INTERNATIONAL STANDARD

ISO/IEC 10373-2

Second edition
2006-04-15

Identification cards — Test methods —

Part 2: Cards with magnetic stripes

Cartes d'identification — Méthodes d'essai —

Partie 2: Cartes à bandeaux magnétiques

Reference number
ISO/IEC 10373-2:2006(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 10373-2 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 10373-2:1998), which has been technically revised.

ISO/IEC 10373 consists of the following parts, under the general title *Identification cards — Test methods*:

— *Part 1: General characteristics*

— *Part 2: Cards with magnetic stripes*

— *Part 3: Integrated circuit(s) cards with contacts and related interface devices*

— *Part 5: Optical memory cards*

— *Part 6: Proximity cards*

— *Part 7: Vicinity cards*

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Identification cards — Test methods —

Part 2:
Cards with magnetic stripes

1 Scope

ISO/IEC 10373 defines test methods for characteristics of identification cards according to the definition given in ISO/IEC 7810. Each test method is cross-referenced to one or more base standards, which may be ISO/IEC 7810 or one or more of the supplementary standards that define the information storage technologies employed in identification card applications.

This part of ISO/IEC 10373 defines test methods which are specific to magnetic stripe technology.

NOTE 1 - Criteria for acceptability do not form part of this part of ISO/IEC 10373 but will be found in the International Standards mentioned above.

NOTE 2 - Test methods described in this part of ISO/IEC 10373 are intended to be performed separately. A given card is not required to pass through all the tests sequentially.

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 1302, *Geometrical Product Specficiations (GPS) — Indication of surface texture in technical product documentation*

ISO 2409:1992, *Paints and varnishes — Cross-cut test*

ISO 3274, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments*

ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

ISO/IEC 7811-2, *Identification cards — Recording technique — Part 2: Magnetic stripe — Low coercivity*

ISO/IEC 7811-6, *Identification cards — Recording technique — Part 6: Magnetic stripe — High coercivity*

ISO/IEC 7811-7, *Identification cards — Recording technique — Part 7: Magnetic stripe — High coercivity, high density*

IEC 454-2, *Specification for pressure-sensitive adhesive tapes for electrical purposes — Part 2: Methods of test*

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3 Terms and definitions

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

3.1
test method
method for testing characteristics of identification cards for the purpose of confirming their compliance with International Standards

3.2
testably functional
has survived the action of some potentially destructive influence to the extent that:

a) any magnetic stripe present on the card shows a relationship between signal amplitudes before and after exposure that is in accordance with the base standard;

b) any integrated circuit(s) present in the card continue to show an Answer to Reset response[1] which conforms to the base standard;

c) any contacts associated with any integrated circuit(s) present in the card continue to show electrical resistance and impedance which conform to the base standard;

d) any optical memory present in the card continues to show optical characteristics which conform to the base standard;

e) any contactless integrated circuit(s) in the card continue to operate as intended.

3.3
warpage
deviation from flatness

3.4
flux transitions per millimetre
ft/mm
linear recording density applied to a track on a magnetic stripe

3.5
recording
creating a track of flux reversals according to a test method given in this part of ISO/IEC 10373, with the values of all applicable test parameters specified

3.6
encoding
creating a track of flux reversals whose spacing is modified, according to a coding scheme, to represent data

3.7
surface roughness
surface topology of an area of surface, qualified in the international standards by reference to various resolution determinants and methods of calculation

[1] This part of ISO/IEC 10373 does not define any test to establish the complete functioning of integrated circuit(s) cards. The test methods require only that the minimum functionality (testably functional) be verified. This may, in appropriate circumstances, be supplemented by further, application specific functionality criteria which are not available in the general case.

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3.8
amplitude measurements
⟨magnetic stripe⟩ measurement of readback signal amplitude according to a test method given in this part of ISO/IEC 10373, with the values of all applicable test parameters specified

3.9
flux transition spacing variation
deviation from nominal of measured values of the distance between adjacent flux transitions along a line parallel to the centre-line of the encoded track

3.10
magnetic stripe adhesion
strength of the bond between the magnetic stripe and the card

3.11
normal use
use as an identification card (see clause 4 of ISO/IEC 7810:2003), involving equipment processes appropriate to the card technology and storage as a personal document between equipment processes

3.12
static saturation *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 (see IEC 50(221))

3.13
coercivity
$H'_{cM} = H'_{cJ}$
continuously applied magnetic field which reduces the magnetisation to zero from a previously saturated state in the opposite direction (see IEC 50(221)), measured parallel to the longitudinal axis of the stripe

3.14
remanent coercivity
H_r
applied magnetic field which when removed returns the material to a zero magnetisation state from a previously saturated state in the opposite direction, measured parallel to the longitudinal axis of the stripe

3.15
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 (relationship is informative, see annex A (informative) of ISO 31-5:1992)

3.16
static demagnetisation
S_{160}
reduction in magnetisation under the influence of an opposing magnetic field; characterised by $(M_r - M^+(-160)) \div M_r$; the average slope of the "demagnetisation" quadrant of the static saturation $M(H)$ loop between magnetic field strength values of $H = 0$ and $H = -160$ kA/m

3.17
squareness
SQ
ratio of the value of magnetisation (M) at zero magnetic field strength ($H = 0$) to that at H_{max} obtained from the static saturation $M(H)$ loop

NOTE $SQ = M_r/M(H_{max})$.

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3.18
longitudinal squareness
$SQ_{||}$
squareness of the medium measured parallel to the longitudinal axis of the magnetic stripe

3.19
perpendicular squareness
$SQ_{\perp}$
squareness of the medium measured perpendicular to the plane of the magnetic stripe

3.20
switching field by derivative
SF_D
width at half height of the differentiated static magnetisation curve $M(H)$ divided by the coercivity from the same curve

3.21
switching field by slope
SF_S
difference between the field values at the intercept of the static magnetisation $M(H)$ loop with $M(H) = 0{,}5M_r$ and $M(H) = -0{,}5M_r$, divided by the coercivity

NOTE $SF_S = (/H_2/-/H_1/)/ H'_{cM}$, where $M(-/H_1/) = 0{,}5M_r$ and $M(-/H_2/) = -0{,}5M_r$.

3.22
angle of maximum squareness
$\Theta(SQ_{max})$
angle between the direction at which the maximum value of squareness is found and the longitudinal axis of the magnetic stripe

3.23
resolution
average signal amplitude at some specified higher recording density divided by the average signal amplitude at some specified lower recording density, multiplied by 100, expressed as a percentage

3.24
U_{Fi}
magnitude of the individual element at specified frequency of the Fourier spectrum of the entire waveform of the stripe

4 Default items applicable to the test methods

4.1 Test environment

Unless otherwise specified, testing shall take place in an environment of temperature 23°C ± 3°C (73°F ± 5°F) and of relative humidity 40% to 60%.

4.2 Pre-conditioning

Where pre-conditioning is required by the test method, the identification cards to be tested shall be conditioned to the test environment for a period of 24 h before testing.

4.3 Selection of test methods

Tests shall be applied as required to test the attributes of the card defined by the relevant base standard.

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4.4 Default tolerance

Unless otherwise specified, a default tolerence of ± 5% shall be applied to the quantity values given to specify the characteristics of the test equipment (e.g. linear dimensions) and the test method procedures (e.g. test equipment adjustments).

4.5 Total measurement uncertainty

The total measurement uncertainty for each quantity determined by these test methods shall be stated in the test report.

5 Test methods

5.1 Magnetic stripe area warpage

The purpose of this test is to measure the degree of warpage of a card test sample in the area of the magnetic stripe (see ISO/IEC 7811-2, ISO/IEC 7811-6 and ISO/IEC 7811-7).

The method is applicable to both embossed and unembossed cards.

5.1.1 Apparatus

The apparatus is shown in Figure 1. It comprises:

a) a level rigid plate whose surface roughness is not greater than 3,2 μm (130 μin) in accordance with ISO 1302. The plate shall contain an aperture to allow access for a micrometer probe;

b) a dial indicator accurate to within 2,5 μm (98 μin)with a probe whose contact area is a hemisphere with a diameter in the range of 3 mm to 8 mm (0.1 in to 0.3 in). The force exerted by the probe shall be f = 0,6 N ± 0,3 N (0.13 lbf ± 0.07 lbf);

c) a means of applying a force F = 2,2 N (0.49 lbf) evenly distributed on the front face of the card opposite the magnetic stripe area.

not to scale

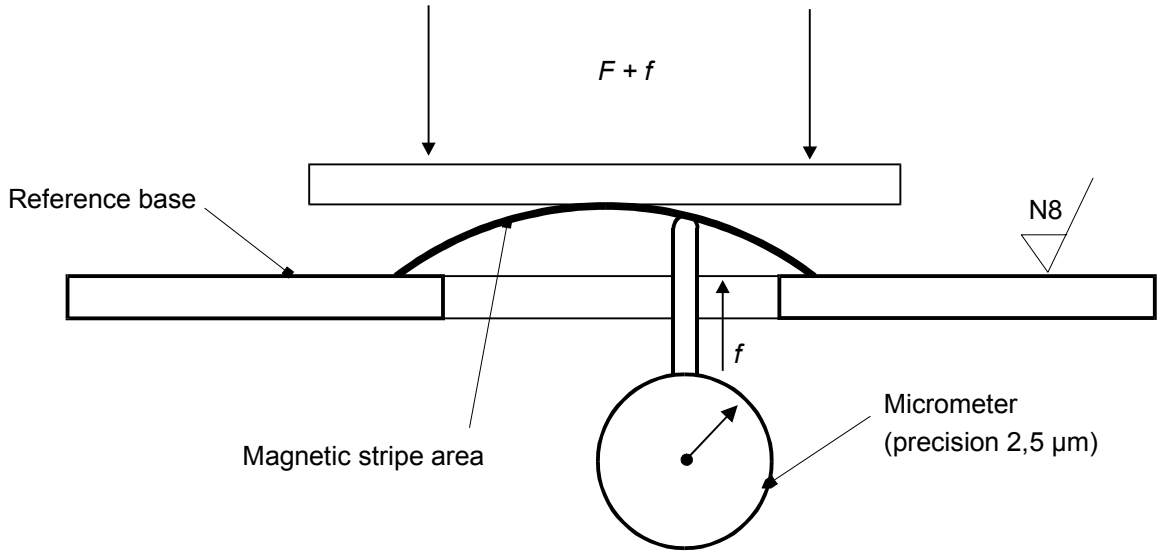


Figure 1 — Measuring arrangement

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5.1.2 Procedure

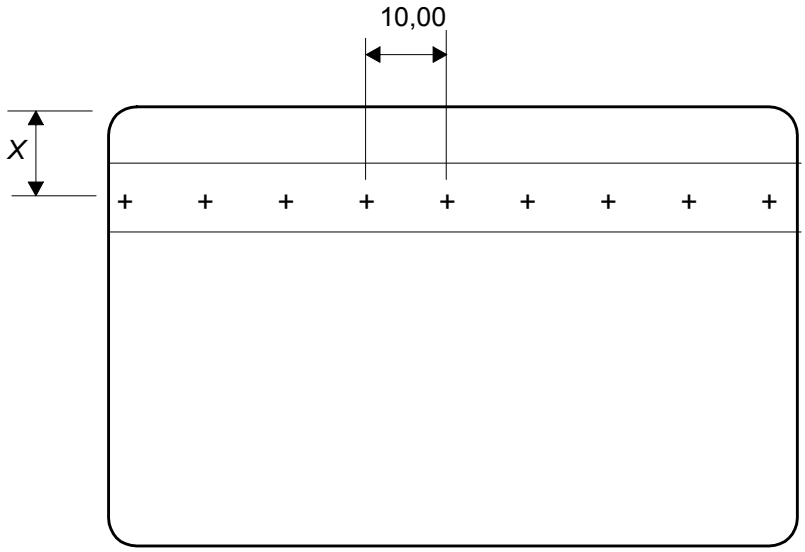
Place the sample card, front side up, on the level rigid plate. Position the magnetic stripe area to be measured over the aperture.

The load of 2,2 N (0.49 lbf) should be increased by an amount *f* to compensate for the micrometer force which is acting in the opposite direction to that force.

Apply the force *F* (+ *f*) directly over the magnetic stripe area on the front side of the card. Wait 1 minute before making any measurements.

Measure the card stripe area warpage at the nine positions along the stripe as shown in Figure 2. Additional locations shall be measured if the magnetic stripe area warpage appears greater in those areas than in the nine designated areas.

dimensions in mm
not to scale



NOTE - the value of *X* is given in Table 1.

Figure 2 — Measuring points on the card

Table 1 — Position of the line of measuring points

Magnetic stripe area	Dimension *X* (mm)
Tracks 1 and 2	8,00
Tracks 1, 2 and 3	10,70

5.1.3 Test report

The test report shall give the maximum value obtained from the set of nine measurements.

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5.2 Height and surface profile of the magnetic stripe

The purpose of this test is to determine the height and flatness of the magnetic stripe of a card test sample (see ISO/IEC 7811-2, ISO/IEC 7811-6 and ISO/IEC 7811-7).

The height of the magnetic stripe is determined by reference to the card and the stripe surface profile.

5.2.1 Apparatus

The following items are required:

a) a profilometer (see Figure 3);

b) a notched rigid metal plate as shown in Figure 4. Any rigid metal can be used to construct the plate, but its thickness shall be adjusted, according to the density of the material, to achieve a weight of 2,2 N ± 0,1 N (0.49 lbf ± 0.02 lbf). All dimensions of the plate shall be ± 0,5 mm (0.02 in) or better.

not to scale

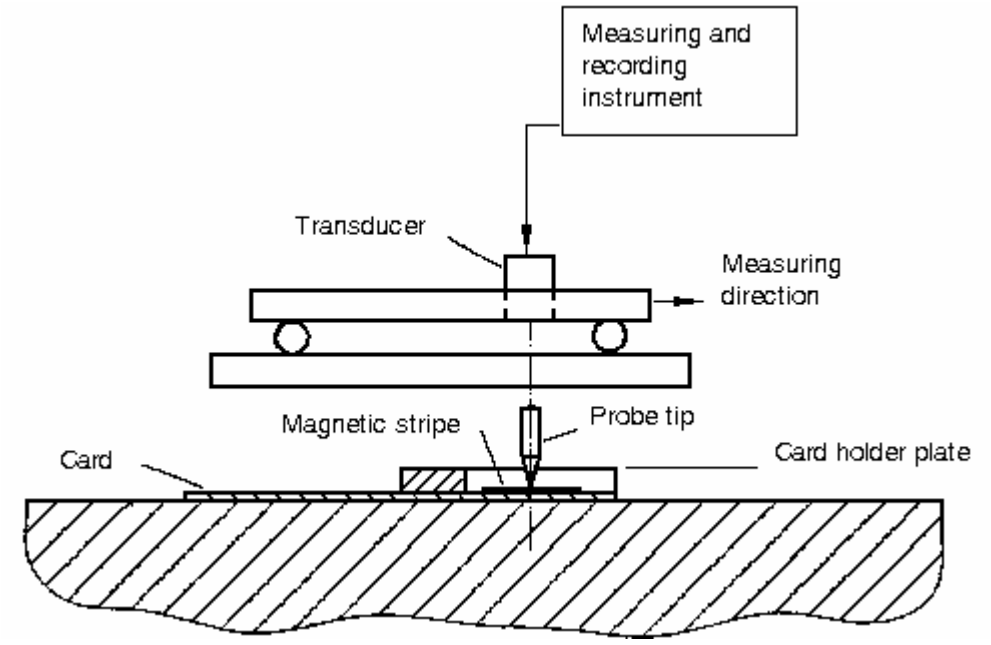


Figure 3 — Measuring device for the height and the profile of the magnetic stripe

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not to scale
dimensions in millimetres

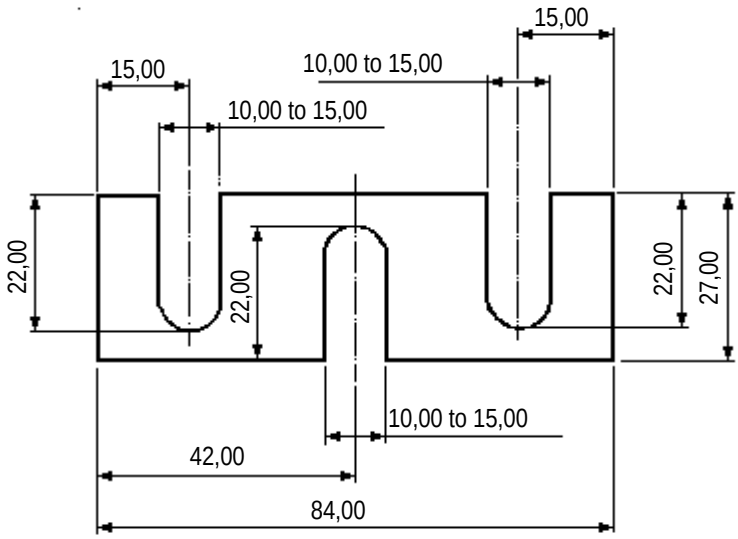


Figure 4 — Card holder plate (contact area)

5.2.2 Procedure

Hold the card to be tested under the notched rigid metal plate shown in Figure 4.

Measure the height and the surface profile of the magnetic stripe and the surrounding card surface using a measuring recording instrument.

Measure the profile at a maximum speed of 1 mm/s (0.04 in/s) using a probe having a radius of 0,38 mm to 2,54 mm (0.015 in to 0.1 in) applied with a force of 0,5 mN to 6 mN (0.0001 lbf to 0.0013 lbf).

Take three measurements on each specimen across the width of the stripe. The three locations V, X and Y are defined as the distance of 15 mm ± 2 mm (0.59 in ± 0.08 in) from each end of the card and location X the centreline of the card (see Figure 5).

Additional areas shall be measured if the height or surface profile deviations appear to be greater in those areas than in the three designated areas.

The starting point for measurement along each line V,X,Y begins 1 mm min (0.04 in min) above the top edge of the magnetic media and ends 1 mm min (0.04 in min) below the bottom edge of the magnetic media.

NOTE – In preparing the test card for the surface profile measurement, it is helpful to lightly scribe a line, using a sharp knife, parallel to the top reference edge of the card for locating the minimum stripe width *W* on the profile recording.

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not to scale
dimensions in millimetres

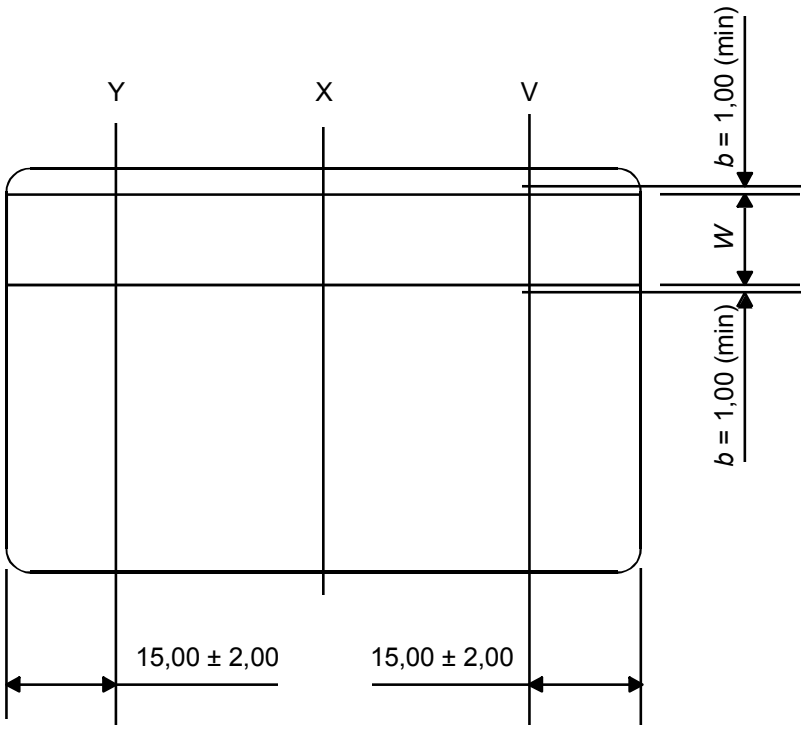


Figure 5 — Magnetic stripe profile measurement location

5.2.3 Expression of results

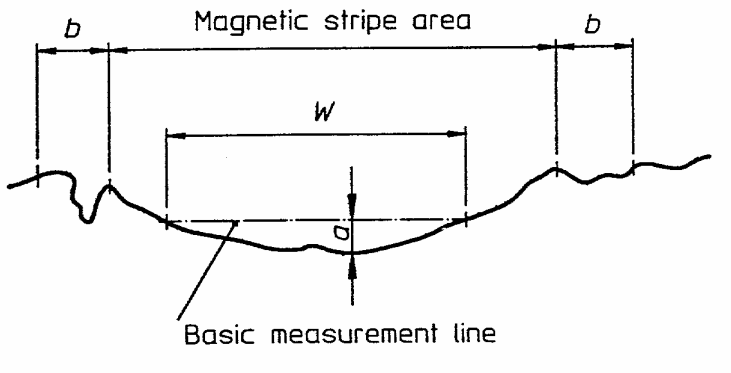
5.2.3.1 Surface profile of the magnetic stripe

For the measurements along V, X and Y line (see Figure 5), form a first basic measurement line (see Figure 6 and Figure 7) by connecting the top and bottom points that define the edges of the minimum stripe width. The basic measurement line shall lie within 10° of the chart recording direction.

The maximum vertical deviation (*a*) is the distance between the basic measuring line and the point on the magnetic media furthest away from the basic measurement line. The measurement shall be made perpendicular to the chart recording direction.

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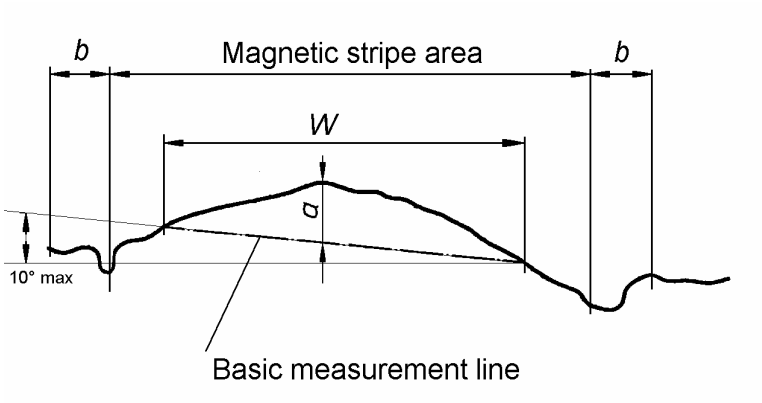


a = maximum vertical deviation

b = 1 mm (min)

W = Minimum stripe width as specified in the relevant base standard

Figure 6 — Concave stripe profile



a = maximum vertical deviation

b = 1 mm (min)

W = Minimum stripe width as specified in the relevant base standard

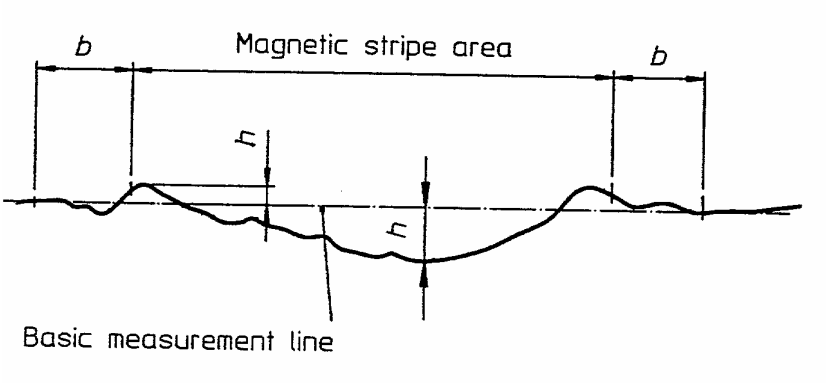
Figure 7 — Convex stripe profile

5.2.3.2 Height of the magnetic stripe

For the three measurements along V, X and Y, form a basic measurement line by connecting the starting and ending points (see Figure 8 and Figure 9). The basic measurement line shall lie within 10º of the chart recording direction.

The maximal vertical deviation (*h*) is the distance between the basic measurement line and the point on the magnetic media furthest away from the basic measurement line. The measurement shall be made perpendicular to the chart recording direction.

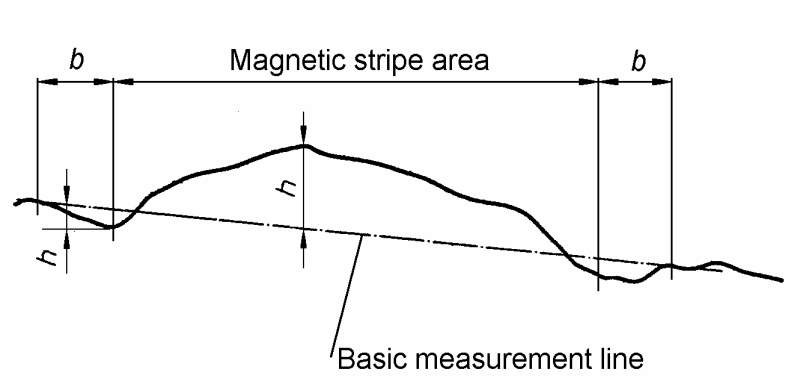
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b = 1 mm (min)

h = maximum vertical deviation as specified in the relevant base standard

Figure 8 — Concave stripe profile



b = 1 mm (min)

h = maximum vertical deviation as specified in the relevant base standard

Figure 9 — Convex stripe profile

5.2.4 Test report

5.2.4.1 Surface profile of the magnetic stripe

The test report shall give the values of the three measurements of maximum vertical deviation (*a*) obtained along lines V, X and Y.

5.2.4.2 Height of the magnetic stripe

The test report shall give the values of the three measurements of maximum vertical deviation (*h*) obtained along lines V, X and Y.

5.3 Surface roughness of the magnetic stripe

The purpose of this test is to determine the degree of roughness of the magnetic stripe of a card test sample (see ISO/IEC 7811-2 and ISO/IEC 7811-6).

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5.3.1 Procedure

The surface roughness of the magnetic stripe shall be measured with a measuring recording instrument as shown in Figure 3. Perform at least three measurements in each direction, traversing those areas where the surface roughness appears worst.

All test conditions specified in 5.2 apply except:

— probe stylus has a radius of 2 μm (79 μin) or 5 μm (197 μin);

— cutoff wavelength and roughness evaluation length shall be chosen in accordance with ISO 3274 and ISO 4288;

— longitudinal and transverse measurements are taken on the stripe.

5.3.2 Test report

The test report shall give the centreline average R_a values of the magnetic stripe roughness obtained by measuring in both longitudinal and transverse directions.

5.4 Wear test for magnetic stripe

The purpose of this test is to determine the signal amplitude of the magnetic stripe of a card test sample after controlled abrasion (see ISO/IEC 7811-2 and ISO/IEC 7811-6).

5.4.1 Apparatus

A metal dummy head whose hardness is between 110 HV - 130 HV (Vickers scale) or its equivalent in Rockwell scale. The required dimensions are as shown in Figure 10.

A rigid flat plate capable of holding the card still.

not to scale
dimensions in mm

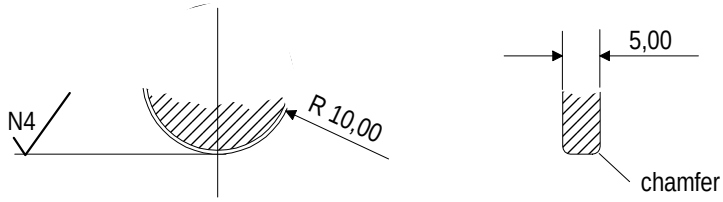


Figure 10 — Dimensions of the contact area of the dummy head

5.4.2 Procedure

Record the sample card at 20 ft/mm (500 ftpi) using a test recording current of I_{min}, read and note the signal amplitude, measured as specified in the base standard.

Fasten the card, magnetic stripe uppermost, to the flat plate so that the dummy head can traverse the length of the stripe or alternatively, the card can move under the head (see Figure 11). Take care when mounting the card on the rigid flat plate to ensure that the card is held flat and fixed while the tests are performed.

Apply a force of 1,5 N ± 0,2 N (0.34 lbf ± 0.05 lbf)to the head and allow the head to move back and forth at a speed of between 200 mm/sec (7.9 in/s) and 500 mm/sec (19.7 in/s) for 2 000 cycles, (1 cycle is equivalent to

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one forward and one backward movement). Read the signal amplitude on the same apparatus and compare the result with the amplitude obtained at the beginning of the test.

The position of the read and write heads shall be completely contained within the area of the zone of wear from the dummy head.

not to scale

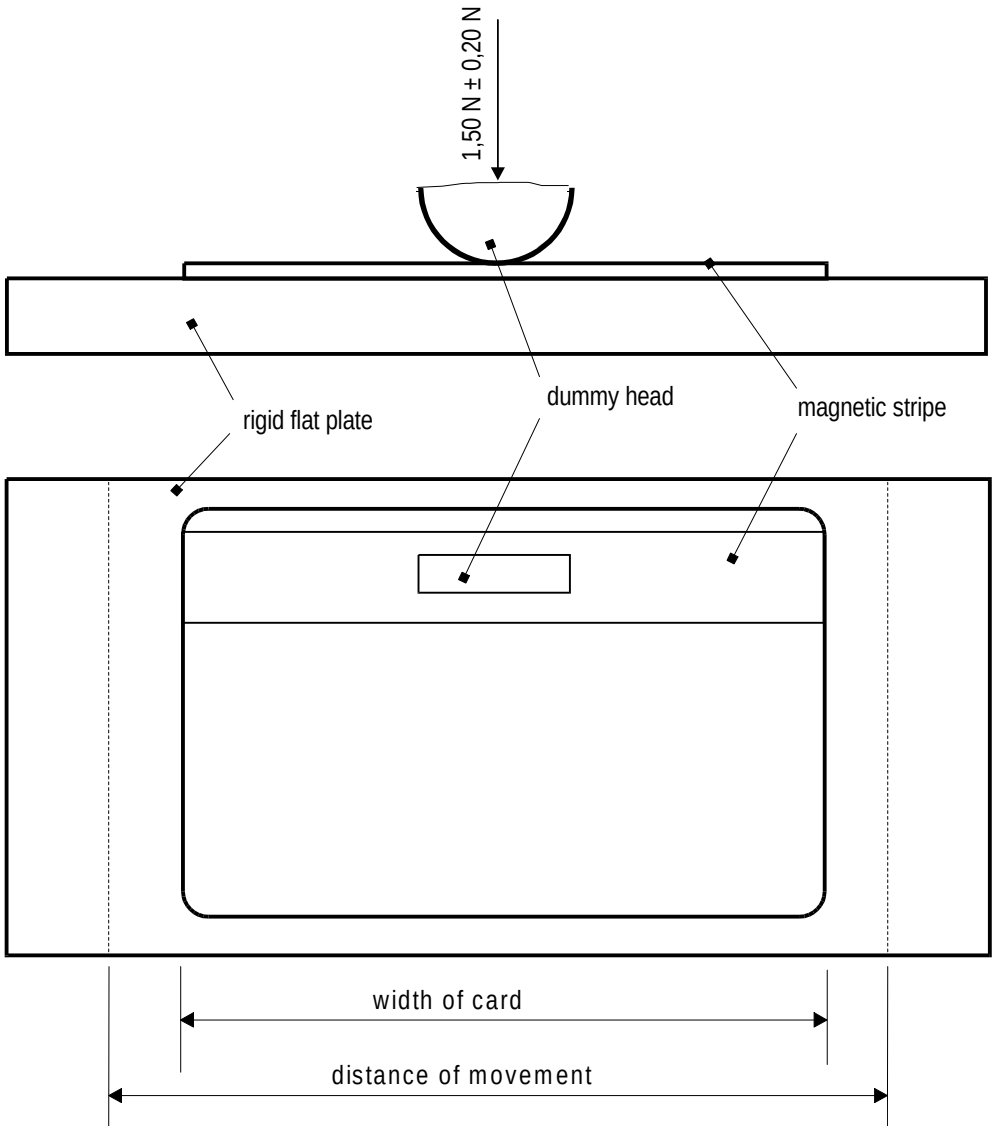


Figure 11 — Dummy head and magnetic stripe

5.4.3 Test report

The test report shall give the values of the signal amplitudes defined in the base standard, measured before and after wear.

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5.5 Amplitude measurements

The purpose of this test is to measure the signal amplitude, resolution, erasure, demagnetisation and waveform characteristics of the magnetic stripe of a card test sample to check conformity with the appropriate base standard, i.e.

— for checking magnetic stripes with coercivities up to about 48 kA/m (600 oersteds) for conformance to ISO/IEC 7811-2;

— for checking magnetic stripes with coercivities above 80 kA/m (1000 oersteds) for conformance to ISO/IEC 7811-6;

— for checking magnetic stripes with coercivities above 80 kA/m (1000 oersteds) and recording density of 40 bpmm (1016 bpi) for conformance to ISO/IEC 7811-7.

NOTE - Demagnetisation and waveform characteristics are requirements only of ISO/IEC 7811-6.

5.5.1 Calibration reference

Calibration reference cards shall be selected according to the base standard against which conformance is to be checked:

When the base standard is ISO/IEC 7811-2, use reference card type RM 7811-2.

When the base standard is ISO/IEC 7811-6, use reference card type RM 7811-6.

When the base standard is ISO/IEC 7811-7, use reference card type RM 7811-7.

NOTE 1 - Reference cards can be ordered from Physikalisch–Technische Bundesanstalt, Flab. 2.24 Bundesallee 100, D–38116 Braunschweig, Germany, whilst stocks last. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO/IEC of the product named.

NOTE 2 - Cleaning agents may cause deterioration of the certified properties. Any reference cards so treated can no longer be considered certified and should be destroyed.

5.5.2 Apparatus

A record/read-back system is required which comprises the items and characteristics given in 5.5.2.1, 5.5.2.2, 5.5.2.3 and 5.5.2.4.

5.5.2.1 Mechanical drive

The card shall be held flat during the measurements.

The drive system shall have an average transport speed variation of no more than ± 0,5% and stable head pressure.

NOTE - Variations in speed and head pressure will reduce the accuracy of measurement. In particular, it should be recognised that instantaneous (transient) speed variations will affect the accuracy of individual signal amplitude measurements.

If the drive used has a speed variation greater than ± 0,5%, then the actual speed variation shall be recorded with the test results.

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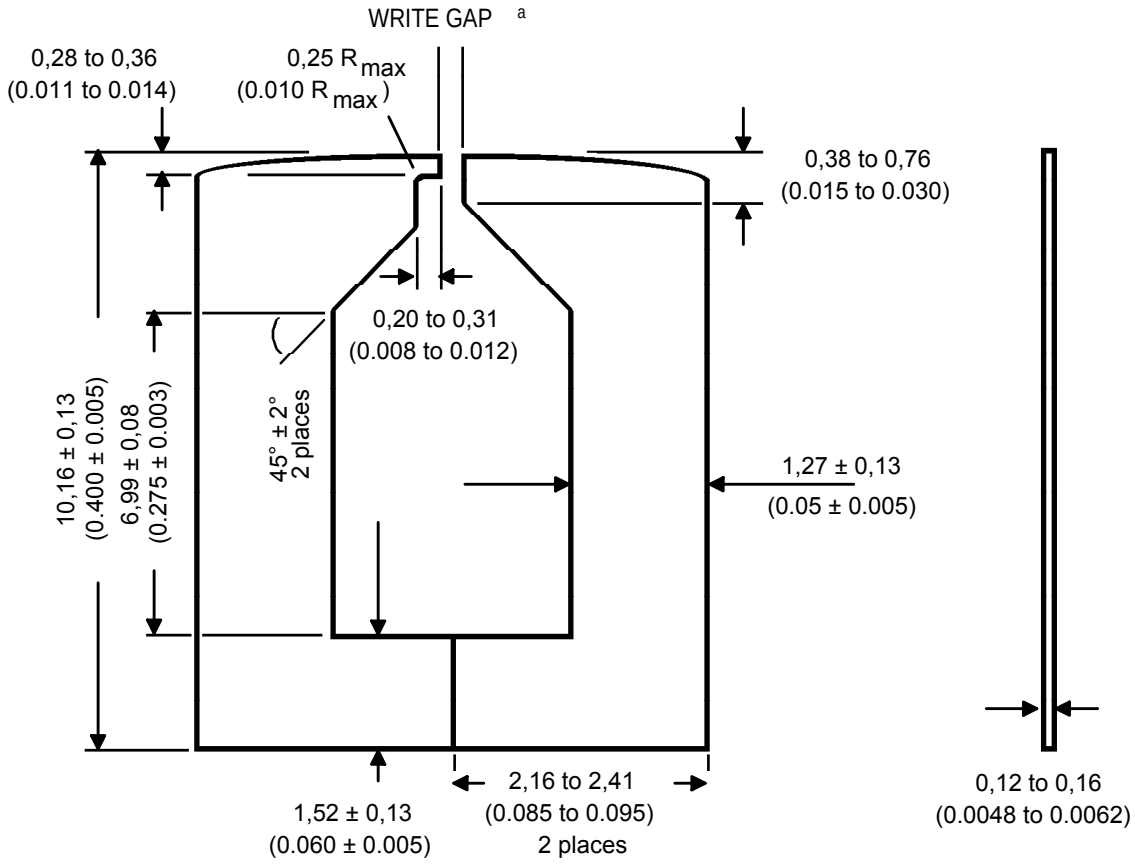
5.5.2.2 Test heads

Test heads shall comprise separate write and read heads constructed in bodies of non-magnetic material, such as brass or aluminium.

To ensure adequate frequency response, the read head shall be constructed of laminated metal with a maximum thickness of 0,18 mm (0.0071 in).

The write head core shall be constructed of metal laminations conforming to Figure 12. The front gap material shall be beryllium copper, free from ferromagnetic impurities. Wear resistant coatings shall not be used (see Annex A)

not to scale
dimensions in millimetres (inches)



a See Table 2 for value

Figure 12 — Test write head laminations

Coils of 100 turns shall be wound on each leg of the write head core in no more than 2 layers, with all four leads terminating in external leads, as shown in Figure 13.

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not to scale

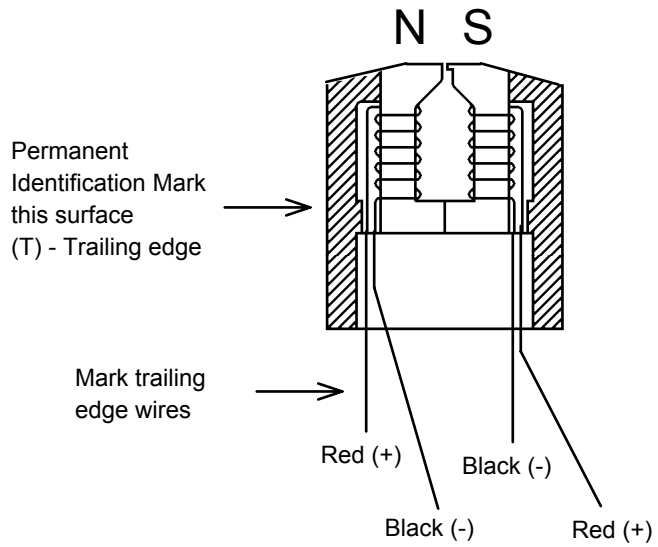


Figure 13 — Test write head coil connections

Gap and track widths etc. are given in Table 2. All the quantities in the table shall be measured optically.

Table 2 — Test heads specification

Head function	**Read**		**Write**		
Base standard	ISO/IEC 7811-2 ISO/IEC 7811-6	ISO/IEC 7811-7	ISO/IEC 7811-2	ISO/IEC 7811-6	ISO/IEC 7811-7
Lamination thickness	0,18 mm max. (0.0071 in max.)		see Figure 12		
Radius of curvature†	19 mm ± 10 % (0.75 in ± 10 %) for a new head. A flat area at the gap is permitted.				
Width of contact with stripe	2,8 mm to 3,5 mm (0.11 in to 0.14 in)				
Width of magnetic core	1,4 mm ± 10% (0.055 ± 10%)	0,5 mm ± 10% (0.02 in ± 10%)	2,79 mm min) (0.110 in min)		1,0 mm min (0.04 in min)
Gap	12,7 µm ± 10% (0.0005 in ± 10%)	6 µm ± 10% (236 uin ± 10%)	0,025 mm ± 10 % (0.001 in ± 10 %)	0,051 mm ± 10 % (0.002 in ± 10 %)	0,025 mm ± 10 % (0.001 in ± 10 %)
Saturation induction			0,8 T min. (8 kgauss min.)	2,3 T min (23 kgauss min.)	

† The size of the test head flat area influences its ability to maintain good contact with the magnetic stripe. Recalibration will be necessary as the test head wears.

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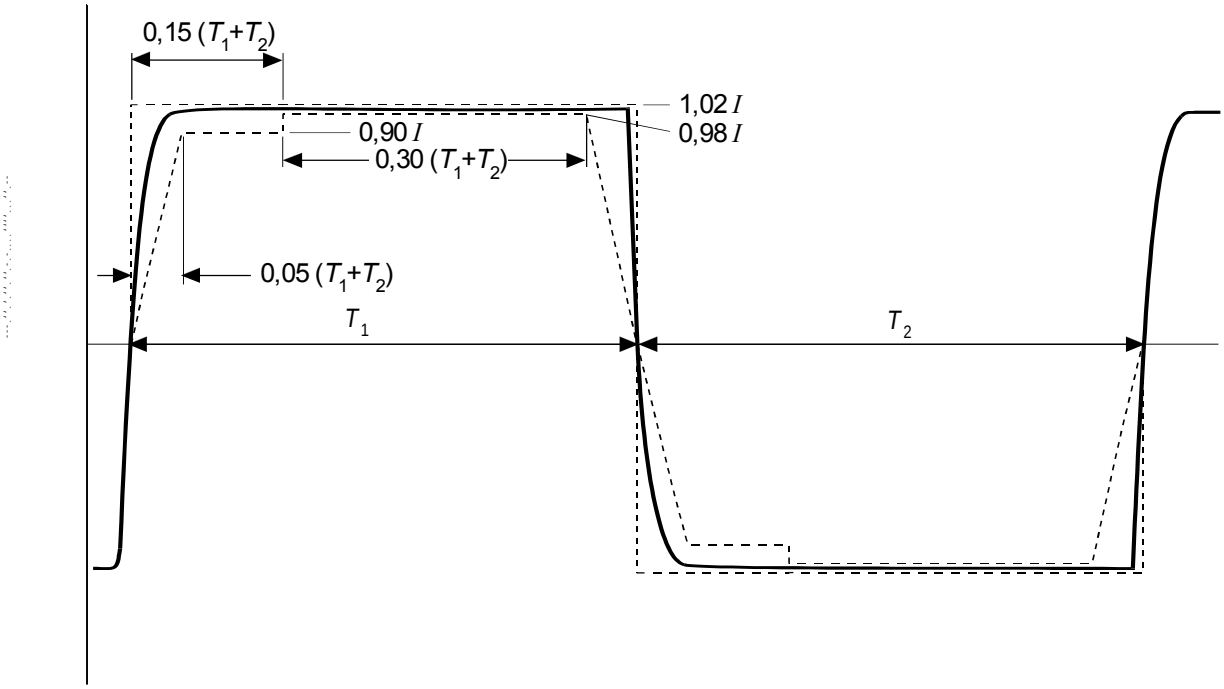
The heads shall be mounted such that they are mechanically independent from each other and such that the azimuth error is less than 10 minutes. They shall be aligned such that the centre line of the read track lies within ± 0,15 mm of the centre line of the written track.

The force on the heads shall be set to the minimum amount required to achieve the maximum output from the reference card at the time of calibration but shall not exceed 7 N (1.6 lbf).

NOTE - A typical head force is 3 N (0.7 lbf).

5.5.2.3 Write head drive

The waveform of the recording current I, at nominal recording densities of 8 ft/mm (200 ftpi) and 20 ft/mm (500 ftpi), shall be as shown in Figure 14a, except when testing for conformance to ISO/IEC 7811-7, in which case the recording current waveform shall be as shown in Figure 14b.



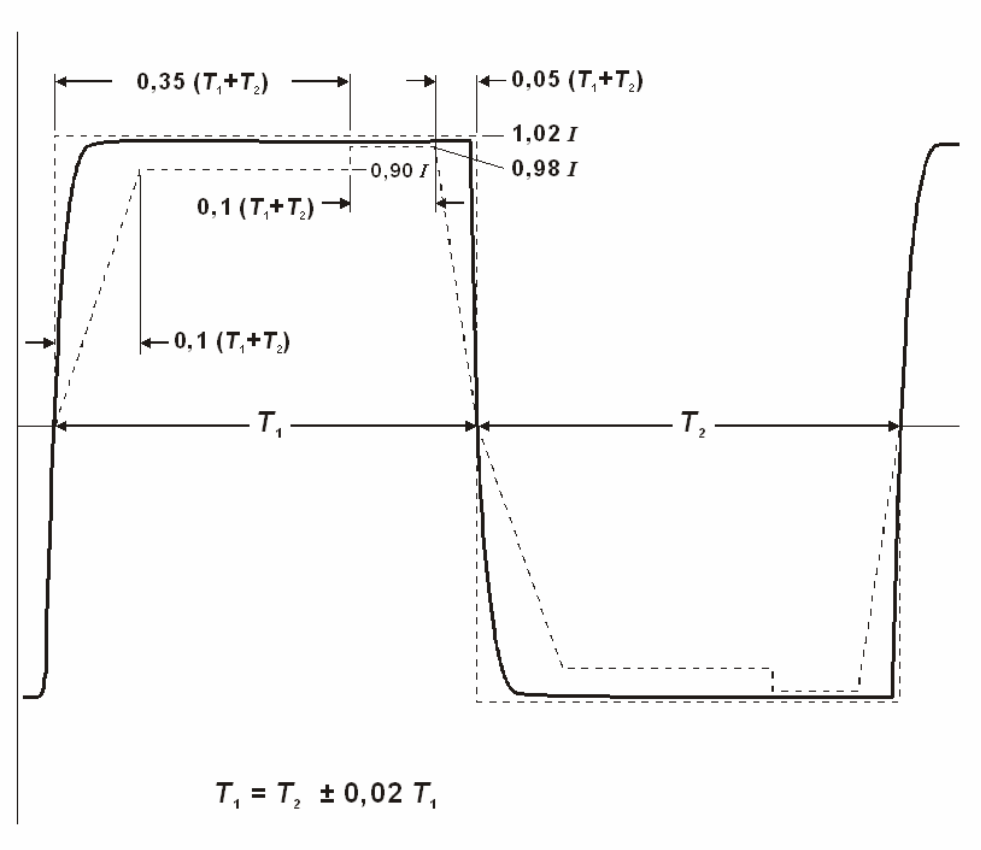
NOTE 1 - The current waveform shall remain within the limits shown as broken lines.

NOTE 2 - The mark-space ratio of the waveform shall be such that $T_1 = T_2 \pm 5$ %

Figure 14a — Default recording current waveform

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NOTE 1 - The current waveform shall remain within the limits shown as broken lines.

NOTE 2 - The mark-space ratio of the waveform shall be such that $T_1 = T_2 \pm 5$ %

Figure 14b – Recording current waveform when testing for conformance to ISO/IEC 7811-7

5.5.2.4 Reading sub-system

The effective remanence of the read head when connected to the read-back sub-system shall not reduce the average signal amplitude of the reference card being used by more than 5% after 5 successive read-only passes.

The resolution of the read-back sub-system shall be between 85% and 100% when testing on the reference card using a test recording current of I_{max} (see 5.5.3.3) and test recording densities of:

— 8 ft/mm (200 ft/in) and 20 ft/mm (508 ft/in) when testing for conformance to ISO/IEC 7811-2 and ISO/IEC 7811-6;

— 20 ft/mm (508 ft/in) and 40 ft/mm (1016 ft/in) when testing for conformance to ISO/IEC 7811-7.

It shall comprise:

a) a linear amplifier

The amplifier shall be without automatic gain control and with noise less than 0,5% of U_R (see 5.5.3.2) and a frequency response that is flat within ± 0,2 dB betwen frequencies corresponding to positions 2 and 3 of Figure 15.

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This range corresponds to the characteristics of the bandpass of the filter described in c) below. Outside this range the response may not rise.

b) display and measurement means

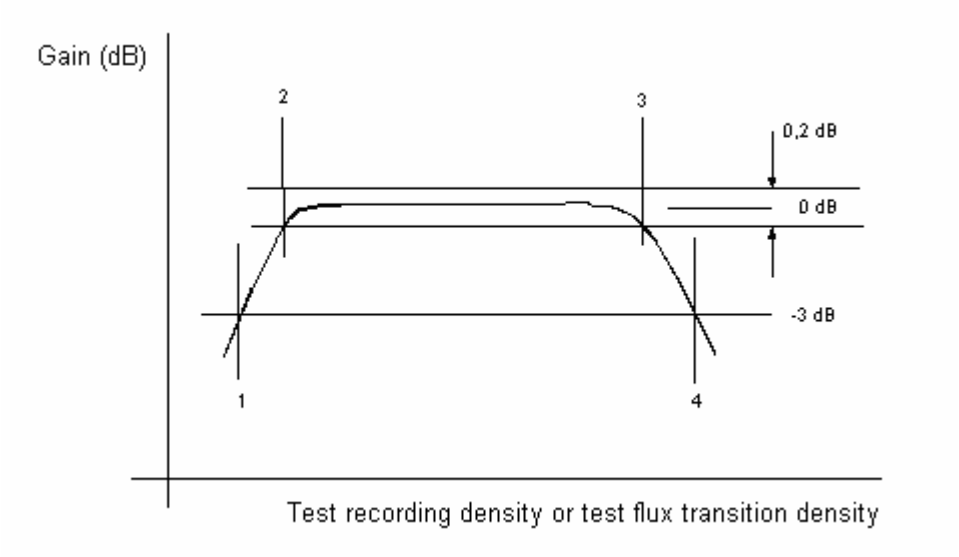
Equipment such as a storage oscilloscope for determining the amplitudes of the signal peaks.

c) a bandpass filter

This filter shall be used for all measurements except Erasure (U_{A4}) and Extra Pulse (U_{i4}).

The upper and lower band edges of the filter shall show a second order response (slope 12 dB/octave). The passband response shall be flat within 0,2 dB wide band from frequencies corresponding to 0,25 cycles/mm (0.5 ft/mm) to 10,5 cycles/mm (21 ft/mm). Figure 15 shows the required characteristic.

The filter response shall continue downward for at least one decade after the band edges and shall not rise more than -40 dB outside this one decade range. Other filtering functions outside the one decade ranges may be used.



Position	Test recording density		Test flux transition density	
	ISO/IEC 7811-2 ISO/IEC 7811-6	ISO/IEC 7811-7	ISO/IEC 7811-2 ISO/IEC 7811-6	ISO/IEC 7811-7
	Cycles/mm (cycles/in)		Ft/mm (ft/in)	
1	0,009 (0.23)		0,018 (0.46)	
2	0,25 (0.63)		0,05 (1.27)	
3	10,5 (267)	28 (711)	21 (533)	56 (1422)
4	30 (762)	80 (2032)	60 (1524)	160 (4064)

Figure 15 — Filter characteristic

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5.5.3 Procedure

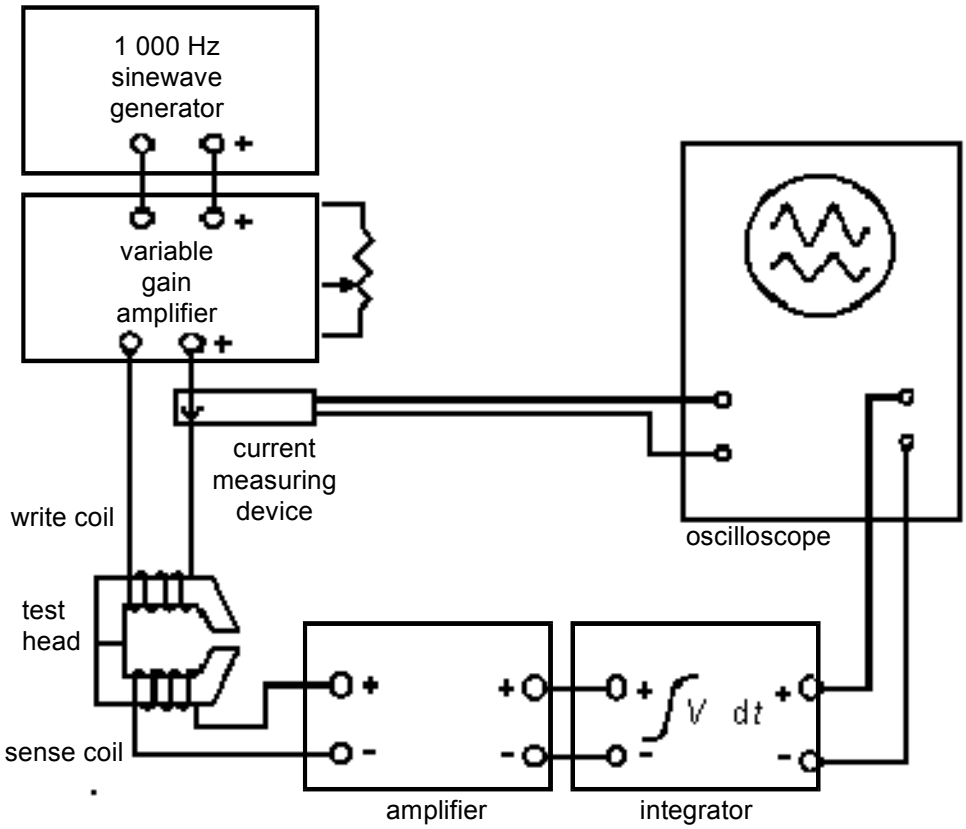
The entire sequence of measurements shall be performed on the same equipment and under the same conditions.

All measurements shall be performed while reading in the same direction as recording and shall be taken after the same number of passes.

5.5.3.1 Determine the flux/current characteristic of the test write head

Characterise the write head to find the relationship between flux output and write current in the following manner.

For each current amplitude (I), note the corresponding flux amplitude (F), using the apparatus described in Figure 16.



NOTE 1 - The voltage/current linearity of the current source shall be better than ± 2%.

NOTE 2 - The loss of the integrator = $2000\pi \times RC \approx 6283 \times RC$ shall be at least 200.

Figure 16 — Typical head characterization test setup

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5.5.3.2 Determine U_{max} and I_R from the reference card

Draw the saturation curve to determine the maximum signal amplitude (U_{max}) and reference current (I_R) using the reference card (see 5.5.1) and calibration test recording density appropriate to the base standard. The calibration test recording density for base standards ISO/IEC 7811-2 and ISO/IEC 7811-6 is 8 ftpmm (200 ftpi) and that for ISO/IEC 7811-7 is 20 ftpmm (208 ftpi). For each current amplitude, note the corresponding value of the average signal amplitude of the reference card.

Before recording at each current amplitude, erase the card with high frequency alternating current. The degree of erasure shall be sufficient to ensure that the average remaining signal is less than 0,05 U_R

This calibration process (which determines the value of U_R from the Reference Card) shall be performed such that the recording pass across the Reference Card is directly followed by the read pass.

NOTE - Any contact by write or read heads after the recording pass, before the reading pass occurs, may affect the resulting value of U_R.

Perform the calibration process at least three times. If output variation is greater than 2% (i.e.± 1%), repeat the calibration procedure.

NOTE - The user is advised to check the accuracy of the Reference Card periodically by comparing the signal output amongst five certified Reference Cards.

5.5.3.3 Derive the reference values

Calculate the reference signal amplitude (U_R) and test recording currents (I_{min} and I_{max}) as follows:

$$U_R = \frac{U_{max}}{a}$$

where a is the calibration factor for the reference card, defined as:

$$a = \frac{\text{reference card amplitude}}{\text{primary standard amplitude}}$$

Derive the values of the following reference quantities:

a) I_R = reference current when U is 0,8 × U_R.

b) F_R = reference flux when current is I_R.

c) For testing against ISO/IEC 7811-2 requirements, I_{min} = current when flux is 3,5 × F_R;
for testing against ISO/IEC 7811-6 requirements, I_{min} = current when flux is 2,8 × F_R;
for testing against ISO/IEC 7811-7 requirements I_{min} = current when flux is 2,2 × F_R.

d) For testing against ISO/IEC 7811-2 requirements, I_{max} = current when flux is 5,0 × F_R;
for testing against ISO/IEC 7811 6 requirements, I_{max} = current when flux is 3,5 × F_R;
for testing against ISO/IEC 7811-7 requirements, I_{max} = current when flux is 2,5 × F_R.

When checking conformity with ISO/IEC 7811-2:1995 only, ensure that the following criteria are met:

— $U_{A2} \leq 0{,}95\ U_R$

— $0{,}9\ I_{max} \leq 5{,}0\ I_R \leq 1{,}1\ I_{max}$

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When checking conformity with ISO/IEC 7811-6:1996 only, ensure that the following criteria are met:

— $U_{A2} \leq 0{,}95\ U_R$

— $0{,}8\ I_{max} \leq 3{,}5\ I_R \leq 1{,}2\ I_{max}$

5.5.3.4 Measure the card under test

Record and read the card under test under the various test conditions defined by the base standard.

Erase the card under test with high frequency alternating current before testing and before each individual test except for erasure and extra pulse. The degree of erasure shall be sufficient to ensure that the average remaining signal is less than 0,05 U_R

Do not erase the card between the two recordings of any overwriting tests that specifically require a comparison between signal amplitudes before and after overwriting.

Prior to erasing the card under test for erasure and extra pulse measurement, record it at test recording density 1 with a recording current of I_{max}.

Prior to perfoming the test for demagnetisation against the requirements of ISO/IEC 7811-6, record the card with the value of I_{min} appropriate to the base standard and a test density of 20 ftpmm (500 ftpi) when the base standard is ISO/IEC 7811-2 or ISO/IEC 7811-6; 40 ftpmm (1016 ftpi) when the base standard is ISO/IEC 7811-7.

5.5.4 Test report

The test report shall give the values measured for the quantities defined by the base standard.

In addition to the total measurement uncertainty associated with each quantity, it shall also state the measured speed variation of the drive if greater than ± 0,5% and whether the test heads include wear resistant coatings.

5.6 Flux transition spacing variation

The purpose of this test is to determine the variation in flux transition positions on an encoded card test sample (see ISO/IEC 7811-2, ISO/IEC 7811-6 and ISO/IEC 7811-7).

5.6.1 Apparatus

The apparatus for measuring transition to transition spacing variation shall conform to 5.5.2.1, 5.5.2.4. It shall also conform to those parts of 5.5.2.2 relevant to the read head.

Specifically, the apparatus shall maintain a 0,5% positional accuracy at 40 ft/mm (1016 ftpi) for all speeds of operation while testing and shall be so constructed that it is protected from debris and contamination.

The read head shall be aligned such that the centre line of the read track lies within ± 0,15 mm of the centre line of the written track under test.

NOTE - Either the head or the card position may be measured while holding the other stationary.

Figure 17 shows a block schematic of the apparatus.

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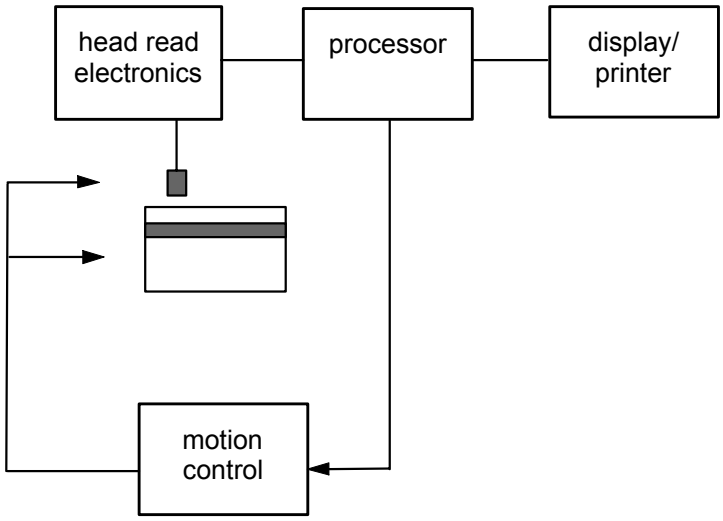


Figure 17 — Example measurement schematic

5.6.2 Procedure

Place the test specimen card in the apparatus.

The force on the head shall be set to the minimum amount required to achieve the maximum output from the card under test at the time of measurement but do not exceed 7 N (1.6 lb).

Activate the apparatus and obtain distance measurements between adjacent signal peaks.

5.6.3 Test report

The test report shall give the measured values of the quantities defined by the base standard, together with the total measurement uncertainty of each.

5.7 Magnetic stripe adhesion

The purpose of this test is to determine the degree of adhesion between the magnetic stripe and the body of a card test sample (see ISO/IEC 7811-2 and ISO/IEC 7811-6).

5.7.1 Apparatus

The following items are required:

— single blade cutting tool (see 4.1 of ISO 2409:1992);

— transparent adhesive tape as specified in 4.4 of ISO 2409:1992, tested according to IEC 454-2 and no more than 20 mm wide;

— card holder comprising a rigid rectangular metal plate with a rectangular aperture 25 mm × 50 mm.

5.7.2 Procedure

Make two cuts in the stripe about 20 mm (0.75 in) long that intersect near the middle of the stripe with an angle of about 20° to 45°. When making the cuts use the side of the card holder and cut through the stripe to the card in one steady motion.

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Place the card holder on the card with the aperture centred on the intersection of the cuts. Cut a 75 mm (3 inch) length of pressure sensitive tape and place the tape on the stripe in the aperture of the card holder. Smooth the tape into place in the area of the incision using a finger-tip.

Figure 18 shows the card positioned under the card holder, with the adhesive tape in place.

Within 5 minutes of applying the tape, remove it by grasping its free end and pulling it off steadily, in 0,5 s to 1 s, while maintaining an angle of 60° between the detached portion of tape and that which remains attached to the surface of the card. The card holder shall be held firmly to avoid any movement of the card during peeling.

Inspect the tape and the cross-cut area of stripe. Record any evidence of removal of magnetic material from the card.

not to scale

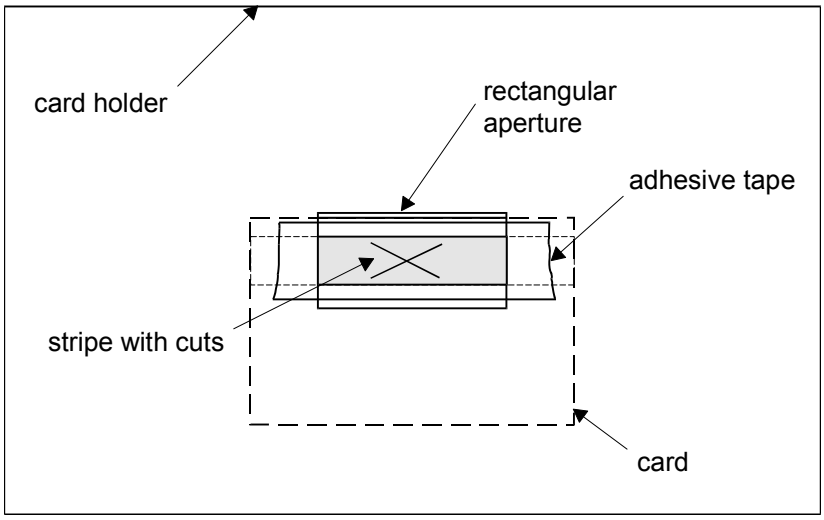


Figure 18 — Magnetic stripe adhesion test

5.7.3 Test report

The test report shall state whether, on final inspection, any material was found to be removed from the card. If any such removal is found then the test report shall describe its nature and severity.

5.8 Static magnetic characteristics

The purpose of this test is to the determine the static magnetic characteristics of magnetic stripes specified in Annex D of ISO/IEC 7811-6.

NOTE - Annex D of ISO/IEC 7811-6 is an informative annex containing information for guidance. This test method is provided only in order to ensure consistency of results when Annex D of ISO/IEC 7811-6 is applied.

For definitions of the quantities used in this test method, see clause 3.

5.8.1 Apparatus

Equipment having the following capability:

1) Maximum test field ± H_{max} = ± 1 200 kA/m (± 15,000 Oe);

2) Capability of measurement accuracy: H_c ± 2%, $SQ_{||}$ ± 2%, SF_D (or SF_S) ± 4%, $SQ_{\perp}$ ± 6%, S_{160} ± 4%.

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5.8.2 Procedure

5.8.2.1 Test Conditions

Temperature of sample 21°C to 23°C (default, room temperature).

NOTE - The temperature of the sample during the test will affect the measured value of H_{cM}.

5.8.2.2 Preparation

Calibrate the equipment according to the manufacturer's instructions.

Prepare a sample according to the manufacturer's instructions.

5.8.2.3 Measurements

Perform the measurements of the required quantities, as described in the following.

5.8.2.4 Measurement of hysteresis loop in the longitudinal direction

Orient the sample such that the longitudinal direction is parallel to the field direction.

Measure the magnetic moment M of the sample over the range $\pm H_{max}$.

Plot the hysteresis loop using data taken every 40 kA/m (500 Oe) maximum, and every 4 kA/m (50 Oe) maximum in the area of H'_{cM}. An example is shown in Figure 19.

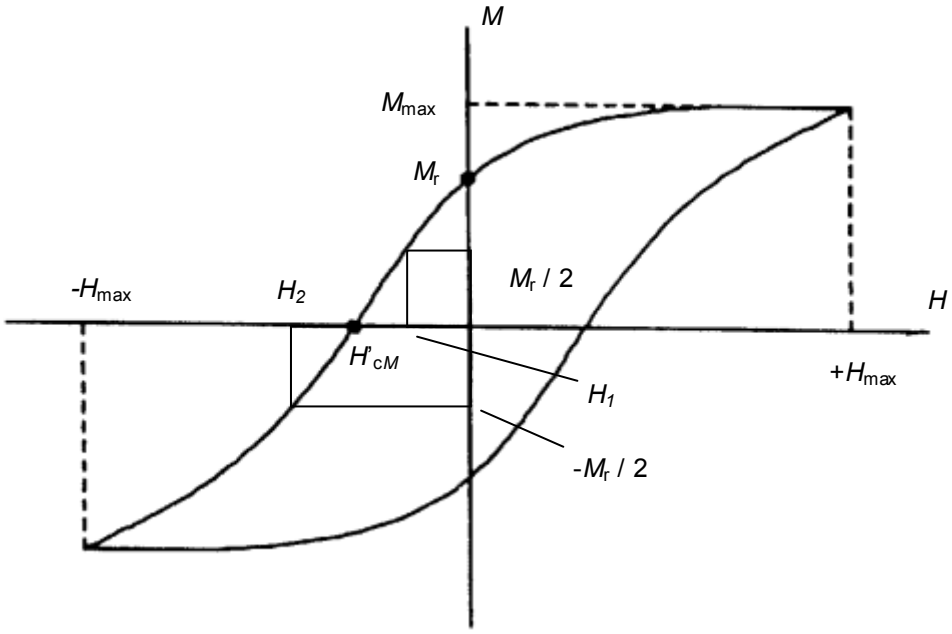


Figure 19 — Example of a hysteresis loop

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From the hysteresis loop obtained, find the values of the following quantities :

— coercivity H'_{cM} of the sample.

— saturation magnetization at H_{max} M_{max}.

— remanent magnetization M_r.

— field values H_1 and H_2 corresponding to $\pm$ 0,5 M_r.

From these, calculate longitudinal squareness $SQ_{||}$ and switching field distribution SF_S or SF_D (for which the derivative of the hysteresis loop must be plotted) as defined in the base standard.

5.8.2.5 Measurement of hysteresis loop in the perpendicular direction

Orient the sample such that the longitudinal direction is at 90° $\pm$ 2° to the field direction.

Measure the magnetic moment M of the sample over the range $\pm H_{max}$.

Plot the hysteresis loop using data taken every 40 kA/m (500 Oe) maximum, and every 4 kA/m (50 Oe) maximum in the area of H'_{cM}. The result will be similar to the loop shown in Figure 19.

From the hysteresis loop obtained, find the values of the following quantities:

— saturation magnetization M_{max};

— remanent magnetization M_r;

Calculate the perpendicular squareness $SQ_{\perp}$ as defined in the base standard.

5.8.2.6 Measurement of the static demagnetisation S_{160} in the longitudinal direction

Orient the sample such that the longitudinal direction is parallel to the field direction within $\pm$ 2°.

Apply a the magnetic field of $+H_{max}$ and then reduce it to zero and measure the remanence of the sample M_r.

Next apply a magnetic field of -160 kA/m (-2 000 Oe) ant then reduce it to zero and measure the remanence of the sample. $M^{+}_{(-160)}$. Calculate the static demagnetisation S_{160} as defined in the base standard.

5.8.3 Test report

The report shall give the quantity values obtained and shall state whether or not each result conforms to the requirements of the base standard.

5.9 Waveform U_{i6}

The purpose of this test is to determine the degree of waveform distortion present in the read back waveform when recorded under the specified conditions (see ISO/IEC 7811-6 and ISO/IEC 15457-2).

5.9.1 Apparatus

The test shall be conducted using the apparatus specified in 5.5 for Amplitude measurements against the ISO/IEC 7811-6 base standard.

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5.9.2 Procedure

Perform the entire sequence of measurements on the same equipment and under the same conditions.

The read pass upon which measurements are made shall be performed while reading in the same direction as recording. Only the traverse necessary to restore the card to its start position shall intervene between the recording pass and the read pass upon which the measurements are performed.

Record and read the card under the conditions specified in the base standard, with the following additional constraints:

1) Encode the flux transitions along the full length of the track 2 position (the full width of the card).

2) Determine the value of the average amplitude U_{A6}.

3) Using the procedure in the base standard, find the largest value of U_{i6} for the card and record this as the U_{i6} value.

5.9.3 Test report

The report shall give the quantity values obtained and shall state whether or not the result conforms to the requirements of the base standard.

5.10 High coercivity, high density over-write

The purpose of this test is to determine the degree of distortion of the current waveform caused by the magnetic recording history of the magnetic stripe (see ISO/IEC 7811-7).

5.10.1 Apparatus

The test shall be conducted using the apparatus specified in 5.5 for Amplitude measurements, including the filter, against the ISO/IEC 7811-7 base standard.

5.10.2 Test method

Write entire length of the card stripe at 20ft/mm (508ft/in) using a current of I_{max}. Record U_{Fi7} at 20ft/mm (508ft/in) using a Hanning window.

Write entire length of the card stripe at 40ft/mm (1016ft/in) using a current of I_{min}. Record U_{Fi8} at 20ft/mm (508ft/in) using a Hanning window.

5.10.3 Test report

The test report shall give the values of UFi7 and UFi8 values obtained and shall state whether or not the result conforms to the requirements of the base standard.

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Annex A
(informative)

Effects of wear on test heads and the use of wear resistant test heads

A.1 Effects of wear on test heads

The radius and geometry of the test head as defined in this part of ISO/IEC 10373 is critical to calibration of the test head for conformance testing. Test heads tend to develop a “flatspot” as the equipment is used over time. The flat spot will affect test results. It is imperative that test heads be maintained or replaced on a regular basis depending on the frequency of use. The flat spot will grow to some stage at which the test results can no longer be relied on for compliance testing. Users should monitor the flat spot wear and replace the head when dimension W exceeds the test equipment manufacturer recommendation. If a recommendation for dimension W is not given, 2mm is a recommended default for W.

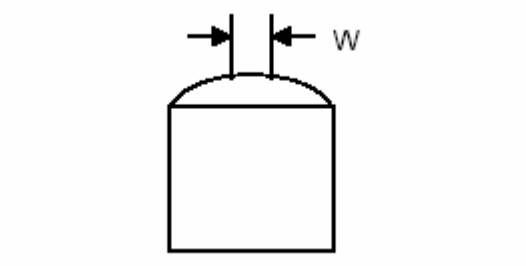


Figure A.1 — Dimension W of a flat spot

A.2 Test heads with wear resistant coatings

Wear resistant coatings have been shown to introduce measurement errors in excess of 7% when testing ID-1 cards for conformance to ISO/IEC 7811-2 and ISO/IEC 7811-6. While it is recognised that high speed, high volume test equipment often uses wear resistant coatings and/or other non-compliant features, the results of such measurements should be taken as indicative only, even when the material is well known.

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