INTERNATIONAL STANDARD

ISO/IEC 7811-6

Fifth edition
2018-08

Identification cards — Recording technique —

Part 6: Magnetic stripe: High coercivity

Cartes d'identification — Technique d'enregistrement —

Partie 6: Bandeau magnétique: Haute coercivité

Reference number
ISO/IEC 7811-6:2018(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.

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 6:2014), 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;

— changed the title of Figure 10 to: Noise in signal waveform;

— changed from 0,08 U_R to 0,07 U_R in Figure 10 to match text.

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.

Identification cards — Recording technique —

Part 6: Magnetic stripe: High coercivity

1 Scope

ISO/IEC 7811 defines the characteristics for identification cards as defined in Clause 3 of this document and the use of such cards for international interchange.

This document specifies requirements for a high 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. The main characteristic of the high coercivity magnetic stripe is its improved resistance to erasure. This is achieved with minimal probability of damage to other magnetic stripes by contact while retaining read compatibility with magnetic stripes as defined in ISO/IEC 7811-2.

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 reconverting 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 RM7811-6

3.2
secondary standard
reference card designated RM7811-6 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 11

3.16
subinterval
distance that is nominally half the distance between two clocking flux transitions as shown in Figure 11

3.17
demagnetisation current
I_d
D.C. current value that reduces the average signal amplitude to 80 % of the reference signal amplitude (U_R) on a secondary reference card that has been encoded at a density of 20 ft/mm (500 ftpi) at a current of I_{min}

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.

Dimensions in millimetres (inches)

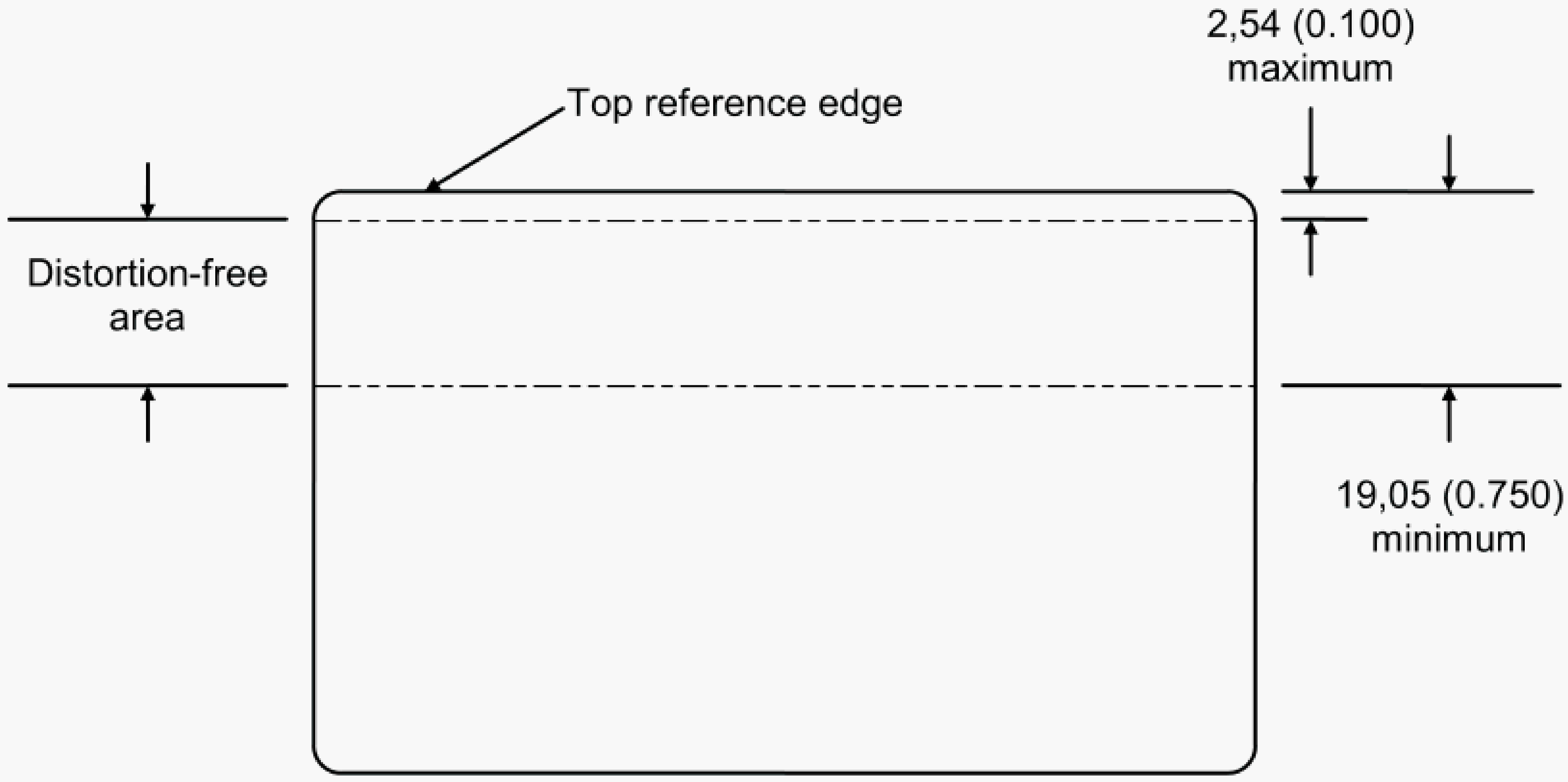


Figure 1 — Distortion-free area on card with magnetic stripe

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 12 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)

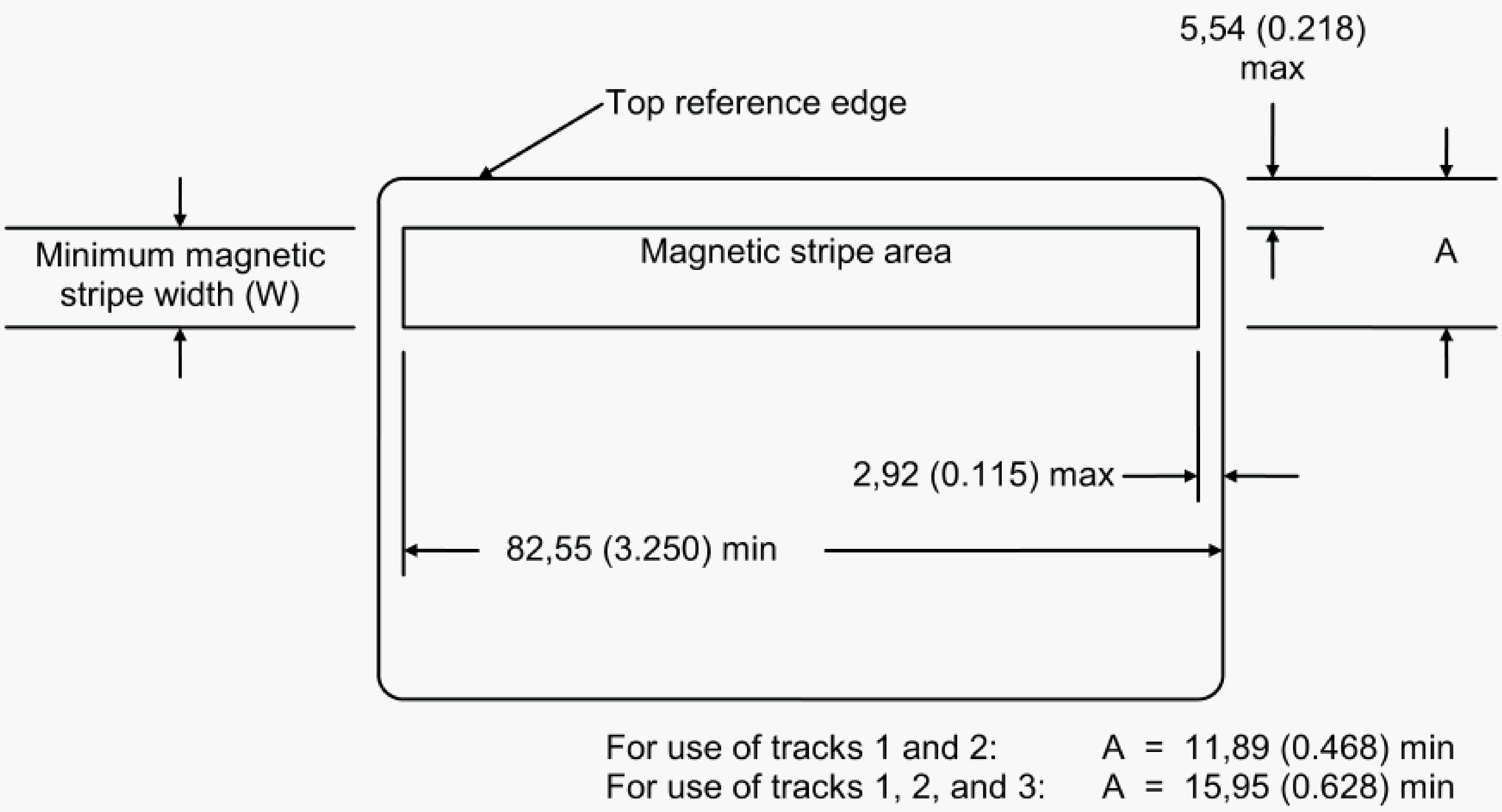


Figure 2 — Location of magnetic material for ID-1 type card

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 < 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 ≤ 9,5 µm (375 µin)	a ≤ 5,8 µm (225 µin)
W = 10,28 mm (0.405 in)	a ≤ 15,4 µm (607 µin)	a ≤ 9,3 µm (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 ≤ 7,3 µm (288 µin)	a ≤ 4,5 µm (175 µin)
W = 10,28 mm (0.405 in)	a ≤ 11,7 µm (466 µin)	a ≤ 7,3 µm (284 µin)

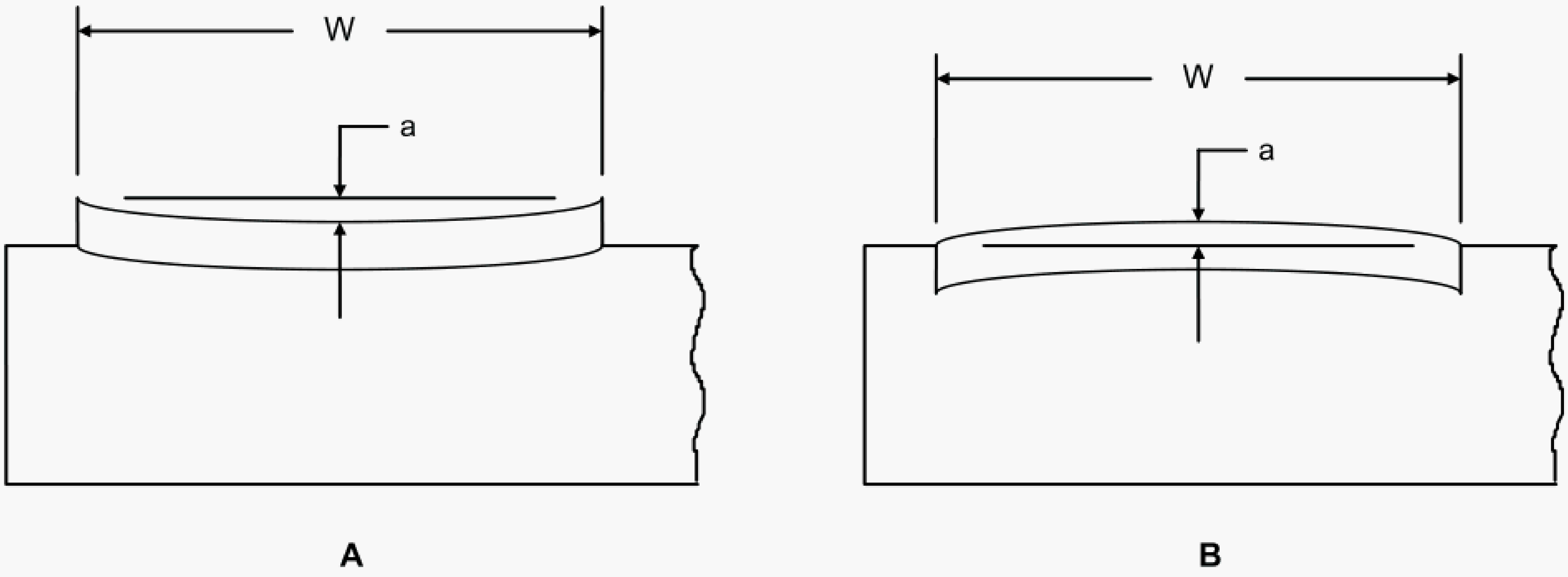


Figure 3 — Surface profile

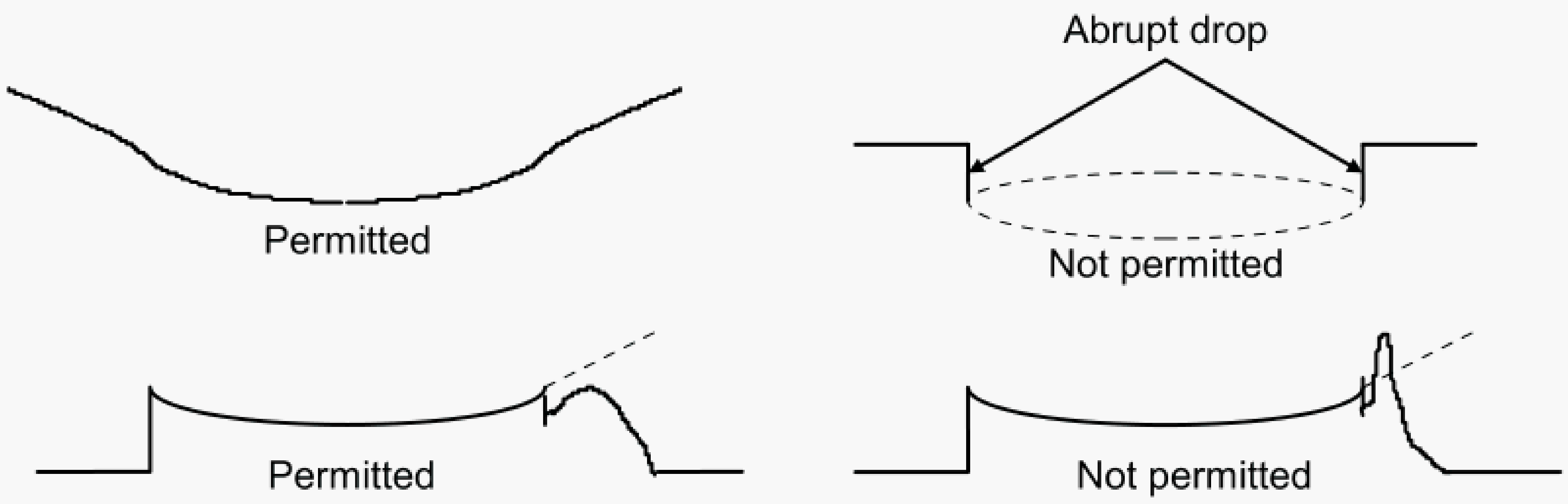


Figure 4 — Surface profile examples

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:

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

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 µm (15.9 µin) 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:

$$U_{A\ after} \geq 0{,}60\ U_{A\ before} \quad \text{and} \quad U_{i\ after} \geq 0{,}80\ U_{A\ after}$$

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:

$$U_{A\ after} \geq 0{,}90\ U_{A\ before} \quad \text{and} \quad U_{i\ after} \geq 0{,}90\ U_{A\ after}$$

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

$$U_{A\ after} \geq 0{,}90\ U_{A\ before} \quad \text{and} \quad U_{i\ after} \geq 0{,}90\ U_{A\ after}$$

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 °C ± 3 °C (73 °F ± 5 °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 °C to 50 °C (−31 °F to 122 °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. The media's performance requirements specified in 7.3 shall be met in order to achieve improved resistance to erasure, and to enable magnetic interchange between card and processing systems. The properties in Annex C are intended as guidelines for magnetic material. Annex C is informative and shall not be used as performance criteria for cards.

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 $U_R \leq U_{A1} \leq$ 1,2 U_R
Signal amplitude	8(200)	I_{min}	U_{i1}	$U_{i1} \leq$ 1,26 U_R
Signal amplitude	8(200)	I_{max}	U_{A2}	$U_{A2} \geq$ 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
Demagnetisation	0	I_d, DC	U_{A5}	$U_{A5} \geq$ 0,64 U_R
Demagnetisation	0	I_d, DC	U_{i5}	$U_{i5} \geq$ 0,54 U_R
Waveform	3(75)	I_{max}	U_{i6}, U_{A6}	$U_{i6} \leq$ 0,07 U_{A6}

U_{i6} is the absolute value of the largest signal amplitude in the U_{i6} measurement area as shown in Figure 7.

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.

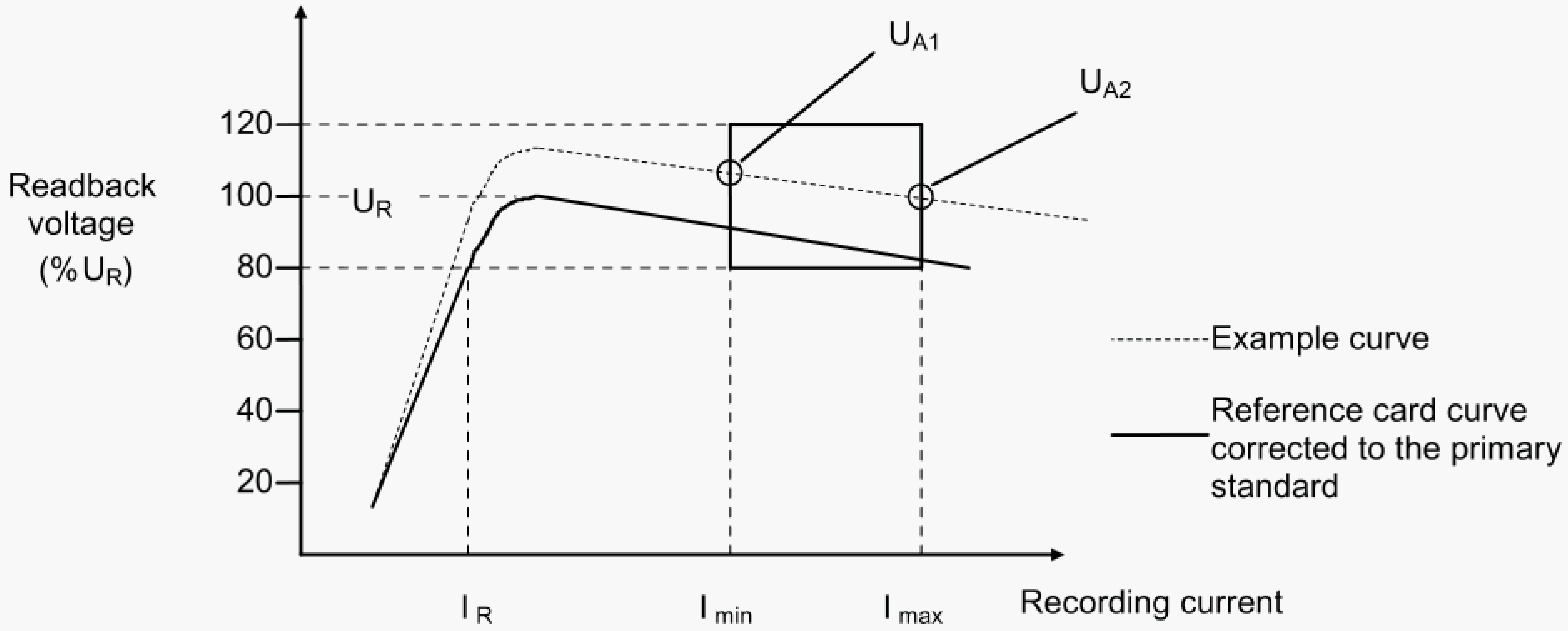
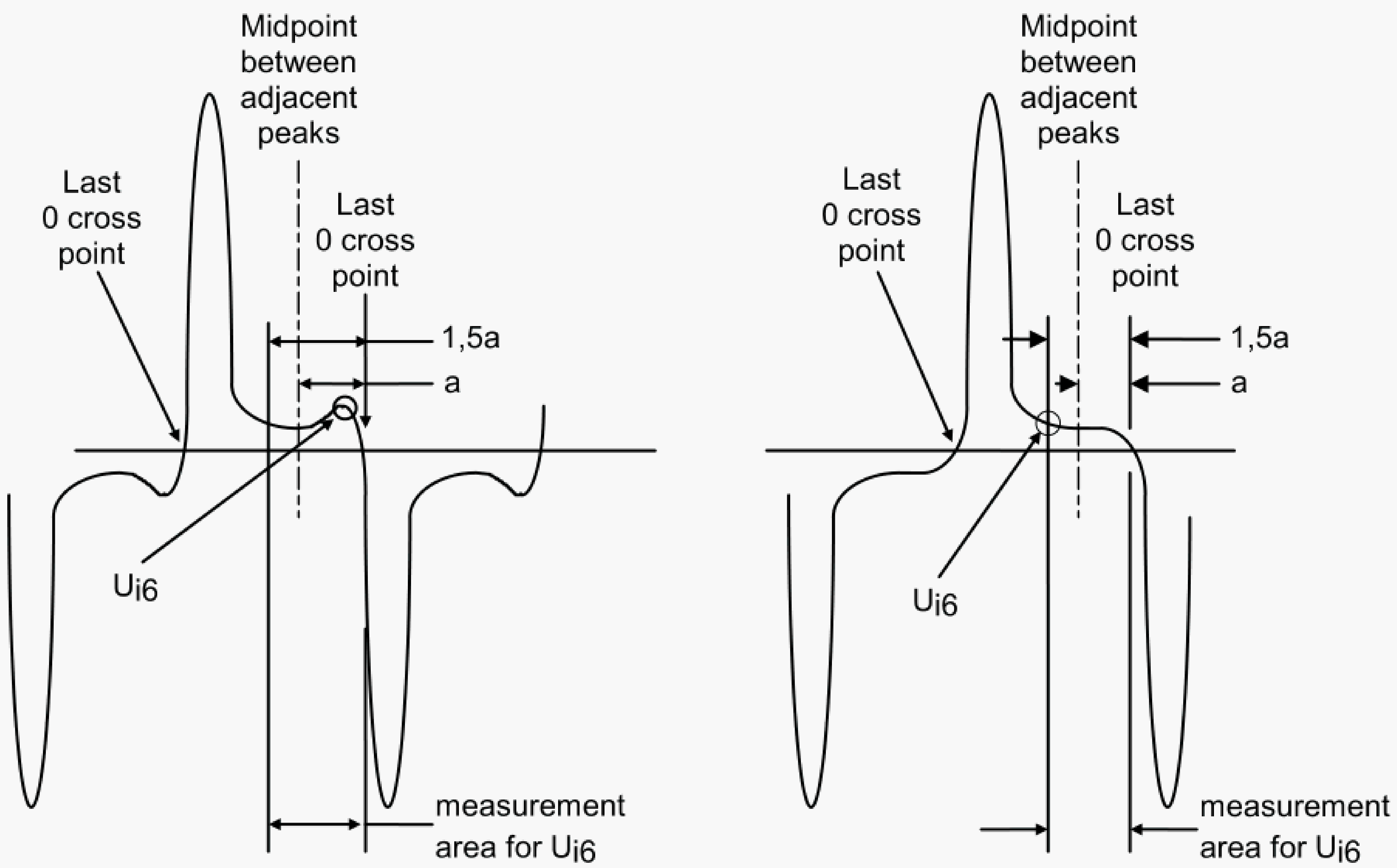


Figure 6 — Saturation curve example showing tolerance area at 8 ft/mm (200 ftpi)

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.

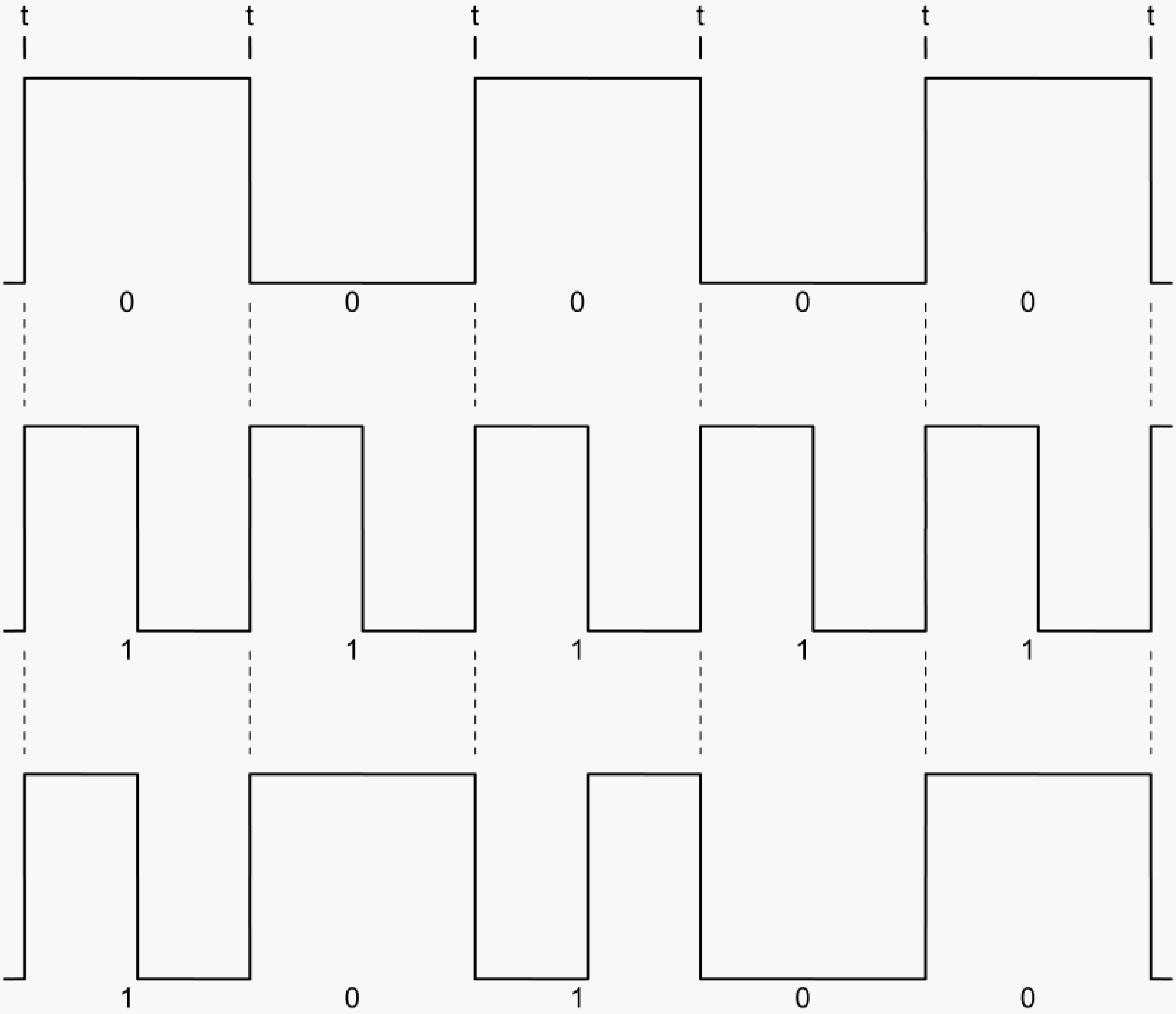


1.	Find midpoint between 2 adjacent peaks.
2.	Find 0 crossing point for waveform between midpoint and adjacent peak.
3.	The measurement area is 1,5 times a (the distance between the midpoint and 0 cross point).
4.	Find the largest signal amplitude level in the measurement area defined in the figure.
5.	The absolute value of this level is the U_{i6} for the waveform.

Figure 7 — Waveform measurements

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 8).



Key

t self-clocking (timing) intervals

Figure 8 — 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 9).

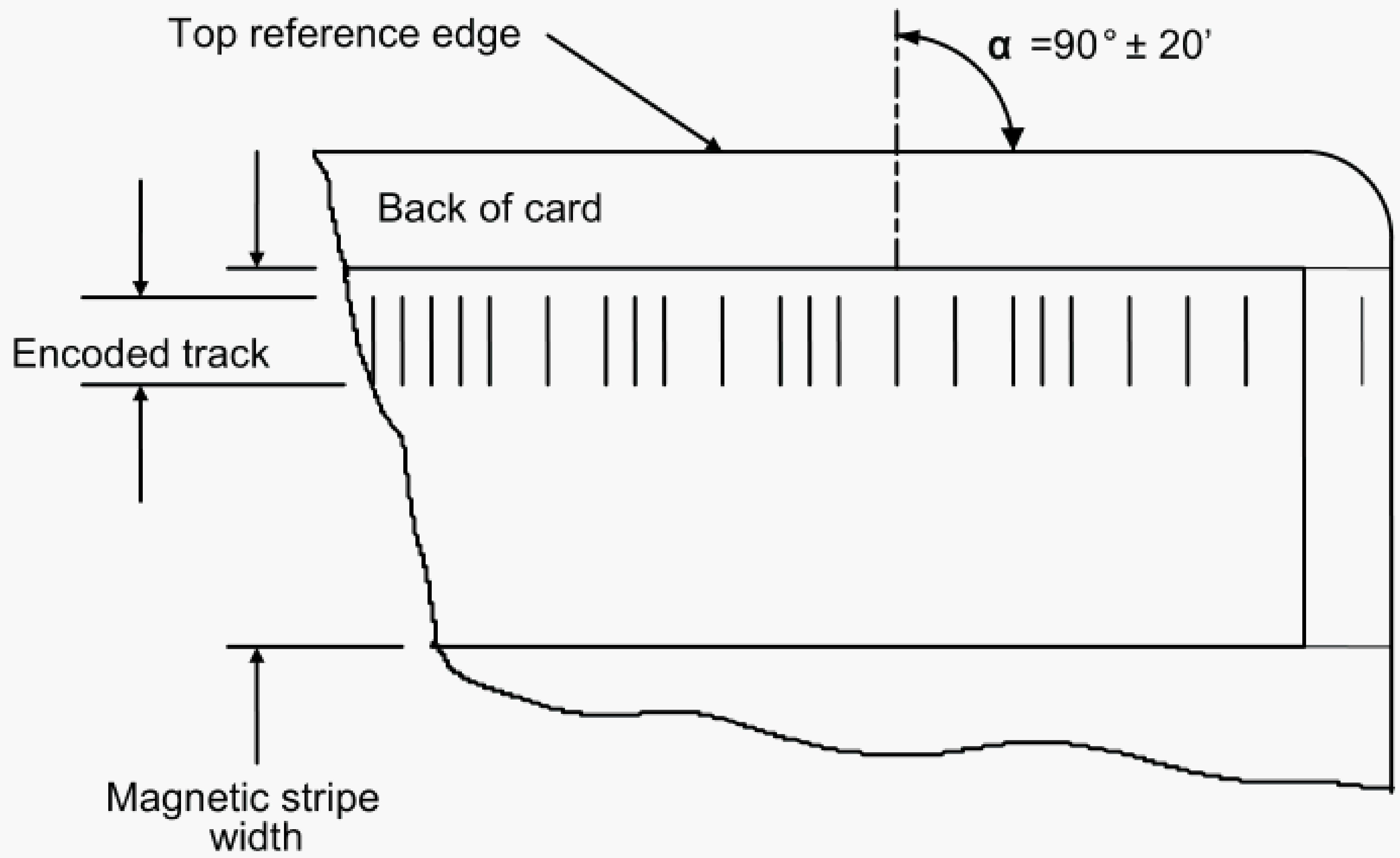


Figure 9 — Angle of recording

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 10).

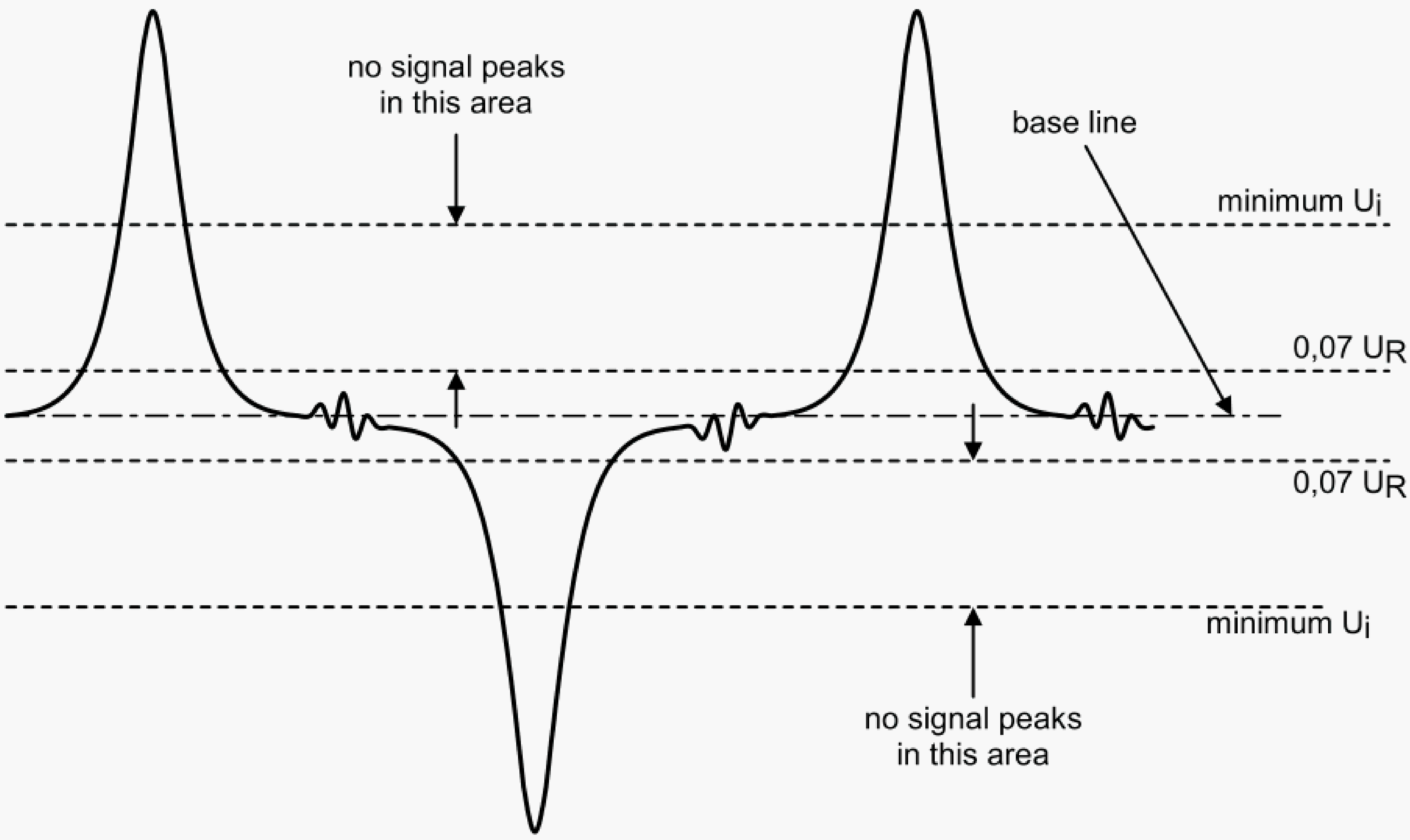


Figure 10 — Noise in signal waveform

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) ±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 11.

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 µm (4 381 µin) ≤ B_a ≤ 131 µm (5 143 µin)	±8 %
B_{in}	Individual length between clocking flux transitions	109 µm (4 286 µin) ≤ B_{in} ≤ 133 µm (5 238 µin)	±10 %
B_{in+1}	Adjacent bit-to-bit variation	0,90 B_{in} ≤ B_{in+1} ≤ 1,10 B_{in}	±10 %
S_{in}	Subinterval length	53 µm (2 095 µin) ≤ S_{in} ≤ 68 µm (2 667 µin)	±12 %
S_{in+1}	Adjacent subinterval length	0,88 $B_{in}/2$ ≤ S_{in+1} ≤ 1,12 $B_{in}/2$	±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 µm (4 381 µin) ≤ B_a ≤ 131 µm (5 143 µin)	±8 %
B_{in}	Individual length between clocking flux transitions	103 µm (4 048 µin) ≤ B_{in} ≤ 139 µm (5 476 µin)	±15 %
B_{in+1}	Adjacent bit-to-bit variation	0,85 B_{in} ≤ B_{in+1} ≤ 1,15 B_{in}	±15 %
S_{in}	Subinterval length	48,4 µm (1 905 µin) ≤ S_{in} ≤ 72,6 µm (2 857 µin)	±20 %
S_{in+1}	Adjacent subinterval length	0,70 $B_{in}/2$ ≤ S_{in+1} ≤ 1,30 $B_{in}/2$	±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.

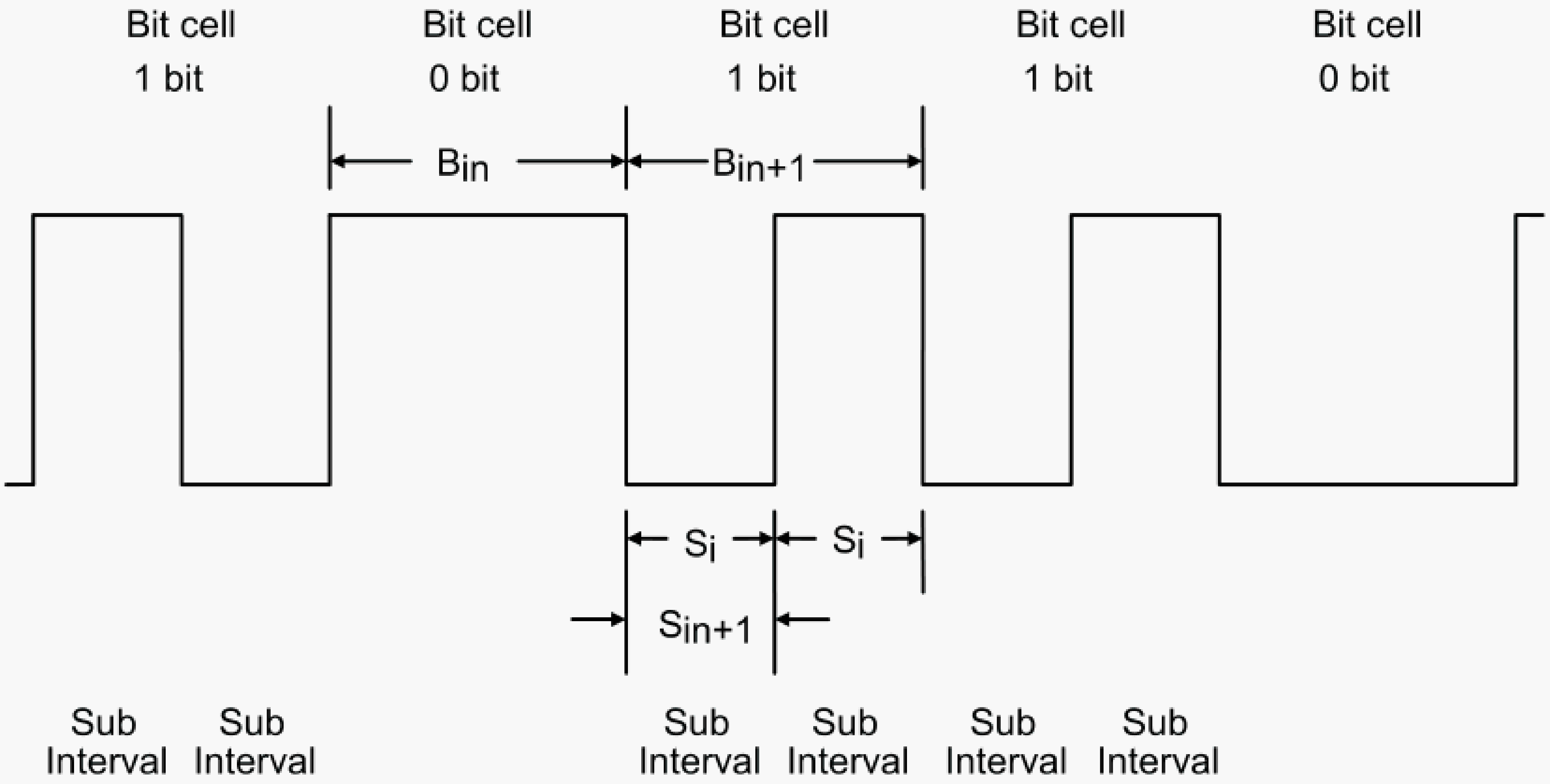


Figure 11 — Flux transition spacing variation

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 7811-2 (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.

10.2 Numeric track, Track 2

10.2.1 Average bit density

The average bit density (B_a) shall be 2,95 bits/mm (75 bpi) ± 5 % measured in a longitudinal direction parallel to the top reference edge.

10.2.2 Flux transition spacing variation

Flux transition spacing variations are shown in Table 5 for unused encoded cards and in Table 6 for returned cards. See also Figure 11.

Table 5 — Flux transition spacing variation for unused encoded cards — Track 2

Term	Description	Requirement	Variation
B_a	Average length between clocking flux transitions	322 μm (12 667 μin) ≤ B_a ≤ 356 μm (14 000 μin)	±5 %
B_{in}	Individual length between clocking flux transitions	315 μm (12 400 μin) ≤ B_{in} ≤ 363 μm (14 267 μin)	±7 %
B_{in+1}	Adjacent bit-to-bit variation	0,90 B_{in} ≤ B_{in+1} ≤ 1,10 B_{in}	±10 %
S_{in}	Subinterval length	153 μm (6 000 μin) ≤ S_{in} ≤ 186 μm (7 333 μin)	±10 %
S_{in+1}	Adjacent subinterval length	0,88 $B_{in}/2$ ≤ S_{in+1} ≤ 1,12 $B_{in}/2$	±12 %
B_{in+1} or S_{in+1} is the length between flux transitions immediately following and adjacent to B_{in}.			

Table 6 — Flux transition spacing variation for returned cards — Track 2

Term	Description	Requirement	Variation
B_a	Average length between clocking flux transitions	322 μm (12 667 μin) ≤ B_a ≤ 356 μm (14 000 μin)	±5 %
B_{in}	Individual length between clocking flux transitions	288 μm (11 333 μin) ≤ B_{in} ≤ 390 μm (15 333 μin)	±15 %
B_{in+1}	Adjacent bit-to-bit variation	0,85 B_{in} ≤ B_{in+1} ≤ 1,15 B_{in}	±15 %
S_{in}	Subinterval length	136 μm (5 333 μin) ≤ S_{in} ≤ 203 μm (8 000 μin)	±20 %
S_{in+1}	Adjacent subinterval length	0,70 $B_{in}/2$ ≤ S_{in+1} ≤ 1,30 $B_{in}/2$	±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.			

10.2.3 Coded character set

The coded character set for track 2 shall be 5 bit numeric as shown in Table 7. 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
;	start sentinel
=	field separator
?	end sentinel

Table 7 — Coded character set for 5 bit numeric

	Char.	Binary						Char.	Binary				
		P	2^3	2^2	2^1	2^0			P	2^3	2^2	2^1	2^0
	0	1	0	0	0	0		**8**	0	1	0	0	0
	1	0	0	0	0	1		**9**	1	1	0	0	1
	2	0	0	0	1	0		**:**	1	1	0	1	0
	3	1	0	0	1	1		**;**	0	1	0	1	1
	4	0	0	1	0	0		**<**	1	1	1	0	0
	5	1	0	1	0	1		**=**	0	1	1	0	1
	6	1	0	1	1	0		**>**	0	1	1	1	0
	7	0	0	1	1	1		**?**	1	1	1	1	1

NOTE This coded character set is identical to the coded character set in ISO/IEC 7811-2 (derived from ASCII.).

10.2.4 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 40 characters.

10.3 Numeric track, Track 3

10.3.1 Average bit density

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

10.3.2 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 11.

10.3.3 Coded character set

The coded character set for track 3 shall be 5 bit numeric as shown in Table 7. 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
;	start sentinel
=	field separator
?	end sentinel

10.3.4 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 107 characters.

11 Error detection

11.1 General

Two techniques of error detection, as described below, shall be encoded. In both techniques, the leading and trailing zeroes shall not be regarded as data characters.

11.2 Parity

A parity bit for each encoded character shall be used. The value of the parity bit is defined such that the total quantity of one bits recorded, for each character, including the parity bit, shall be odd.

11.3 Longitudinal redundancy check (LRC)

The longitudinal redundancy check (LRC) character shall appear for each data track. The LRC character shall be encoded so that it immediately follows the end sentinel when the card is read in a direction giving the start sentinel first, followed by data and the end sentinel. The bit configuration of the LRC character shall be identical to the bit configuration of the data characters.

The LRC character shall be calculated using the following procedure:

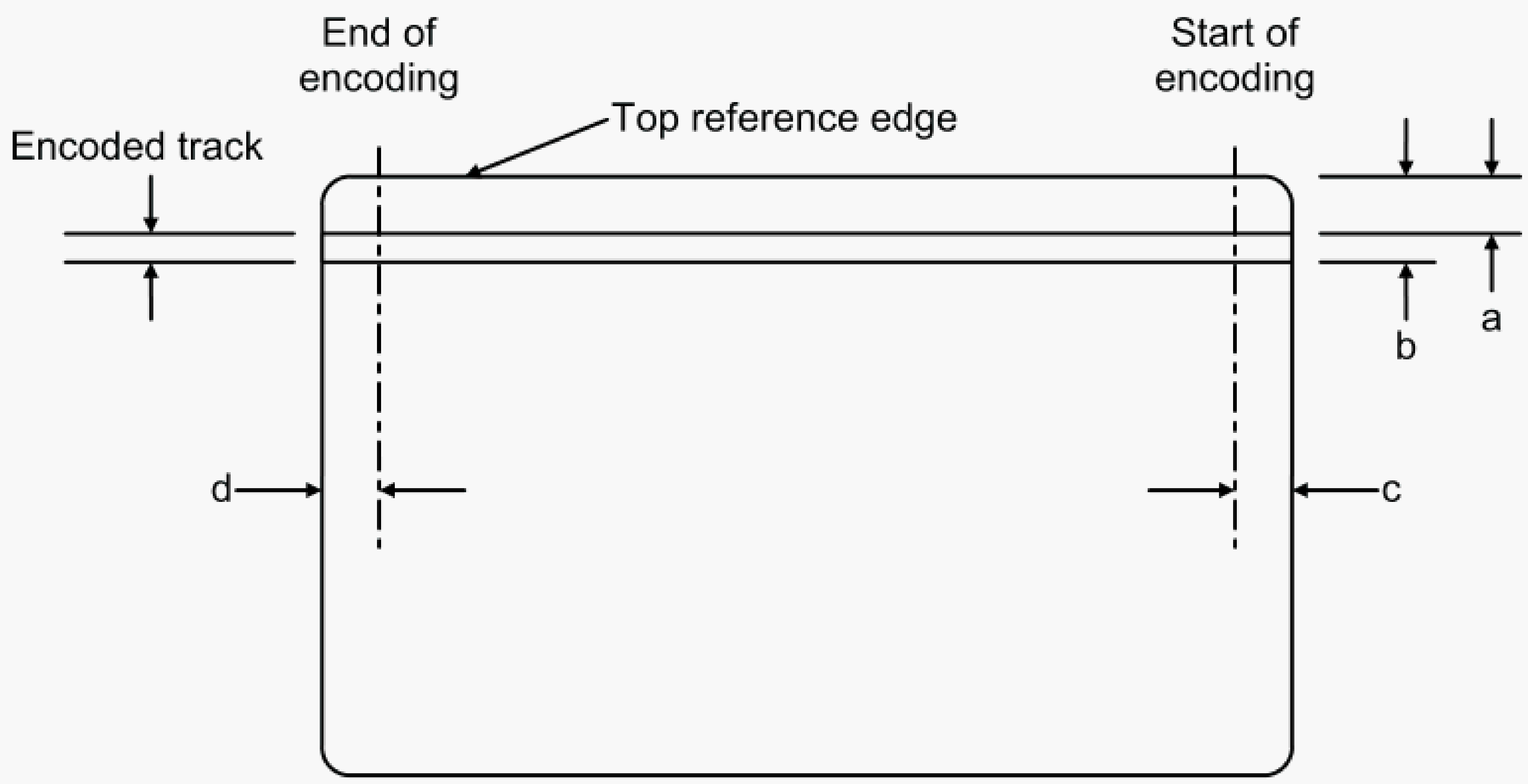
The value of each bit in the LRC character, excluding the parity bit, is defined such that the total count of one bits encoded in the corresponding bit location of all characters of the data track, including the start sentinel, data, end sentinel, and LRC characters, shall be even.

The LRC characters parity bit is not a parity bit for the individual parity bits of the data track, but is only the parity bit for the LRC character encoded as described in 11.2.

12 Location of encoded tracks

Each encoded track shall be located between the two lines as shown in Figure 12. The start of encoding is located at the centreline of the first “one” bit in the start sentinel. The end of encoding is located at the centreline of the last bit in the longitudinal redundancy check character (the last bit is the parity bit).

Dimensions in millimetres (inches)



Term	Track 1	Track 2	Track 3
a	5,79 (0.228) maximum	8,33 (0.328) minimum 9,09 (0.358) maximum	11,63 (0.458) minimum 12,65 (0.498) maximum
b	8,33 (0.328) minimum 9,09 (0.358) maximum	11,63 (0.458) minimum 12,65 (0.498) maximum	15,19 (0.598) minimum 15,82 (0.623) maximum
c	7,44 ± 1,00 (0.293 ± 0.039)	7,44 ± 0,50 (0.293 ± 0.020)	7,44 ± 1,00 (0.293 ± 0.039)
d	6,93 (0.252) minimum	6,93 (0.252) minimum	no requirement
NOTE All tracks have a minimum width of 2,54 (0.100).			

Figure 12 — Location of encoded tracks

Annex A
(informative)

Magnetic stripe read compatibility — ISO/IEC 7811-2, ISO/IEC 7811-6

The purpose of this annex is to explain to users the limitations of the term 'read compatibility' as mentioned in the scope of this document, and applied to ISO/IEC 7811-2 and ISO/IEC 7811-6.

Ideally, high coercivity magnetic stripes would have significantly improved resistance to erasure but would be identical in read-back signal characteristics to 'low coercivity' magnetic stripes (i.e. those magnetic stripes conforming to ISO/IEC 7811-2). In practice, however, the difference in magnetic characteristics between high and low coercivity magnetic stripes causes the read-back signal characteristics to differ sufficiently to make evaluation of relative read-back signal amplitude dependent on the measuring equipment.

In general, it is to be expected that read-back sub-systems with greater sensitivity to shorter recorded wavelengths will produce an increase in high coercivity read-back signal amplitudes relative to low coercivity read-back signal amplitudes.

Users of this document should therefore take careful note of the fact that obtaining comparable read-back signal amplitudes from magnetic stripes conforming to ISO/IEC 7811-2 is dependent upon reproducing the exact conditions of measurement given in ISO/IEC 10373-2.

Annex B
(informative)

Magnetic stripe abrasivity

The purpose of this annex is to explain why the abrasive properties of magnetic stripes as they relate to head life are not among the physical characteristics governed by this standard. The absence of any specification for abrasive properties reflects the difficulty of defining the parameters of abrasive wear and devising an accurate, repeatable test for measuring abrasive properties. Although no repeatable test methods are available, there are known technologies available for extending head life such as improved head materials, magnetic stripe formulation additives, or overcoats on magnetic stripe.

A quantified stripe abrasivity would seem to be an essential prerequisite to any attempt to predict magnetic head lifetimes. However, just as there is considerable variation in the abrasive nature of different magnetic stripes, there are a multitude of magnetic stripe reader/writer environments. The variety of combinations of influences and the complexity of the manner in which these affect abrasivity makes it extremely difficult to predict magnetic head lifetimes even when the environmental, mechanical and magnetic stripe conditions are specified.

Current equipment-specific abrasivity testing is done on a purely comparative basis. It is time consuming and usually expensive in terms of the number of cards used. The results of such tests are simply rankings that show one stripe to be some degree more or less abrasive than others under the specific conditions of test. There are no accurate absolute values and the rankings may change from one set of conditions to another.

Performing a successful read or write operation on a magnetic stripe requires the stripe and magnetic head to be in contact for the whole operation. The relative movement between the magnetic head and magnetic stripe produces wear of both. Initially the abrasivity of the magnetic stripe falls rapidly with the number of head passes, so that the abrasivity of a new unused magnetic stripe may be much greater than that of a magnetic stripe which has only been written once, but as the number of head passes increases the rate of change of abrasivity decreases.

The influences affecting magnetic stripe abrasivity are known to include temperature, humidity, head material (and its state of wear and finish), head pressure, card speed, the specific physical properties of the magnetic stripe surface in contact with the head, surface roughness, and contamination on the magnetic stripe. Under field conditions dust, dirt and grease from the environment are deposited at the head/stripe interface often producing major discrepancies between abrasive wear measured under laboratory conditions and that actually achieved.

It may be seen, therefore, that not only are there difficulties involved in achieving an acceptable level of measurement uncertainty for abrasivity testing but that there are significant doubts regarding the applicability of the results of abrasivity tests on cards under laboratory conditions to predictions of performance in the real world. Unless these problems are resolved, there can be no useful standard specification and test.

Annex C
(informative)

Static magnetic characteristics

C.1 Introduction

This annex gives definitions and values for certain static magnetic characteristics of high coercivity magnetic stripes. These parameters are useful in the manufacture of magnetic material and are not directly related to magnetic performance characteristics given in Table 1 for cards. There is no guarantee that magnetic stripes with values given in this informative annex will meet the mandatory requirements given in Table 1. However, magnetic stripes that do not comply with the suggested static magnetic values probably will not conform to Table 1 properties.

C.2 Terms and definitions

C.2.1
maximum field
H_{max}
maximum absolute magnetic field strength applied as described by the test method

C.2.2
static M(H) loop
normal hysteresis loop for which the magnetic field strength is cycled between the extremes $-H_{max}$ to $+H_{max}$ at such a low rate of change that the loop is not influenced by the rate of change

C.2.3
coercivity
$H'_{cM} = H'_{cJ}$
continuously applied magnetic field which reduces the magnetisation to zero from a previous maximum magnetisation state in the opposite direction, the quantity of interest being that which is measured parallel to the longitudinal axis of the stripe

C.2.4
remanence
M_r
value of magnetisation (M) in a given direction at zero magnetic field ($H = 0$) after the application and removal of the maximum field (H_{max}) in the same direction

C.2.5
remanence coercivity
H_r
applied magnetic field which when removed returns the material to a zero magnetisation state from a previous maximum magnetisation state in the opposite direction, the quantity of interest being that which is measured parallel to the longitudinal axis of the stripe

C.2.6
oersted
Oe
Gaussian cgs unit of magnetic field strength which is commonly used in the magnetic recording industry equal to approximately 79,578 A/m

C.2.7
static demagnetisation
S_{160}
reduction in remanent magnetisation under the influence of an opposing magnetic field; characterised by $(M_r - M^+(-160))/M_r$

C.2.8
longitudinal squareness
$SQ = M_r/M$ *at* (H_{max})
ratio of the value of remanence (M_r) after the application and removal of the maximum field (H_{max}) to the magnetisation (M) at the maximum field applied (H_{max}) measured along the longitudinal axis of the stripe

C.2.9
remanence ratio
$R_M = (M_{rP}/M_{rL})$

ratio of the perpendicular remanence measured perpendicular to the surface of the magnetic stripe (M_{rP}) to the longitudinal remanence measured along the longitudinal direction of the magnetic stripe (M_{rL})

C.2.10
switching field by slope
SF_S
$(/H_2/-/H_1/)/H'_{cM}$ where $M(-/H_1/) = 0{,}5M_r$ and $M(-/H_2/) = -0{,}5\ M_r$; the difference between the field values at the intercept of the static magnetisation $M(H)$ loop with $M(H) = 0{,}5\ M_r$ and $M(H) = -0{,}5\ M_r$, divided by the coercivity

C.2.11
switching field by derivative
SF_D
the width at half height of the differentiated static magnetisation curve $M(H)$ divided by the coercivity value on the same curve

NOTE Static magnetic characteristics definitions were originally derived from IEC standards on electromagnetism units and magnetic materials vocabulary.

C.3 Recommended characteristics

The recommended static characteristics of high coercivity magnetic stripe are shown in Table C.1.

Table C.1 — Static characteristics of high coercivity magnetic material

Number	Parameter	Symbol	Value
1	Coercivity	H'_{cM}	335 kA/m (4200 Oe) maximum 200 kA/m (2500 Oe) minimum
2	Static demagnetisation	S_{160}	0,20 maximum
3	Longitudinal squareness	SQ	0,80 minimum
4	Remanence ratio	R_M	0,35 maximum
5	Switching field by slope	SF_S	0,30 maximum
6	Switching field by derivative	SF_D	0,50 maximum

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Textiles — Determination of dimensional change in washing and drying

Textiles — Détermination des variations dimensionnelles au lavage et au séchage domestiques

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Foreword

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

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member 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 shall not be held responsible for identifying any or all such patent rights.

ISO 5077 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 2, *Cleansing, finishing and water resistance tests*.

This second edition cancels and replaces the first edition (ISO 5077:1984), which has been technically revised.

Textiles — Determination of dimensional change in washing and drying

1 Scope

This International Standard specifies a method for the determination of the dimensional change of fabrics, garments or other textile articles when subjected to an appropriate combination of specified washing and drying procedures.

In the case of textile articles or deformable materials, it is necessary to exercise all possible caution in the interpretation of the results.

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 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 3759, *Textiles — Preparation, marking and measuring of fabric specimens and garments in tests for determination of dimensional change*

ISO 6330, *Textiles — Domestic washing and drying procedures for textile testing*

3 Principle

The specimen is conditioned in the specified standard atmosphere and measured before subjection to the appropriate washing and drying procedures. After drying, conditioning and remeasuring of the specimen, the changes in dimensions are calculated.

4 Apparatus and reagents

Use apparatus and reagents as specified in ISO 3759 and ISO 6330.

5 Atmospheric conditions

The atmospheric conditions required for conditioning and testing are specified in ISO 139.

6 Test specimens

6.1 The selection, dimensions, marking and measuring of test specimens are specified in ISO 3759.

6.2 When possible, three specimens from each sample should be used. One or two specimens may be used when insufficient sample is available.

7 Procedure

7.1 Determine the original length and width dimensions, as appropriate, after the specimens have been conditioned and measured according to the procedure specified in ISO 139 and ISO 3759.

7.2 Wash and dry the specimens according to one of the procedures specified in ISO 6330, as agreed between the interested parties.

7.3 After washing and drying, condition and measure the specimens and calculate the dimensional change of the specimens according to the procedure specified in ISO 3759.

8 Expression of results

8.1 Calculate the mean changes in dimensions in both the length and width directions in accordance with the arrangement in ISO 3759 as follows:

$$\frac{x_\mathrm{t} - x_\mathrm{o}}{x_\mathrm{o}} \times 100$$

where

x_o is the original dimension;

x_t is the dimension measured after treatment.

Record the changes in measurement separately as a percentage of the corresponding original value.

8.2 Express the average dimensional changes to the nearest 0,5 %.

8.3 State whether the dimension has decreased (shrinkage) by means of a minus sign ($-$) or increased (extension) by means of a plus sign ($+$).

9 Test report

The test report shall specify the following:

a) the number and year of this International Standard;

b) the number of specimens washed and dried;

c) the procedure used for washing and drying from ISO 6330;

d) for fabric specimens, the average dimensional change in the length (warp or wale) and the average dimensional change in the width (weft or course) to the nearest 0,5 %;

e) for garments, the description, make and size of the garment tested;

f) for garments, an adequate description of each measuring position and the average dimensional change to the nearest 0,5 % at each position for each garment tested.