding to $3,5 F_R$

I_{\max} = recording current corresponding to $5,0 F_R$

**3.10
individual signal amplitude**

U_i
base-to-peak amplitude of a single readback voltage signal

3.11**average signal amplitude** U_A

sum of the absolute value of the amplitude of each signal peak (U_i) divided by the number of signal peaks (n) for a given track over the length of the magnetic stripe area

3.12**reference signal amplitude** U_R

maximum value of the average signal amplitude of a reference card corrected to the primary standard

3.13**physical recording density**

number of flux transitions per unit length recorded on a track

3.14**bit density**

number of data bits stored per unit of length

3.15**bit cell**

distance between two clocking flux transitions as shown in [Figure 10](#)

3.16**subinterval**

distance that is nominally half the distance between two clocking flux transitions as shown in [Figure 10](#)

4 Conformance

A prerequisite for conformance with this document is conformance with ISO/IEC 7810. An identification card is in conformance with this document if it meets all mandatory requirements specified herein. Default values apply if no others are specified.

5 Physical characteristics of the identification card**5.1 General**

The identification card shall conform to the specification given in ISO/IEC 7810.

WARNING — The attention of card issuers is drawn to the fact that information held on the magnetic stripe may be rendered ineffective through contamination by contact with dirt and certain commonly used chemicals including plasticizers. It should also be noted that any printing or screening placed on top of the magnetic stripe must not impair the function of the magnetic stripe.

5.2 Magnetic stripe area warpage

Application of a 2,2 N (0.5 lbf) load evenly distributed on the front face opposite the magnetic stripe shall bring the entire stripe within 0,08 mm (0.003 in) of the rigid plate.

5.3 Surface distortions

There shall be no surface distortions, irregularities or raised areas on both the front and the back of the card in the area shown in [Figure 1](#) that might interfere with the contact between the magnetic head and magnetic stripe.

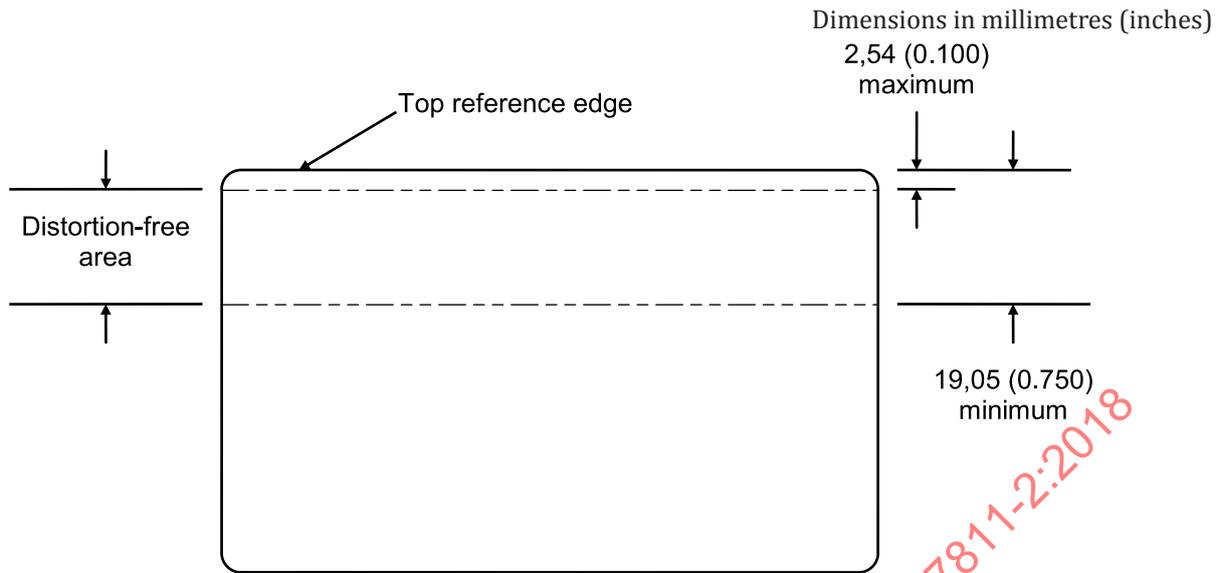


Figure 1 — Distortion-free area on card with magnetic stripe

If a raised signature panel area is located on the front or back of the card, then it shall be no closer to the top edge of the card than 19,05 mm (0.750 in).

NOTE Raised areas and distortions on other areas of the card can cause card transport problems with magnetic stripe processing equipment resulting in reading or writing errors.

6 Physical characteristics of the magnetic stripe

6.1 Height and surface profile of the magnetic stripe area

The magnetic stripe area is located on the back of the card as shown in [Figure 2](#).

NOTE In the case of the magnetic stripe area used for track 1 and 2, the dimension a as shown in [Figure 2](#) of the magnetic media could be less than the maximum dimension b as shown in [Figure 11](#) for the location of track 2 data on the card. It is desirable that the magnetic stripe area extend beyond the limits of the encoded track.

Dimensions in millimetres (inches)

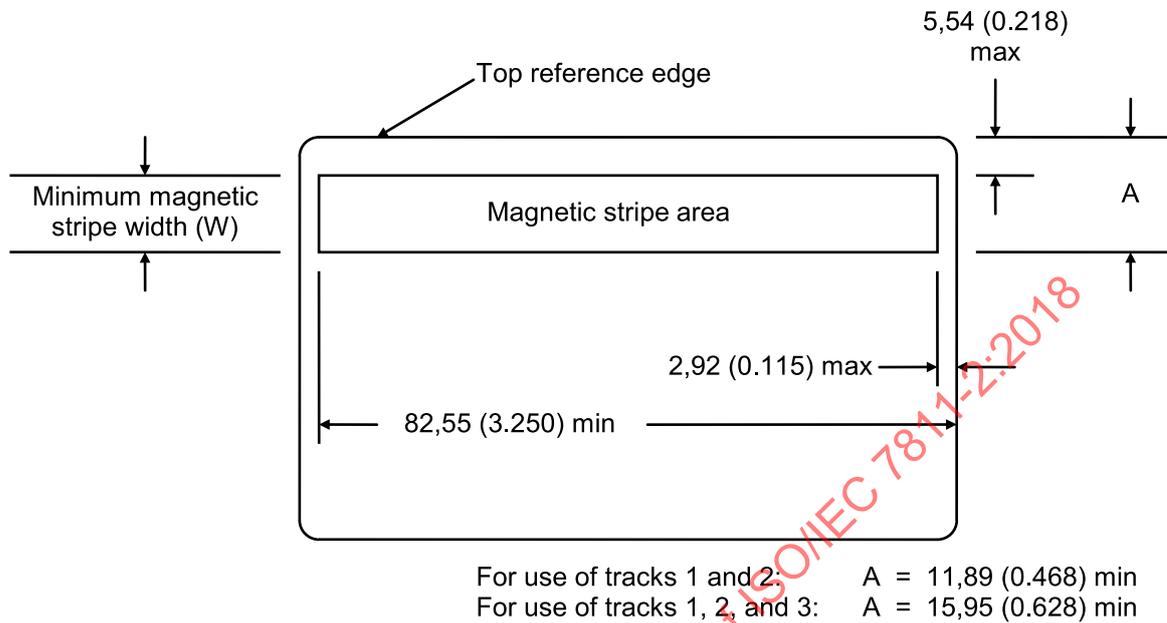


Figure 2 — Location of magnetic material for ID-1 type card

6.1.1 Surface profile of the magnetic stripe area

The maximum vertical deviation (a) of the transverse surface profile of the magnetic stripe area is shown below. See Figure 3, Figure 4, and Figure 5. The slope of the surface profile curve shall be limited to: $-4a/W < \text{slope} < 4a/W$.

When the bending stiffness value (see ISO/IEC 7810) for the card is 20 mm or more then the surface profile limits are:

Minimum stripe width	As shown in Figure 3 A	As shown in Figure 3 B
W = 6,35 mm (0.25 in)	$a \leq 9,5 \mu\text{m}$ (375 μin)	$a \leq 5,8 \mu\text{m}$ (225 μin)
W = 10,28 mm (0.405 in)	$a \leq 15,4 \mu\text{m}$ (607 μin)	$a \leq 9,3 \mu\text{m}$ (365 μin)

When the bending stiffness value (see ISO/IEC 7810) for the card is less than 20 mm then the surface profile limits are:

Minimum stripe width	As shown in Figure 3 A	As shown in Figure 3 B
W = 6,35 mm (0.25 in)	$a \leq 7,3 \mu\text{m}$ (288 μin)	$a \leq 4,5 \mu\text{m}$ (175 μin)
W = 10,28 mm (0.405 in)	$a \leq 11,7 \mu\text{m}$ (466 μin)	$a \leq 7,3 \mu\text{m}$ (284 μin)

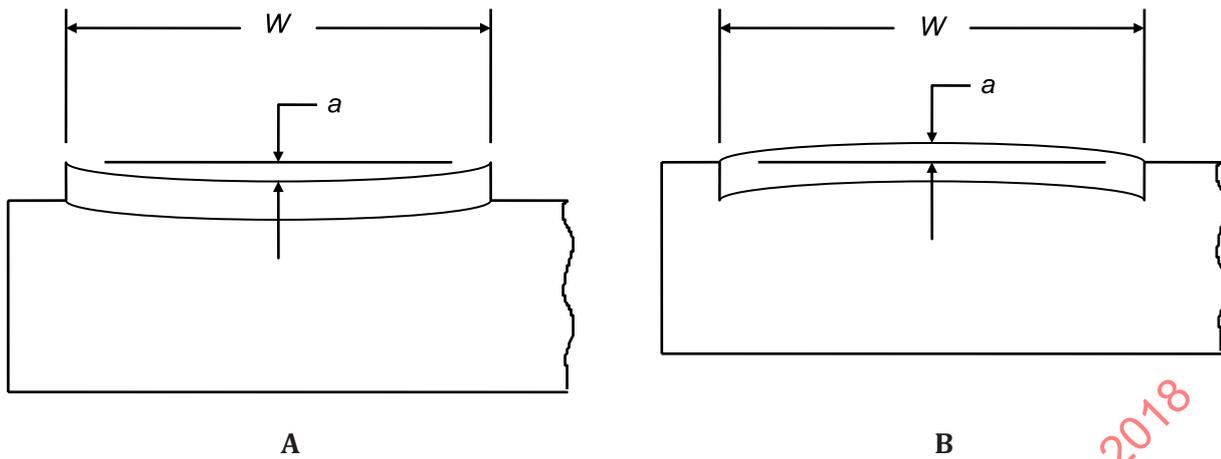


Figure 3 — Surface profile

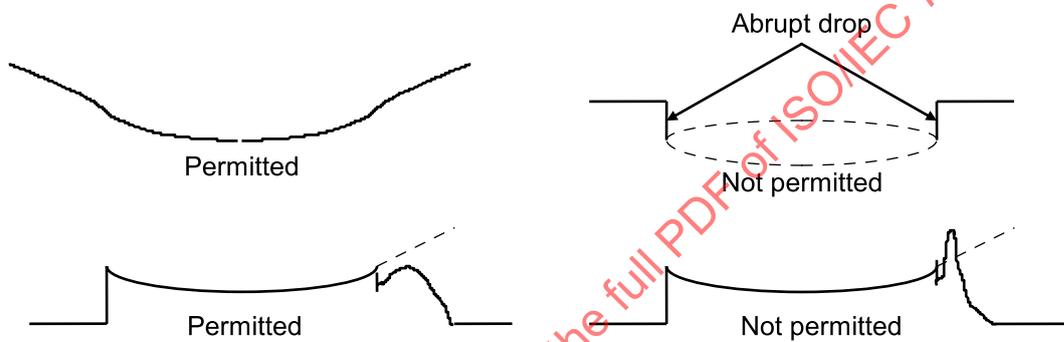


Figure 4 — Surface profile examples



Irregular profiles as shown may result in poor quality encoding.

Figure 5 — Irregular surface profile examples

6.1.2 Height of the magnetic stripe area

The vertical deviation (h) of the magnetic stripe area relative to the adjacent surface of the card shall be:

$$-0,005 \text{ mm } (-200 \text{ }\mu\text{in}) \leq h \leq 0,038 \text{ mm } (1500 \text{ }\mu\text{in})$$

Spiking in the profile caused by the material "squirt out" in hot stamping is not part of the stripe. It shall not extend above the magnetic stripe area height (h) as defined above.

6.2 Surface roughness

The average surface roughness (R_a) of the magnetic stripe area shall not exceed $0,40 \text{ }\mu\text{m}$ ($15.9 \text{ }\mu\text{in}$) in both the longitudinal and transverse directions when measured according to ISO 4287.

6.3 Adhesion of stripe to card

The stripe shall not separate from the card under normal use.

6.4 Wear of magnetic stripe from read/write head

Average signal amplitude (U_A) and individual signal amplitude (U_i) are measured before and after 2 000 wear cycles and shall result in:

$$U_A \text{ after} \geq 0,60 U_A \text{ before} \quad \text{and} \quad U_i \text{ after} \geq 0,80 U_A \text{ after}$$

6.5 Resistance to chemicals

Average signal amplitude (U_A) and individual signal amplitude (U_i) are measured before and after short-term exposure as defined in ISO/IEC 10373-1 and shall result in:

$$U_A \text{ after} \geq 0,90 U_A \text{ before} \quad \text{and} \quad U_i \text{ after} \geq 0,90 U_A \text{ after}$$

Average signal amplitude (U_A) and individual signal amplitude (U_i) are measured before and after long-term exposure (24 hours) to acid and alkaline artificial perspiration, as defined in ISO/IEC 10373-1.

$$U_A \text{ after} \geq 0,90 U_A \text{ before} \quad \text{and} \quad U_i \text{ after} \geq 0,90 U_A \text{ after}$$

7 Performance characteristics for the magnetic material

7.1 General

The purpose of this clause is to enable magnetic interchangeability between card and processing systems. Media coercivity is not specified. The media's performance criteria, regardless of coercivity, is specified in [7.3](#).

This method uses a reference card whose material is traceable to the primary standard (see [Clause 3](#)). All signal amplitude results from the use of the secondary reference card must be corrected by the factor supplied with the secondary reference card. Test methods given in ISO/IEC 10373-2 shall be used.

7.2 Testing and operating environment

The testing environment for signal amplitude measurements is $23 \text{ }^\circ\text{C} \pm 3 \text{ }^\circ\text{C}$ ($73 \text{ }^\circ\text{F} \pm 5 \text{ }^\circ\text{F}$) and 40 % to 60 % relative humidity. When tested under otherwise identical conditions, the average signal amplitude measured at 8 ft/mm (200 ftpi) shall not deviate from its value in the above test environment by more than 15 % after 5 min exposure over the following operating environment range:

Temperature	$-35 \text{ }^\circ\text{C}$ to $50 \text{ }^\circ\text{C}$ ($-31 \text{ }^\circ\text{F}$ to $122 \text{ }^\circ\text{F}$)
Relative humidity	5 % to 95 %

7.3 Signal amplitude requirements for magnetic media

The requirements for recording characteristics of the card are shown in [Table 1](#) and [Figure 6](#).

Table 1 — Signal amplitude requirements for unused unencoded cards

Description	Density ft/mm (ftpi)	Test recording current	Signal amplitude result	Requirement
Signal amplitude	8 (200)	I_{min}	U_{A1}	$0,8 U_R \leq U_{A1} \leq 1,3 U_R$
Signal amplitude	8 (200)	I_{min}	U_{i1}	$U_{i1} \leq 1,36 U_R$
Signal amplitude	8 (200)	I_{max}	U_{A2}	$U_{A1} \geq U_{A2} \geq 0,8 U_R$
Signal amplitude	20 (508)	I_{max}	U_{i2}	$U_{i2} \geq 0,65 U_R$
Resolution	20 (508)	I_{max}	U_{A3}	$U_{A3} \geq 0,7 U_{A2}$
Erasure	0	I_{min}, DC	U_{A4}	$U_{A4} \leq 0,03 U_R$
Extra pulse	0	I_{min}, DC	U_{i4}	$U_{i4} \leq 0,05 U_R$

The slope of the saturation curve shall never be positive between I_{min} and I_{max} .

NOTE 1 It is not permissible to combine the above requirements mathematically. These values are for unencoded card tests and are **not** applicable for encoded cards.

NOTE 2 It has been observed that low resolution as measured per [Table 1](#) can correlate with high flux transition spacing variation as measured per [Table 2](#).

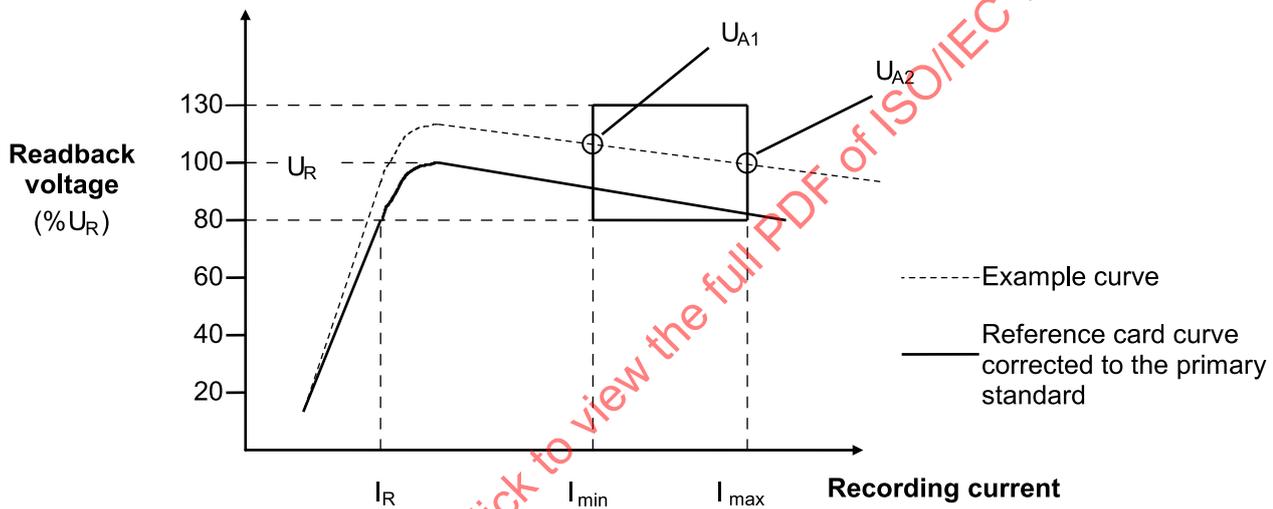
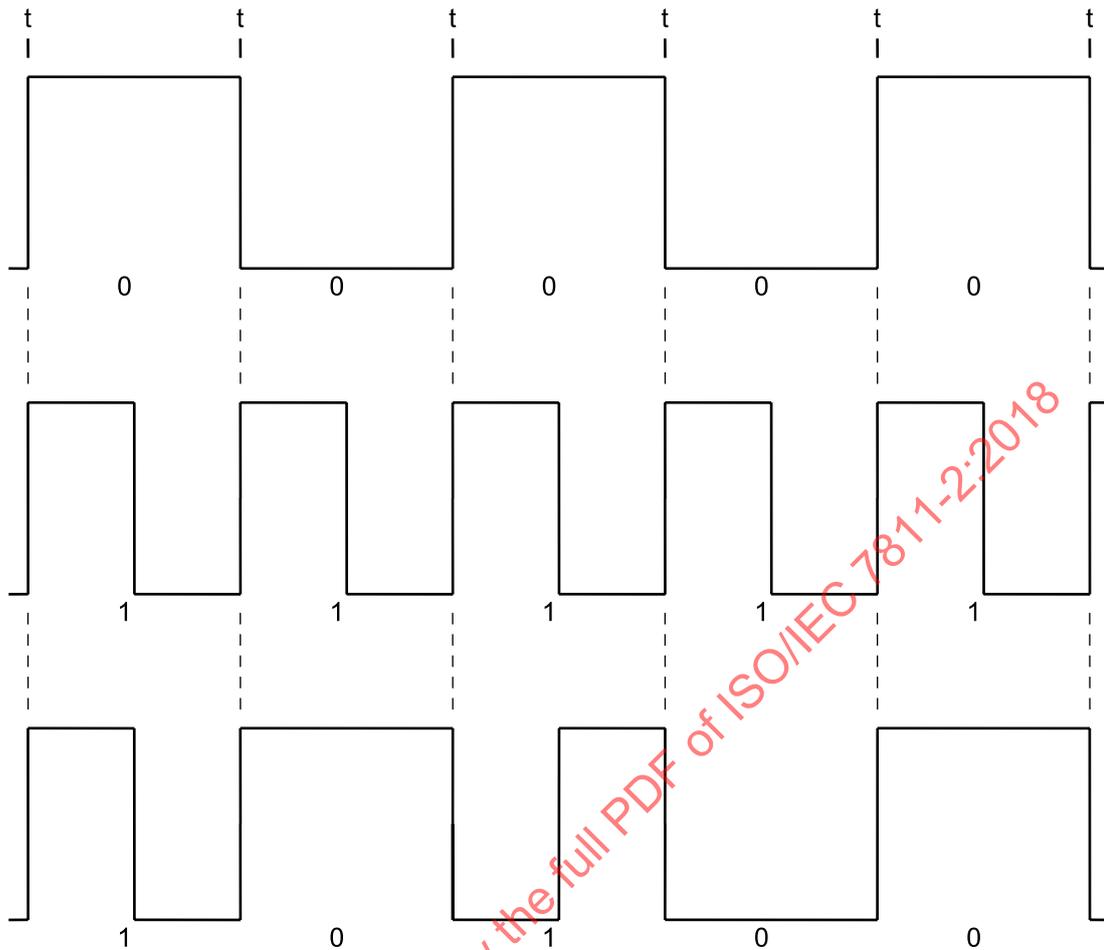


Figure 6 — Saturation curve example showing tolerance area at 8 ft/mm (200 ftpi)

NOTE The curve defines the primary standard response (on a card). The window parameters define a card that will be functional in the machine readable environment.

8 Encoding technique

The encoding technique for each track is known as two-frequency recording. This method allows for serial recording of self-clocking data. The encoding comprises data and clocking transitions together. A flux transition occurring between clocks signifies that the bit is a "one" and the absence of a flux transition between clocking transitions signifies that the bit is a "zero" (see [Figure 7](#)).

**Key**

t self-clocking (timing) intervals

Figure 7 — Examples of two-frequency encoding

The data shall be recorded as a synchronous sequence of characters without intervening gaps.

NOTE Recording with a write current which is less than I_{\min} can result in poor quality encoding.

9 Encoding specification, general

9.1 Angle of recording

The angle of recording shall be normal to the nearest edge of the card parallel to the magnetic stripe with a tolerance of ± 20 min. The angle of recording (α) is determined by measuring the angle of the head gap when the reading amplitude is maximum (see [Figure 8](#)).

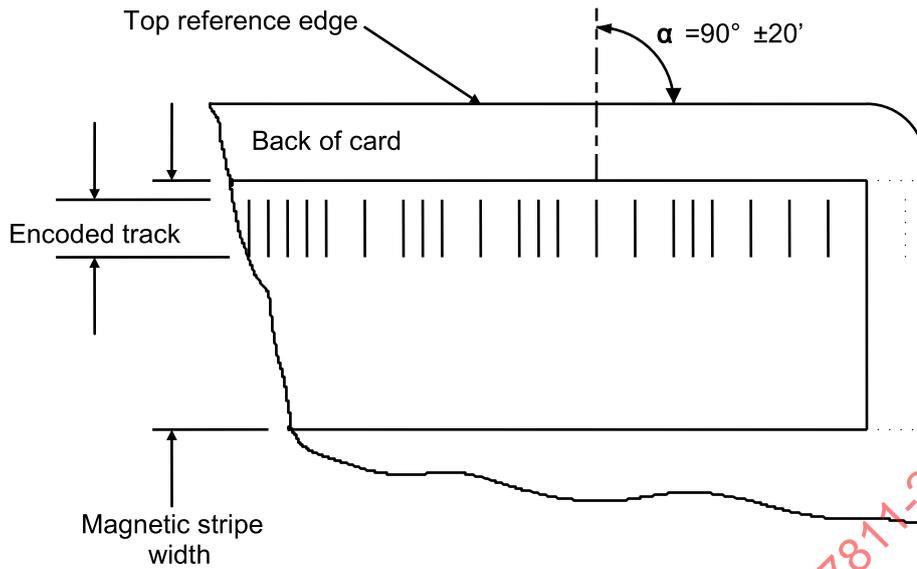


Figure 8 — Angle of recording

9.2 Nominal bit density

The nominal bit density for each of the tracks shall be:

- for track 1 8,27 bits/mm (210 bpi);
- for track 2 2,95 bits/mm (75 bpi);
- for track 3 8,27 bits/mm (210 bpi).

9.3 Signal amplitude requirements for tracks 1, 2 and 3

The requirements for signal amplitude on tracks 1, 2 and 3 shall be as follows:

Unused encoded cards: $0,64 U_R \leq U_i \leq 1,36 U_R$

Returned cards: $0,52 U_R \leq U_i \leq 1,36 U_R$

There shall be no signal peaks between the minimum requirement ($0,64 U_R$ for Unused encoded cards or $0,52 U_R$ for Returned cards) and $0,07 U_R$. (see [Figure 9](#)).

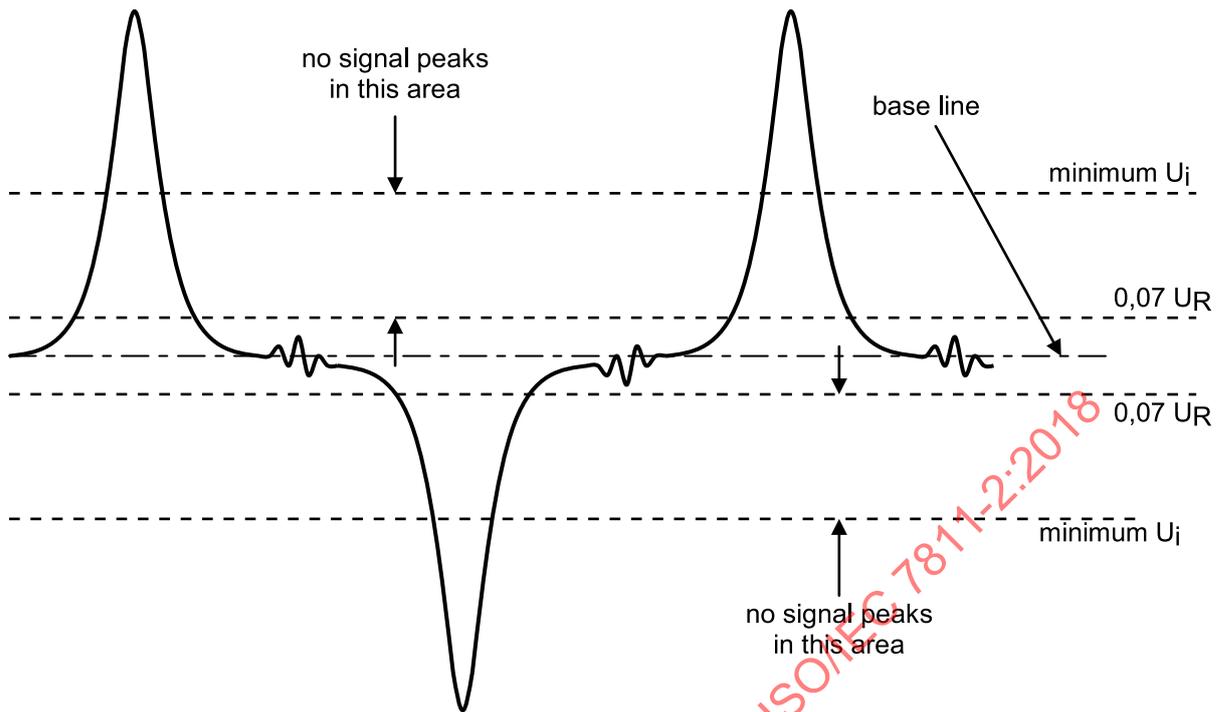


Figure 9 — Noise in signal waveform

NOTE The requirements above specify the interchange signal amplitude limits for each of the encoded track locations at the specified bit densities. This is different from the extra pulse requirement specified in [Table 1](#) which reflects the characteristics of the unencoded magnetic media.

9.4 Bit configuration

In the bit configuration for each character on the magnetic area, the least significant bit (2^0) shall be encoded first and the parity bit last.

9.5 Direction of recording

The encoding shall begin from the right-hand side viewed from the side with the magnetic stripe and with the stripe at the top.

9.6 Leading and trailing zeroes

The lead-in up to the first data bit shall be recorded with zeroes and the space after the last bit shall also be recorded with zeroes. Zeroes prior to 3,30 mm (0.130 in) or after 82,17 mm (3.235 in) from the right edge of the card when viewed from the back are not required to meet the specifications given herein.

10 Encoding specifications

10.1 Alphanumeric track, Track 1

10.1.1 Average bit density

The average bit density (B_a) shall be 8,27 bits/mm (210 bpi) \pm 8 % measured in a longitudinal direction parallel to the top reference edge.

10.1.2 Flux transition spacing variation

Flux transition spacing variations are shown in [Table 2](#) for unused encoded cards and in [Table 3](#) for returned cards. See also [Figure 10](#).

Table 2 — Flux transition spacing variation for unused encoded cards — Track 1 and 3

Term	Description	Requirement	Variation
B_a	Average length between clocking flux transitions	$111 \mu\text{m} (4\,381 \mu\text{in}) \leq B_a \leq 131 \mu\text{m} (5\,143 \mu\text{in})$	$\pm 8 \%$
B_{in}	Individual length between clocking flux transitions	$109 \mu\text{m} (4\,286 \mu\text{in}) \leq B_{in} \leq 133 \mu\text{m} (5\,238 \mu\text{in})$	$\pm 10 \%$
B_{in+1}	Adjacent bit-to-bit variation	$0,90 B_{in} \leq B_{in+1} \leq 1,10 B_{in}$	$\pm 10 \%$
S_{in}	Subinterval length	$53 \mu\text{m} (2\,095 \mu\text{in}) \leq S_{in} \leq 68 \mu\text{m} (2\,667 \mu\text{in})$	$\pm 12 \%$
S_{in+1}	Adjacent subinterval length	$0,88 B_{in}/2 \leq S_{in+1} \leq 1,12 B_{in}/2$	$\pm 12 \%$

B_{in+1} or S_{in+1} is the length between flux transitions immediately following and adjacent to B_{in} .

NOTE 1 This table shows only the limits within which cards will function normally and does not imply any guarantee of flux transition spacing during valid term for issued card.

NOTE 2 It has been observed that low resolution as measured per [Table 1](#) can correlate with high flux transition spacing variation as measured per [Table 2](#).

Table 3 — Flux transition spacing variation for returned cards — Track 1 and 3

Term	Description	Requirement	Variation
B_a	Average length between clocking flux transitions	$111 \mu\text{m} (4\,381 \mu\text{in}) \leq B_a \leq 131 \mu\text{m} (5\,143 \mu\text{in})$	$\pm 8 \%$
B_{in}	Individual length between clocking flux transitions	$103 \mu\text{m} (4\,048 \mu\text{in}) \leq B_{in} \leq 139 \mu\text{m} (5\,476 \mu\text{in})$	$\pm 15 \%$
B_{in+1}	Adjacent bit-to-bit variation	$0,85 B_{in} \leq B_{in+1} \leq 1,15 B_{in}$	$\pm 15 \%$
S_{in}	Subinterval length	$48,4 \mu\text{m} (1\,905 \mu\text{in}) \leq S_{in} \leq 72,6 \mu\text{m} (2\,857 \mu\text{in})$	$\pm 20 \%$
S_{in+1}	Adjacent subinterval length	$0,70 B_{in}/2 \leq S_{in+1} \leq 1,30 B_{in}/2$	$\pm 30 \%$

B_{in+1} or S_{in+1} is the length between flux transitions immediately following and adjacent to B_{in} .

NOTE This table shows only the limits within which cards will function normally and does not imply any guarantee of flux transition spacing during valid term for issued card.

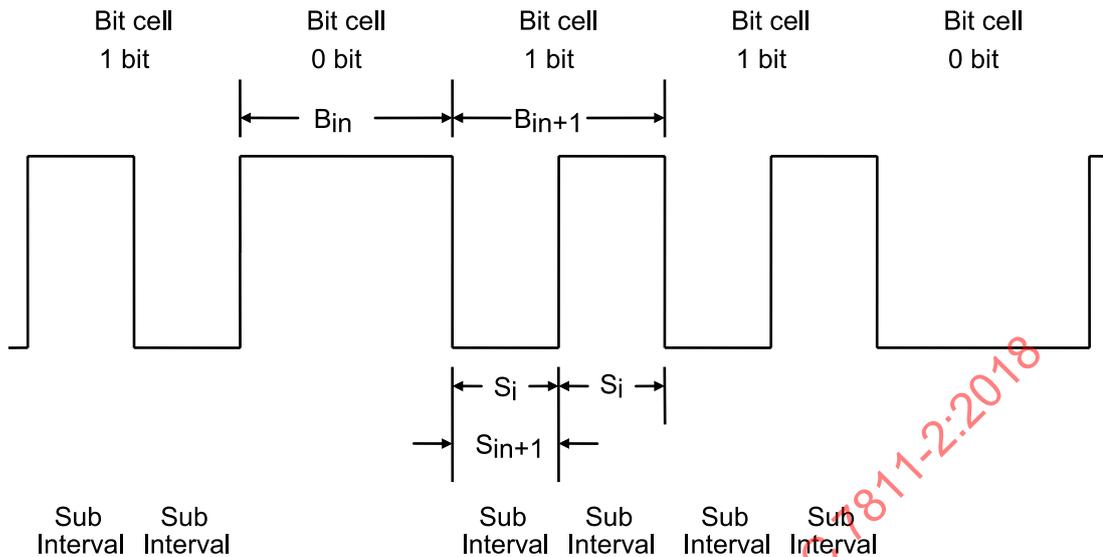


Figure 10 — Flux transition spacing variation

10.1.3 Coded character set

The coded character set for track 1 shall be 7 bit alphanumeric as shown in [Table 4](#). The following characters have special meanings and their use is restricted as described.

Characters	Meaning or use
! " & ' * + , ; < = > @ _	Used for hardware control purposes; shall not be used for data content
[\]	Reserved for additional national characters when required. Do not use internationally
#	Reserved for optional additional graphic symbols
%	Start sentinel
^	Field separator
?	End sentinel

Table 4 — Coded character set for 7 bit alphanumeric

Char.	Binary							Char.	Binary						
	P	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰		P	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
space	1	0	0	0	0	0	0	@	0	1	0	0	0	0	0
!	0	0	0	0	0	0	1	A	1	1	0	0	0	0	1
"	0	0	0	0	0	1	0	B	1	1	0	0	0	1	0
#	1	0	0	0	0	1	1	C	0	1	0	0	0	1	1
\$	0	0	0	0	1	0	0	D	1	1	0	0	1	0	0
%	1	0	0	0	1	0	1	E	0	1	0	0	1	0	1
&	1	0	0	0	1	1	0	F	0	1	0	0	1	1	0
'	0	0	0	0	1	1	1	G	1	1	0	0	1	1	1
(	0	0	0	1	0	0	0	H	1	1	0	1	0	0	0
)	1	0	0	1	0	0	1	I	0	1	0	1	0	0	1
*	1	0	0	1	0	1	0	J	0	1	0	1	0	1	0
+	0	0	0	1	0	1	1	K	1	1	0	1	0	1	1
,	1	0	0	1	1	0	0	L	0	1	0	1	1	0	0
-	0	0	0	1	1	0	1	M	1	1	0	1	1	0	1
.	0	0	0	1	1	1	0	N	1	1	0	1	1	1	0
/	1	0	0	1	1	1	1	O	0	1	0	1	1	1	1
0	0	0	1	0	0	0	0	P	1	1	1	0	0	0	0
1	1	0	1	0	0	0	1	Q	0	1	1	0	0	0	1
2	1	0	1	0	0	1	0	R	0	1	1	0	0	1	0
3	0	0	1	0	0	1	1	S	1	1	1	0	0	1	1
4	1	0	1	0	1	0	0	T	0	1	1	0	1	0	0
5	0	0	1	0	1	0	1	U	1	1	1	0	1	0	1
6	0	0	1	0	1	1	0	V	1	1	1	0	1	1	0
7	1	0	1	0	1	1	1	W	0	1	1	0	1	1	1
8	1	0	1	1	0	0	0	X	0	1	1	1	0	0	0
9	0	0	1	1	0	0	1	Y	1	1	1	1	0	0	1
:	0	0	1	1	0	1	0	Z	1	1	1	1	0	1	0
;	1	0	1	1	0	1	1	[	0	1	1	1	0	1	1
<	0	0	1	1	1	0	0	\	1	1	1	1	1	0	0
=	1	0	1	1	1	0	1	]	0	1	1	1	1	0	1
>	1	0	1	1	1	1	0	^	0	1	1	1	1	1	0
?	0	0	1	1	1	1	1	_	1	1	1	1	1	1	1

NOTE This coded character set is identical to the coded character set in ISO/IEC 7811-6 (derived from ASCII).

10.1.4 Maximum number of characters for ID-1 type card

The data characters, control characters, start and end sentinels, and longitudinal redundancy check character shall together not exceed 79 characters.