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Information technology — 12,7 mm 128-track magnetic tape cartridge for information interchange — Parallel serpentine format

Technologies de l'information — Cartouches de bande magnétique de 12,7 mm, 128 pistes pour l'échange d'information — Format serpentant parallèle

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. 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 International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 117913 was prepared by ECMA (as ECMA-278) and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Annexes A, B, C and D form a normative part of this International Standard. Annexes E to G are for information only.

Information technology — 12,7 mm 128-track magnetic tape cartridge for information interchange — Parallel serpentine format

Section 1 - General

1 Scope

This International Standard specifies the physical and magnetic characteristics of a magnetic tape cartridge, using a magnetic tape 12,7 mm wide, so as to provide physical interchange of such cartridges between drives. It also specifies the quality of the recorded signals, the recording method and the recorded format known as Parallel Serpentine, thereby allowing data interchange between drives by means of such cartridges. The format supports variable length Logical Records, high speed search, and the use of the algorithm for data compression specified in International Standard ISO/IEC 15200.

Information interchange between systems also requires, at a minimum, agreement between the interchange parties upon the interchange code(s) and the specification of the structure and labelling of the information on the interchanged cartridge.

Together with a standard for volume and file structure, e.g. International Standard ISO 1001, this International Standard provides for full data interchange between data processing systems.

2 Conformance

2.1 Magnetic tape cartridge

A tape cartridge shall be in conformance with this International Standard if it meets all the mandatory requirements specified herein. The tape requirements shall be satisfied throughout the extent of the tape.

2.2 Generating system

A generating system shall be in conformance with this International Standard if it generates a tape according to 2.1.

2.3 Receiving system

A receiving system shall be in conformance with this International Standard if it can read all tapes according to 2.1.

3 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1001: 1986, *Information processing — File structure and labelling of magnetic tapes for information interchange*.

IEC 60950:1999, *Safety of information technology equipment.*

ISO/IEC 15200:1996, *Information technology— Adaptive Lossless Data Compression algorithm (ALDC).*

ISO/R 527:1966, *Plastics — Determination of tensile properties.*

ISO/IEC 646:1991, *Information technology — ISO 7-bit coded character set for information interchange.*

ISO 683-13:1986, *Heat-treatable steels, alloy steels and free-cutting steels — Part 13: Wrought stainless steels.*

ANSI MH10.8M-1993, *Materials Handling — Unit Loads and Transport Packages — Bar Code Symbols*.

4 Terms and definitions

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

4.1 algorithm: A set of rules for transforming the logical representation of data.

4.2 anhysteretic erase: A process of erasure utilising an alternating magnetic field of decaying level.

4.3 **average signal amplitude:** The average peak-to-peak value of the signal output measured over a minimum of 25,4 mm, exclusive of missing pulses.

4.4 **azimuth:** The angle, in minutes of arc, of the mean flux transition line of a track from a line normal to the tape Reference Edge.

4.5 **back surface:** The surface of the tape opposite the recording surface.

4.6 **beginning of partition (BOP):** The point along the length of the tape where recording in any partition begins.

4.7 **beginning of tape (BOT):** The point along the length of the magnetic tape, indicated by the start of recorded information.

4.8 **cartridge:** A container holding a single supply reel of magnetic tape with an attached leader block at the BOT end.

4.9 **cyclic redundancy check (CRC) character:** A four-byte character used for error detection.

4.10 **end of tape (EOT):** The point on a track farthest from BOT up to which recording is allowed.

4.11 **error-correcting code (ECC):** An algorithm yielding bytes used for error detection and correction.

4.12 **error-detecting code (EDC):** An algorithm yielding bytes used for error detection.

4.13 **File Mark:** A recorded element requested by a host that marks the end of a host data file or aggregate.

4.14 **flux transition position:** The point on the magnetic tape that exhibits the maximum free-space flux density normal to the tape surface.

4.15 **flux transition spacing:** The distance along a track between successive flux transitions.

4.16 **half-wrap:** A track group recorded in the physical forward or physical reverse direction.

4.17 **logical block:** User data or a File Mark that is received as input by the system or that is sent as output from the system.

4.18 **logical forward:** The direction of tape motion that results in finding an ascending order of device block identifiers.

4.19 **logical reverse:** The direction of tape motion that results in finding a descending order of device block identifiers.

4.20 **magnetic tape:** A tape that accepts and retains magnetic signals intended for input, output, and storage of data for information processing.

4.21 **mark tach count:** The value of the tach counter that exists at the starting point of an Interblock Gap prior to the first device block of a mark.

4.22 **Master Standard Reference Tape:** A tape selected as the standard for Reference Field, signal amplitude, resolution, and broad-band signal-to-noise ratio.

Note - A Master Standard Reference Tape has been established at Imation Corporation.

4.23 **physical recording density:** The number of recorded flux transitions per unit length of track expressed in flux transitions per millimetre (ftpmm).

4.24 **pre-record condition:** The condition of the magnetic tape in preparation for data recording that has been anhysteretically erased and subsequently servo written.

4.25 **recorded element:** A File Mark or a logical block.

4.26 **Reference Field:** The Typical Field of the Master Standard Reference Tape.

4.27 **resync character:** A control character identifying format resynchronisation points in a track. It is intended that read-back circuits be capable of resynchronising operations when such characters are sensed.

4.28 **SDM set:** The group of SDM marks delineated by the beginning and end SDM marks, containing any number of included middle SDM marks including zero middle SDM marks.

4.29 **Secondary Standard Reference Tape (SSRT):** A tape, the performance of which is known and stated in relation to that of the Master Standard Reference Tape.

Note - Secondary Standard Reference Tapes can be ordered from the Imation Corporation, 1 Imation Place, Oakdale, MN 55128-3414 under Part Number 84-9802-4185-9. In principle such tapes will be available for a period of 10 years from the publication of

this International Standard. However, by agreement between ECMA and Imation Corporation, this period may be shortened or extended to take account of demands for such SSRTs.

It is intended that these SSRTs be used for calibrating tertiary reference tapes for use in routine calibration.

4.30 **servo track:** A pre-recorded non-data track that is used by the drive to locate the data recording head at precise locations for recording data.

4.31 **Standard Reference Amplitude (SRA):** The average signal amplitude from the Master Standard Reference Tape when it is recorded with the Test Recording Current at 2 550 ftpmm. Traceability to the Standard Reference Amplitude is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

4.32 **Standard Reference Current (I_r):** The current that produces the Reference Field.

4.33 **Test Recording Current (I_m):** A current whose value is 1,5 times the Standard Reference Current (I_m = 1,5 x I_r).

4.34 **track:** A longitudinal area on the tape along which a series of magnetic signals can be recorded.

4.35 **track group:** The set of tracks recorded simultaneously.

4.36 **trailer:** Data appended to a data entity to provide identification and checking.

4.37 **Typical Field:** The minimum recording field which, when applied to a magnetic tape, will cause an average signal amplitude equal to 85 % of the maximum average signal amplitude at 2 550 ftpmm recording density.

4.38 **write equalisation:** An algorithm that linearly transforms an input binary sequence into another binary sequence.

5 Conventions and notations

5.1 Representation of numbers

The following conventions and notations apply in this International Standard, unless otherwise stated.

— A measured value is rounded off to the least significant digit of the corresponding specified value. It implies that a specified value of 1,26 with a positive tolerance +0,01, and a negative tolerance -0,02 allows a range of measured values from 1,235 to 1,275.

— In each block and in each field the bytes shall be arranged with Byte 0, the most significant, first. Within each byte the bits shall be arranged with Bit 0, the most significant, first and Bit 7, the least significant bit, last. This order applies to the data, and to the input and output of the error-detecting and error-correcting codes, and to the cyclic redundancy characters.

— Letters and digits in parentheses represent numbers in hexadecimal notation.

— The setting of bits is denoted by ZERO or ONE.

— Numbers in binary notation and bit patterns are represented by strings of digits 0 and 1 shown with the most significant bit to the left.

5.2 Dimensions

The dimensions in figures 1 to 3 are nominal dimensions. Unless otherwise stated, the dimensions in figures 4 to 21 are in millimetres with a tolerance of ± 50 mm.

5.3 Names

The names of basic elements, e.g. specific fields, are written with a capital initial letter.

5.4 Acronyms

BOP	Beginning of Partition
BOT	Beginning of Tape
BOW	Beginning of half-Wrap mark
BVCR	Beginning of Volume Control Region
CRC	Cyclic Redundancy Check character
DBM	Device Block Map
ECC	Error-Correcting Code
EDC	Error-Detecting Code

EEIU	ECC encoded interleave unit
ELEOP	Early Logical End of Partition
EOD	End of Data mark
EOP	End of Partition
EOT	End of Tape
EOV	End of Volume
EOW	End of half-Wrap mark
EVCR	End of Volume Control Region
FID	Format Identification
IBG	Interblock Gap
LEOP	Logical End of Partition
LP1	Logical Point 1
LP2	Logical Point 2
LP3	Logical Point 3
MIE	Minimum Interleave Element
MIU	Minimum Interleave Unit
MSRT	Master Standard Reference Tape
RLL	Run Length Limited
SAQ	Servo Acquisition Region
SARS	Statistical Analysis and Reporting
SDM	Servo Demark
SECC	Short Error Correction Code
SRA	Standard Reference Amplitude
SSRT	Secondary Standard Reference Tape
VCR	Volume Control Region

6 Environment and safety

Unless otherwise stated, the conditions specified below refer to the ambient conditions in the test or computer room and not to those within the tape drive.

6.1 Cartridge and tape testing environment

Unless otherwise stated, tests and measurements made on the cartridge and tape to check the requirements of this International Standard shall be carried out under the following conditions:

— temperature: 23 °C ± 2 °C
— relative humidity: 40 % to 60 %
— conditioning before testing: 24 h min.

6.2 Cartridge operating environment

Cartridges used for data interchange shall be capable of operating under the following conditions:

— temperature: 16 °C to 32 °C
— relative humidity: 20 % to 80 %
— wet bulb temperature: 26 °C max.

Note - Localised tape temperatures in excess of 48 °C may cause tape damage.

If during storage and/or transportation a cartridge has been exposed to conditions outside the above values, it shall be conditioned before use by exposure to the operating environment for a time equal to, or greater than, the time away from the operating environment up to a maximum of 24 h. There shall be no deposit of moisture on or in the cartridge.

6.3 Cartridge storage environment

Cartridges shall be stored under the following conditions:

— temperature: 5 °C to 32 °C
— relative humidity: 5 % to 80 %
— wet bulb temperature: 26 °C max.

The stray magnetic field at any point on the tape shall not exceed 4 000 A/m. There shall be no deposit of moisture on or in the cartridge.

6.4 Safety

6.4.1 Safeness

The cartridge and its components shall not constitute any safety or health hazard when used in the intended manner, or through any foreseeable misuse in an information processing system.

6.4.2 Flammability

The cartridge and its components shall be made from materials which, if ignited from a match flame, and when so ignited do not continue to burn in a still carbon dioxide atmosphere.

6.5 Transportation

This International Standard does not specify parameters for the environment in which cartridges should be transported. Annex E gives some recommendations for transportation.

Section 2 - Requirements for the unrecorded tape

7 Mechanical and electrical requirements

7.1 Material

The tape shall consist of a base material (oriented polyethylene terephthalate film or its equivalent) coated on one surface with a strong yet flexible layer of ferromagnetic material dispersed in a suitable binder. The other surface of the tape may be coated to enhance electrical conduction, tape handling and mechanical properties.

7.2 Tape length

The length of the tape shall be 320 m ± 5 m.

7.3 Width

The width of the tape shall be 12,650 mm ± 0,025 mm.

The width shall be measured across the tape from edge to edge when the tape is under a tension of less than 0,28 N.

7.4 Total thickness

The total thickness of the magnetic tape at any point shall be 17,0 µm ± 1,0 µm.

7.5 Base material thickness

The thickness of the base material shall be 14,2 µm ± 0,7 µm.

7.6 Discontinuity

There shall be no discontinuities in the tape such as those produced by tape splicing or perforations.

7.7 Longitudinal curvature

The longitudinal curvature is measured as the departure of the Reference Edge of the tape from a straight line along the longitudinal dimension of the tape in the plane of the tape surface.

7.7.1 Requirement

The radius of curvature of the edge of the tape shall be greater than 33,75 m.

7.7.2 Procedure

Allow a 1 m length of tape to unroll and measure its natural curvature on a flat, smooth surface. Measure the deviation from a 1 m chord. The deviation shall not be greater than 3,0 mm within a span of 900 mm. This corresponds to the minimum radius of curvature of 33,75 m when measured over an arc of circle.

7.8 Out-of-Plane distortions

Out-of-plane distortions are local deformations which cause portions of the tape to deviate from the plane of the surface of the tape. Out-of-plane distortions are most readily observed when the tape is lying on a flat surface under no tension.

There shall be no visual evidence of out-of-plane distortion when the tape is subjected to a uniform tension of 0,4 N.

7.9 Cupping

Cupping is the departure across the width of the tape (transverse to motion) from a flat surface.

7.9.1 Requirement

There shall be no cupping toward the recording surface of the tape. Cupping away from the recording surface shall be 0,4 mm max.

7.9.2 Procedure

i. Cut a tape sample at least 1,0 m in length.

ii. Condition the sample by hanging it so that the coated surface is freely exposed to the test environment for a minimum of 3 h.

iii. From the centre portion of the tape, cut a sample 0,5 m ± 0,1 m in length.

iv. Install the tape sample on a fixture that uses a clamping bar to hold one end of the sample and a 3,5 g tensioning weight to pull the other end of the tape sample across a roller. There shall be a minimum distance of 200 mm between the roller and the clam.

v. Place the fixture on a 40X microscope stage so that the centre of the fixture is under the microscope. Adjust the microscope to focus on the first edge of the tape, and record the vertical positioning of the focusing adjustment. The microscope focusing adjustment shall be known to 1 µm.

vi. While positioning the tape laterally under the microscope, use the focusing adjustment to find the point of maximum departure of the tape surface from the reference edge height. Note the vertical height and determine the difference between the first reference of step v and the departed surface height.

vii. Move the tape under the microscope to view the other reference edge. Adjust the microscope focus and note the focused vertical scope position.

viii. Calculate cupping as the average of the height departures from the two reference edges determined in steps vi and vii. No individual measurement shall exceed the allowed maximum.

7.10 Coefficient of dynamic friction

The dynamic friction between the recording surface and the back surface is the resistance to motion between the recording surface and the back surface of the tape.

7.10.1 Requirements

The coefficient of dynamic friction between the magnetic surface and the back surface shall be greater than 0,28.

7.10.2 Procedure

i. Wrap a first piece of tape around a cylinder of diameter 25,4 mm and wrap it with a total wrap angle of more than 90 ° with the back surface outwards.

ii. Wrap a second test piece, with the magnetic surface inwards, around the first test piece with a total wrap angle of 90 °.

iii. Exert on one end of the outer test piece a force of F_1 = 0,64 N.

iv. Attach the other end to a force gauge mounted on a linear slide.

v. Drive the slide at a speed of 1 mm/s, measure the force F_2 required.

vi. Calculate the coefficient of dynamic friction γ from the equation

$$\gamma = \frac{1}{\phi} \times \ln\left(\frac{F_2}{F_1}\right)$$

where ϕ is the value of the wrap angle in radians.

7.11 Coating adhesion

The force required to peel any part of the coating from the tape base material shall not be less than 0,44 N.

Procedure

i. Take a test piece of the tape approximately 380 mm long and scribe a line through the recording coating across the width of the tape 125 mm from one end.

ii. Using a double-sided pressure sensitive tape, attach the full width of the test piece to a smooth metal plate, with the magnetic coating (recording surface) facing the plate, as shown in figure 1.

iii. Fold the test piece over 180 °, adjacent to, and parallel with, the scribed line. Attach the metal plate and the free end of the test piece to the jaws of a universal testing machine and set the speed of the jaw separation to 254 mm per min.

iv. Note the force at which any part of the coating first separates from the base material. If this is less than 0,44 N, the tape has failed the test. If the test piece peels away from the double-sided pressure sensitive tape before the force exceeds 0,44 N, an alternative type of double-sided pressure sensitive tape shall be used.

v. Repeat i to iv for the back coating, if any.

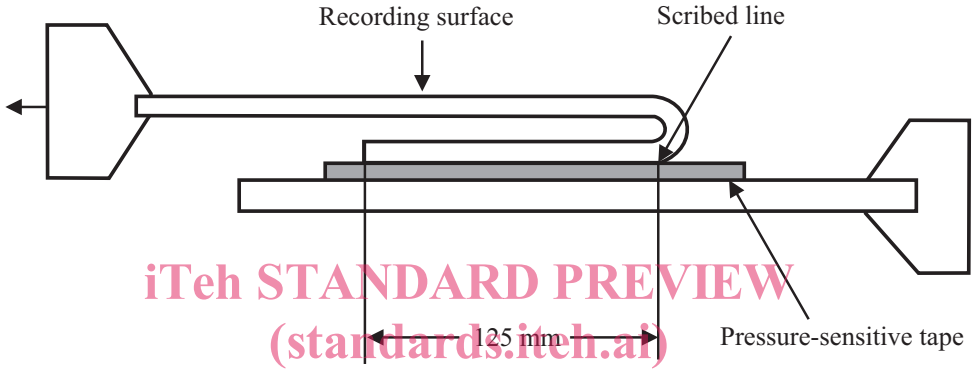

Figure 1 - Measurement of the coating adhesion

7.12 Layer-to-layer adhesion

Layer-to-layer adhesion refers to the tendency of a layer, when held in close proximity to the adjacent layer, to bond itself to an adjacent layer so that free and smooth separation of the layers is difficult.

7.12.1 Requirements

There shall be no evidence of delamination or other damage to the coatings.

7.12.2 Procedure

i. Fasten one end of a 914 mm length of tape, magnetic coating inwards, to a horizontally mounted stainless steel cylinder with a low cold-flow adhesive material.

ii. The dimensions of the cylinder shall be:

- diameter: 12,7 mm
- length: 102 mm

iii. Attach a mass of 1 000 g to the opposite end of the tape.

iv. Attach, 25,4 mm above the mass, a narrow strip of double-sided adhesive tape to the magnetic coating.

v. Slowly rotate the cylinder, so that the tape winds uniformly around it into a compact and even roll. The double-sided tape secures the end and prevents unwinding when the mass is removed.

vi. The cylinder with the tape shall then be exposed to the following temperature and humidity cycle:

Time	Temperature	RH
16 h to 18 h	54 °C	85 %
4 h	54 °C	10 % or less
1 h to 2 h	21 °C	45 %