International Standard 1864

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Information processing — Unrecorded 12,7 mm (0.5 in) wide magnetic tape for information interchange — 32 ftpmm (800 ftpi) NRZ1, 126 ftpmm (3 200 ftpi) phase encoded and 356 ftpmm (9 042 ftpi) NRZ1

Traitement de l'information — Bande magnétique vierge de 12,7 mm (0,5 in) *de large, pour l'échange d'information* — 32 ftpmm (800 ftpi) *NRZ1,* 126 ftpmm (3 200 ftpi) *par codage de phase et* 356 ftpmm (9 042 ftpi) *NRZ1*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 1864 was prepared by Technical Committee ISO/TC 97, *Information processing systems*.

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1 Scope and field of application

This International Standard specifies the characteristics of 12,7 mm (0.5 in) wide magnetic tape with reel, to enable magnetic and mechanical interchangeability of such tape between information processing systems.

This International Standard applies solely to magnetic tape for digital recording using the NRZ1 method of recording at 32 and 356 ftpmm (800 and 9 042 ftpi) or the phase-encoded method of recording at 126 ftpmm (3 200 ftpi) in which the direction of magnetization is nominally longitudinal.

NOTE — Numeric values in the SI and/or Imperial measurement system in this International Standard may have been rounded off and therefore are consistent with, but not exactly equal to, each other. Either system may be used, but the two should be neither intermixed nor reconverted. The original design was made using the Imperial measurement system.

2 References

ISO/R 209, *Composition of wrought products of aluminium and aluminium alloys — Chemical composition (per cent).*

ISO 468, *Surface roughness — Parameters, their values and general rules for specifying requirements.*

ISO 1863, *Information processing — 9 track,* 12,7 mm (0.5 in) *wide magnetic tape for information interchange recorded at* 32 rpmm (800 rpi).

ISO 3788, *Information processing — 9 track,* 12,7 mm (0.5 in) *wide magnetic tape for information interchange recorded at* 63 rpmm (1 600 rpi) *phase encoded.*

ISO 5652, *Information processing — 9 track,* 12,7 mm (0.5 in) *wide magnetic tape for information interchange — Format and recording using group coding at* 246 cpmm (6 250 cpi).

ISO 6098, *Information processing — Self-loading cartridges for* 12,7 mm (0.5 in) *wide magnetic tapes.*

ASTM D 2000, *Rubber products in automotive applications, classification system for.*

3 Definitions

For the purpose of this International Standard, the following definitions apply.

3.1 magnetic tape : A tape that will accept and retain the magnetic signals intended for input, output and storage purposes on computers and associated equipment.

3.2 reference tape : A tape that has been selected for given properties for use in calibration.

3.3 secondary reference tape : A tape intended for routine calibrating purposes, whose performance is known and stated in relation to that of a reference tape.

3.4 signal amplitude reference tape : A reference tape selected as a standard for signal amplitude.

NOTE — A master standard tape has been established at the US National Bureau of Standards (NBS) for the physical recording densities 32 ftpmm (800 ftpi) and 126 ftpmm (3 200 ftpi). Secondary signal amplitude reference tapes are available from the NBS[1] under the part number SRM 3200.

A further master standard tape has been established at the NBS for the physical recording density of 356 ftpmm (9 042 ftpi). Secondary signal amplitude reference tapes are available from the NBS under the part number SRM 6250.

3.5 typical field : The minimum recording field which, when applied to a magnetic tape, causes a signal output equal to 95 % of the maximum signal amplitude at the specified physical recording density.

3.6 reference field : The typical field of the signal amplitude reference tape at the specified physical recording density.

3.7 standard reference amplitude : The average peak-to-peak signal amplitude derived from the signal amplitude reference tape on the NBS measurement system, or equivalent, under the recording conditions specified in 5.13.

3.8 reference edge : The edge furthest from an observer when the tape is lying flat with the magnetic surface uppermost and the direction of movement for recording is from left to right.

1) Office of Standard Reference Materials, Room B311, Chemistry Building, National Bureau of Standards (NBS), Gaithersburg, M.D. 20899, USA.

3.9 in contact : An operating condition in which the magnetic surface of a tape is in contact with a magnetic head.

3.10 track : A longitudinal area on a tape along which a series of magnetic signals may be recorded.

3.11 row : Nine transversely related locations (one in each track) in which bits are recorded.

3.12 position of flux transition : That point which exhibits the maximum free-space flux density normal to the tape surface.

3.13 physical recording density : The number of recorded flux transitions per unit length of track (ftpmm or ftpi).

3.14 data density : The number of data characters stored per unit length of tape (cpmm or cpi).

3.15 resistance per square : The surface resistance of a square area of any size measured between electrodes placed along two opposite sides of the square. The unit of measurement is the ohm.

3.16 oxide coating to brass and chrome : The resistance of the tape oxide coating to motion on brass (chrome).

3.17 oxide coating to tape back surface : The resistance of the tape oxide coating to motion on the tape back surface.

3.18 tape back surface to stainless steel : The resistance of the tape back surface to motion on stainless steel.

3.19 rubber to tape back surface : The resistance of the tape back surface to motion on rubber.

4 Environment

The conditions specified below refer to the ambient conditions in the test or computer room and not to those within the tape drive equipment.

4.1 Testing environment

Unless otherwise stated, all measurements made on a tape to check compliance with the requirements of this International Standard and all tests prescribed for a tape in the document shall be carried out under the environmental conditions of 23 ± 2 °C (73 ± 5 °F) and relative humidity 40 to 60 %, after at least 24 h of conditioning in the same environment.

4.2 Operating environment

The operating temperature shall be within the range 16 to 32 °C (60 to 90 °F) and the relative humidity 20 to 80 %. Operation near the extremes of these ranges may result in degraded performance. The wet bulb temperature shall not exceed 27 °C (80 °F).

4.3 Storage environment

During storage, it is recommended that the tapes are kept within the following conditions :

4.3.1 Unrecorded tape

temperature : 5 to 48 °C (40 to 120 °F)

relative humidity : 20 to 80 %

wet bulb temperature : not greater than 27 °C (80 °F)

4.3.2 Recorded tape

temperature : 5 to 32 °C (40 to 90 °F)

relative humidity : 20 to 80 %

wet bulb temperature : not greater than 26 °C (78 °F)

5 Characteristics of tape

5.1 Material

The tape shall consist of a base material (oriented polyethylene terephthalate film or its equivalent) coated on one side with a strong yet flexible layer of ferromagnetic material dispersed in a suitable binder. If the tape is also coated on the rear surface, the coating shall be non-ferromagnetic.

5.2 Width

The width of the tape shall be $12{,}7\ ^{0{,}0}_{-0{,}1}$ mm ($0.500\ ^{0.000}_{-0.004}$ in).

5.3 Total thickness of tape

The total thickness of the tape, at any point, shall be 0,048 ± 0,008 mm (0.001 9 ± 0.000 3 in).

5.4 Base material thickness

The thickness of the base material shall be 0,038 mm (0.001 5 in) nominal.

5.5 Coating thickness

The coating thickness shall not exceed 0,015 mm (0.000 6 in).

5.6 Length

The normal minimum length of tape is 732 m (2 400 ft) splice-free. If the length of the tape is less than 732 m (2 400 ft), the actual length shall be stated. Maximum tape length is limited by thickness, E value (see 5.7), moment of inertia and reel dimensions.

5.7 E value

The E value is the radial distance by which the reel flanges extend beyond the outermost layer of a tape which has been wound at a tension of 2 to 3,6 N (7 to 13 ozf) on the specified reel. The minimum E value shall be 3,2 mm (0.125 in).

NOTE — When used with a self-loading cartridge (see ISO 6098), the E value shall satisfy :

6,3 mm (0.25 in) < E < 15,9 mm (0.625 in)

5.8 Elastoplastic properties

The elastoplastic properties of the tape shall be such that when the tape is subjected to a tension of 30 N (108 ozf) for a period of 3 min under any combination of temperature and relative humidity within the ranges of 10 to 50 °C (50 to 122 °F) and 20 to 80 % relative humidity, the permanent elongation measured with negligible tension after a second 3 min interval is less than 1,0 %.

5.9 Longitudinal curvature

There shall be a minimum radius of curvature for the edge of the tape, defined and tested by allowing a 1 m (36 in) length of the tape to unroll and assume its natural curvature on a flat surface. The minimum radius shall be 33 m (108 ft). If measured over an arc of a circle, this corresponds to a deviation of 3,8 mm (1/8 in) from a 1 m (36 in) chord.

5.10 Tape wind

Tape shall be wound, with its magnetic surface toward the reel hub, in a clockwise direction; i.e. when the reel is viewed from the front, the loose end of the tape hangs from the right side of the reel. Tape shall be wound with a tension of 2 to 3,6 N (7 to 13 ozf) (see figure 2).

5.11 Magnetic properties

The magnetic properties of the tape are not defined here by B-H loops or similar parameters, but are defined by the testing procedures given in 5.13 and 5.16.

5.12 Test density

For the purpose of testing tape in accordance with this International Standard, the physical recording density shall be 32, 126 or 356 ftpmm (800, 3 200 or 9 042 ftpi). The flux transitions shall be uniformly spaced. The flux transition spacing and the track configuration shall conform to ISO 1863, ISO 3788 or ISO 5652 as appropriate.

5.13 Recording current

The ratio K between the recording current (I_r) and the current required to produce the reference field (I_f) at various physical recording densities shall be as follows :

$$\text{physical recording density} : K = \frac{I_r}{I_f}$$

For 32 ftpmm (800 ftpi) : 2,0 to 2,2

For 126 ftpmm (3 200 ftpi) : 1,75 to 1,85

For 356 ftpmm (9 042 ftpi) : 1,35 to 1,45

For the physical recording densities of 32 ftpmm (800 ftpi) and 126 ftpmm (3 200 ftpi), the typical field of the tape under test shall be within ± 20 % of the reference field; for the physical recording density of 356 ftpmm (9 042 ftpi), it shall be within ± 15 % of the reference field.

5.14 Average signal amplitude

The average signal amplitude shall be the average value of the peak-to-peak output voltage over at least 76 mm (3 in) of a tape that has been recorded under one of the conditions of 5.13 on all tracks.

When read back on a system, each channel of which has been calibrated by means of the reference track of a signal amplitude reference tape, the average signal amplitude shall be within ± 10 % of the standard reference amplitude at 32 ftpmm (800 ftpi), within − 10 + 25 % at 126 ftpmm (3 200 ftpi) and within ± 40 % at 356 ftpmm (9 042 ftpi).

NOTES

1 This test shall be conducted on the read-while-write pass for both tapes and in accordance with instructions issued with the Signal Amplitude Reference Tape.

2 It has been observed that the average signal amplitude level at 356 ftpmm (9 042 ftpi) can vary along the length of tape. This effect is termed "tilt" and is the subject of an investigation to determine its magnitude. Results indicate that a variation of 20 % can be expected. The effect of such variations is included in the specified tolerance on average signal amplitudes.

5.15 Ease of erasure

When a tape has been recorded according to any of the conditions specified in 5.13 and then passed through a longitudinal unidirectional steady field of 79 500 A/m (1 000 Oe), the remaining average signal amplitude shall not exceed 4 % of the standard reference amplitude for that density.

The field of erasure shall be reasonably uniform, such as that in the middle of a solenoid.

5.16 Test for missing pulses and extra pulses

These tests shall be carried out in the in contact condition and over the entire tested area, which shall extend from 0,2 m (8 in) before the BOT reflective marker to 3,0 m (10 ft) beyond the EOT reflective marker (see figure 1.)

When performing the tests in 5.16.1 and 5.16.2, the output or resultant signal shall be measured on the same relative pass for both the signal amplitude reference tape and the tape under test, i.e. read-while-write or read-on-first-pass-after-write. The standard reference amplitude shall be measured at the appropriate density.

5.16.1 Missing pulses

When a tape has been recorded on all tracks as specified in 5.12 and 5.13, and is played back on a system, each channel of which has been calibrated as in 5.14, a missing pulse shall be

a) at 32 ftpmm (800 ftpi) : Any signal from any track having a base-to-peak amplitude less than 50 % of half the standard reference amplitude;

b) at 126 ftpmm (3 200 ftpi) : Any pair of consecutive output pulses from any track together having a peak-to-peak amplitude less than 35 % of the standard reference amplitude;

c) at 356 ftpmm (9 042 ftpi) : Any signal from any track having a base-to-peak amplitude less than 35 % of half the standard reference amplitude.

5.16.2 Extra pulses

Following DC-erasure of the tape on the machine used for conducting the missing pulse test as described in 5.16.1, any signal from any track when measured base-to-peak which exceeds 10 % of half the standard reference amplitude shall be an extra pulse.

5.16.3 Allowable number of missing pulses and extra pulses

The allowable number of missing pulses and of extra pulses is not specified by this International Standard, but is a matter for agreement between interchange parties.

NOTE — It is considered impractical to specify this number for the following reasons :

a) the performance of test equipment for magnetic tape is not uniform but depends on such things as tape tension, head design, and the method of guidance employed;

b) different machines and systems of programming vary in their ability to tolerate missing and extra pulses on tapes.

5.17 Reflective markers

Each reel of tape shall be furnished with two photo-reflective markers, each consisting of, or equivalent to, a transparent plastic base with a metallic (for example, vaporized aluminium) coating sandwiched between the base and a thin layer of low cold flow thermal setting adhesive.

Reflective markers shall be placed on the side of the tape which does not carry the magnetic surface, and they shall be on opposite edges of the tape with the beginning-of-tape reflective marker (BOT) on the reference edge.

The width of the markers shall be 4,8 ± 0,5 mm (0.19 ± 0.02 in).

The length of the markers shall be 28 ± 5 mm (1.1 ± 0.2 in).

The thickness of the markers, measured after their application to the tape, shall be not greater than 0,020 mm (0.000 8 in).

The beginning-of-tape reflective marker (BOT) shall be placed 4,9 ± 0,6 m (16 ± 2 ft) from the beginning of the tape and the end-of-tape marker (EOT) shall be placed $7{,}6\ ^{+1{,}5}_{0{,}0}$ m ($25\ ^{+5}_{0}$ ft) from the end of the tape.

The distance from the outer edge of a marker to the adjacent edge of the tape shall be 0,8 mm max. (0.031 in max.) and the marker shall not protrude beyond the edge of the tape.

The markers shall be free of wrinkles and excessive adhesive.

NOTE — It is desirable that the thinnest markers be employed which perform satisfactorily in minimizing the distortion of the layers of tape adjacent to them.

5.18 Cupping

Cupping is the departure across the width of tape from a flat surface. The maximum cupping of a 6,35 mm (0.25 in) long length of tape shall not exceed 0,25 mm (0.010 in) when placed concave side down on a smooth, flat surface. The time between cutting and the measurement should be 1 h.

5.19 Opacity

Opacity is a characteristic which limits the amount of transmission of light through the tape. The opacity of tape shall not be less than 95 % over the range of wavelength from 0,4 to 1,5 µm (16 to 59 µin)

5.20 Resistance

The electrical resistance of the magnetic surface shall be within the range of 5×10^5 to 5×10^8 Ω/square.

5.21 Reflectivity

5.21.1 Marker reflectivity

The photo-reflective marker shall possess a reflectivity of at least 90 % compared to a reference standard, at a 60° angle of incidence of light and over the range of wavelengths from 0,4 to 1,5 µm (16 to 59 µin).

NOTE — The reference standard should be constructed from a piece of aluminium Al-Mg 1 Si Cu (see ISO/R 209) with a flat face dimension of 30 mm (1.2 in) by 5 mm (0.20 in) with a surface roughness R_a (arithmetical mean deviation) between 0,008 µm (0.32 µin) and 0,016 µm (0.63 µin) (see ISO 468). The standard should be resurfaced periodically to prevent a reflectivity shift due to oxidation.

5.21.2 Tape backing reflectivity

The tape backing shall possess a reflectivity not exceeding 30 % of that of the reference standard when measured under the conditions specified in 5.21.1.

5.22 Dynamic frictional characteristics

The force specified in 5.22.1.1, 5.22.2.1, 5.22.3.1 and 5.22.4.1 shall be the sum of the forces exerted by the 65 g (2.3 oz) mass and the dynamic friction.

5.22.1 Oxide coating to brass and chrome

5.22.1.1 Requirement

The force shall be 1,28 N max. (4.6 ozf max.).

5.22.1.2 Procedure

The sample shall be pulled at 50 mm (2 in) per minute over a brass (chrome) cylinder (90-degree wrap) of diameter 25 mm (1 in) with a 65 g (2.3 oz) mass on the other end of the tape. The force versus time (or force versus distance) shall be plotted. Particular attention should be given to keeping the samples clean and maintaining the brass (chrome) cylinder finish [0,13 to 0,26 µm (5 to 10 µin) peak-to-peak].

5.22.2 Oxide coating to tape back surface

5.22.2.1 Requirement

The force shall be 0,78 N min. (2.8 ozf min.).

5.22.2.2 Procedure

The oxide-coated surface of the sample shall be pulled at 50 mm (2 in) per minute over a cylinder (90-degree wrap) of diameter 25 mm (1 in) covered with one layer of the same tape, back surface up. A 65 g (2.3 oz) mass shall be suspended on the free end of the tape. The force versus time (or force versus distance) shall be plotted.

5.22.3 Tape back surface to stainless steel

5.22.3.1 Requirement

The force shall be a maximum of 0,83 N max. (3.0 ozf max.).

5.22.3.2 Procedure

The sample shall be pulled at 50 mm (2 in) per minute over a stainless steel cylinder (90-degree wrap) of diameter 25 mm (1 in) with a 65 g (2.3 oz) mass on the other end of the tape. The force versus time (or force versus distance) shall be plotted. Particular attention should be given to keeping the samples clean and maintaining the stainless steel cylinder finish [0,13 to 0,26 µm (5 to 10 µin) peak-to-peak].

5.22.4 Rubber to tape back surface

5.22.4.1 Requirement

The force shall be 0,78 N min. (2.8 ozf min.).

5.22.4.2 Procedure

The sample shall be pulled at 50 mm (2 in) per minute over a rubber-coated cylinder (90-degree wrap) with a 65 g (2.3 oz) mass on the other end of the tape.

The cylinder construction shall consist of a stainless steel inner cylinder 25 mm (1 in) in diameter and 18 mm (0.75 in) in length (a centre core convenient for mounting is optional) to which a 5 mm (0.2 in) coating of rubber is vulcanized. This rubber shall be type BG830, in accordance with ASTM D 2000.

The force versus time (or force versus distance) shall be plotted.

6 Reel

6.1 Description

In figure 3, a reel according to this International Standard is shown for illustrative purposes. The reel shall comprise a hub and two flanges. The front flange shall exhibit a circular relieved area. The rear flange shall exhibit a circular groove for a write-enable ring. All dimensions and tolerances specified apply both to empty reels and reels wound with tape.

6.2 Construction

6.2.1 Cross-section

Reels shall be constructed such, that any cross-section taken through the central axis of the reel conforms to the cross-section shown in figure 3. The ring groove may have a recess to accommodate the write-enable ring tab as an option. This recess shall not interfere with normal tape transport operation.

6.2.2 Symmetry of reel

Reels shall not be symmetrical, the flanges differing from each other as to the presence or absence of a relieved area or the write-enable ring groove, which shall be adjacent to the mounting pedestal for correct machine operation.

6.2.3 Hub and flanges

Hub and flanges need not be integral, but may be separate parts at the manufacturer's option as long as no relative movement between parts can occur and all requirements of this International Standard are met.

6.2.4 Outside surface of flanges

Bosses, ribs, or raised designs are permitted on the outside surface of the flanges, provided that they do not extend beyond the cross-hatched envelope of section A-A shown in figure 3.

6.3 Designation

The reel specified by this International Standard shall be designated by : Size 27.

6.4 Dimensions

6.4.1 Reference surface

The axial dimensions are referred to a reference surface U.

This reference surface U shall be used for reel mounting. It is a circular surface defined by diameters A and D on the rear flange (see 6.4.2 and 6.4.5.1).