Contents

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. 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.

International Standard ISO/IEC 14840 was prepared by ECMA (as Standard ECMA-210) 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 to D, F, G, J, M and N form an integral part of this International Standard. Annexes E, H, K, L and P are for information only.

Information technology - 12,65 mm wide magnetic tape cartridge for information interchange - Helical scan recording - Data-D3-1 format

Section 1 - General

1 Scope

This International Standard specifies the physical and magnetic characteristics of a magnetic tape cartridge, using magnetic tape 12,65 mm wide, so as to provide physical interchangeability of such cartridges. It also specifies the quality of the recorded signals, the recording method and the recorded format, thereby allowing data interchange between drives by means of such magnetic tape cartridges.

This International Standard specifies three types of cartridge which, for the purposes of this International Standard, are referred to as Type A, Type B and Type C.

For Type A, the magnetic tape has a nominal length of 91 m and a nominal capacity of 10 GBytes.

For Type B, the magnetic tape has a nominal length of 204 m and a nominal capacity of 25 GBytes.

For Type C, the magnetic tape has a nominal length of 392 m and a nominal capacity of 50 GBytes.

Together with a Standard for Volume and File Structure this International Standard provides for full data interchange between data processing systems.

2 Conformance

2.1 Magnetic tape cartridge

A claim of conformance with this International Standard shall specify the Type of the cartridge. It shall be in conformance with this International Standard if

- the cartridge meets all the requirements of clause 4 and clauses 7 to 10
- the recording on the tape meets the requirements of clauses 11 to 16
- for each recorded Packet the algorithm used for processing the data therein, if the recorded data has been processed, has been registered and the registered identification is included in Byte 13 of the Packet ID of this Packet (see 11.2.2)

2.2 Generating system

A system generating a magnetic tape cartridge for interchange shall be entitled to claim conformance with this International Standard if all the recordings that it makes, on all three Types of cartridge, meet the mandatory requirements of this International Standard. A claim of conformance shall state whether or not one, or more, registered algorithm(s) is (are) implemented and, if so, the registered number(s) of (all) the implemented algorithm(s).

2.3 Receiving system

A system receiving a magnetic tape cartridge for interchange shall be entitled to claim conformance with this Standard if it is able to handle any recording made on the tape according to this International Standard, and for all three Types.

A claim of conformance shall state whether or not one, or more, registered algorithm(s) is (are) implemented and, if so, the registered number(s) of (all) the implemented algorithm(s).

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 1001:1986	*Information processing - File structure and labelling of magnetic tapes for information interchange.*
ISO 1302:1992	*Technical drawings - Method of indicating surface texture.*
ISO 683-13:1986	*Heat-treatable steels, alloy steels and free-cutting steels - Part 13: Wrought stainless steels.*
ISO/IEC 11576:1994	*Information technology - Procedure for the registration of algorithms for the lossless compression of data.*
IEC 950:1995	*Safety of information technology equipment, including electrical business equipment.*

4 Definitions

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

4.1 **a.c. erase:** A process of erasure utilizing alternating magnetic fields of decaying intensity.

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

4.3 **Average** Signal Amplitude: The average peak-to-peak value of the signal output of a read head measured over a minimum of 3 000 flux transitions, exclusive of missing pulses.

4.4 **azimuth:** The angular deviation, in degrees of arc, of the recorded flux transitions on a track from the line normal to the track centreline.

4.5 **back surface:** The surface of the tape opposite to the magnetic coating used to record data.

4.6 **Beginning of Tape (BOT):** The point along the tape indicated by the start of the density identification burst.

4.7 **Beginning of Tape Sense Slot:** A slot on the centreline of the tape indicating the beginning of usable tape.

4.8 **byte:** An ordered set of 8 bits acted upon as a unit.

4.9 **cartridge:** A case containing a single reel of magnetic tape with a leader attached at the BOT end.

4.10 **character:** A unit of information represented by one or more bytes.

4.11 **Codeword Digital Sum (CDS):** The value of the Digital Sum Variation (DSV) taken over a single 14-bit pattern.

4.12 **Cyclic Redundancy Check (CRC) Character:** Two bytes derived from information contained in the data bytes, pad bytes and other bytes.

4.13 **Data Area Reference Point:** The physical position of the start of the first Outer ECC Sync Block of a positive azimuth helical track.

4.14 **Data Records**

4.14.1 **Logical Data Record (LDR):** The data entity received by the generating system from the host. It may consist of one, or several, Host Data Record(s) depending upon the action taken by the host to use extended blocks.

4.14.2 **Processed Data Record (PDR):** The data entity resulting from the application of an algorithm to an LDR.

4.14.3 **User Data Record (UDR):** The data entity available to the Packet generator. When the data has been processed it is a PDR. When the data has not been processed it is an LDR.

4.15 **Digital Sum Variation (DSV)**

The integrated value of Channel Bits, taken from the point at which byte translation commences, i.e. at the start of each helical track, and counting a ONE as +1 and a ZERO as -1.

4.16 End of Tape (EOT): The point towards the hub end of the tape beyond which no recording shall be made.

4.17 End of Tape Sense Slot: A slot on the centreline of the tape indicating the end of usable tape.

4.18 Error Correcting Code (ECC): A mathematical procedure yielding bits used for the detection and correction of errors.

4.19 File safe: The designation for a tape that allows data to be appended to data that has already been written, but which prevents such previously written data from being overwritten.

4.20 Fixed Scan Group Header: A header which is not changed when the Scan Group is rewritten.

4.21 flux transition position: That point along a track that exhibits the maximum free-space flux density normal to the tape surface.

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

4.23 Helical Time Code (HTC): A time code added to a Scan Group, recorded in the helical tracks and used to ensure that a particular Scan Group Pair can be located if the longitudinal Time Code has been lost.

4.24 Internal Leader Header (ILH): A pair of Scan Groups containing volume information.

4.25 Logical Block Number: A count of the number of blocks of data transferred from the host to the tape system and the number of Tape Marks requested by the host.

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

4.27 Master Standard Reference Tape: A tape selected as the standard for Reference Field, Signal Amplitude and Resolution.

Note 1 - The Master Standard Reference Tape has been established at Pericomp Corporation.

4.28 Packet: A UDR with a Packet Identifier and a Packet Trailer added.

4.29 Packet Identifier: The group of 32 bytes added to the beginning of a UDR when forming a Packet.

4.30 Packet Trailer: The group of bytes of variable size appended to a UDR when forming a Packet.

4.31 physical recording density: The number of recorded flux transitions per unit length of track, specified as flux transitions per millimetre (ftpmm).

4.32 Postamble: A sequence of 8-bit bytes at the end of a logical helical track.

4.33 Preamble: A sequence of 8-bit bytes at the beginning of a logical helical track.

4.34 processed data: Data which has been processed by an algorithm.

4.35 Reference Fields: The Typical Field of the Master Standard Reference Tape. There are three Reference Fields, RF1, RF2 and RF3.

4.36 resolution: The ratio of the average signal amplitude at a high physical recording density to that at a lower physical recording density.

4.37 Scan Group: A set of 6 contiguously recorded helical tracks.

4.38 Scan Group Pair: Two contiguous Scan Groups, the first of which is even-numbered and the second is odd-numbered.

4.39 Scan Group Start Data (SGSD): A series of bytes defining the start of a Scan Group.

4.40 Secondary Standard Reference Tape: A tape the performance of which is known and stated in relation to that of the Master Standard Reference Tape.

Secondary Standard Reference Tapes can be ordered under Part Number #SMRT/Rdwd-PC95, until the year 2006, from Pericomp Corporation, 14 Huron Drive, Natick, MA 01760, USA.

Telephone: +1-508 655 7660
Facsimile: +1-508 653 9288

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

4.41 Standard Reference Amplitudes (SRA): The Average Signal Amplitude derived from the Master Standard Reference Tape when using the appropriate Test Recording Current and the appropriate recording density.

There are three SRAs:

SRA1 is derived from a helically recorded track, recorded at 2 597 ftpmm with TRC1.

SRA2 is derived from the Servo Control Track, recorded at 2,146 ftpmm with TRC2.
SRA3 is derived from the Time Code Track, recorded at 57,2 ftpmm with TRC3.

Traceability to the SRAs is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

4.42 Standard Reference Currents (Ir): The current that produces the Reference Field.

There are three Standard Reference Currents:

Ir1 is the current producing RF1 on a helically recorded track.
Ir2 is the current producing RF2 on the Servo Control Track.
Ir3 is the current producing RF3 on the Time Code Track.

4.43 Tape Reference Edge: The lower edge of the tape when viewing the recording surface of the tape with the supply reel to the observer's right.

4.44 Test Recording Currents (Technical Report): The recording current used to record an SRA.

There are three Test Recording Currents:

TRC1 is 1,7 times Ir1
TRC2 is 2,3 times Ir2
TRC3 is 2,3 times Ir3

4.45 track: A narrow, defined area on the tape along which a series of magnetic transitions may be recorded. A track may be parallel to the Tape Reference Edge or positioned at an angle to it.

4.46 track angle: The angle between the centreline of a helically recorded track and the Tape Reference Edge.

4.47 Typical Field (TF): In the plot of Average Signal Amplitude against the Recording Field at a specified physical recording density, the minimum field that causes an Average Signal Amplitude equal to a specified percentage of the maximum Average Signal Amplitude.

There are three TFs:

TF1 is the field giving an Average Signal Amplitude equal to 90% of the maximum Average Signal Amplitude at the Physical Recording Density of 2 597 ftpmm on a helically recorded track.

TF2 is the field giving an Average Signal Amplitude equal to 90% of the maximum Average Signal Amplitude at the Physical Recording Density of 2,146 ftpmm on the Servo Control Track.

TF3 is the field giving an Average Signal Amplitude equal to 90% of the maximum Average Signal Amplitude at the Physical Recording Density of 57,2 ftpmm on the Time Control Track.

4.48 Variable Scan Group Header: A header which changes when the Scan Group is rewritten.

4.49 zero crossing: A point at which the amplitude of the read signal passes through zero.

5 Conventions and Notations

5.1 Representation of numbers

- 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 of +0,01, and a negative tolerance of -0,02 allows a range of measured values from 1,235 to 1,275.
- Letters and digits in parentheses represent numbers in hexadecimal notation.
- The setting of a bit is denoted by ZERO or ONE.
- Numbers in binary notation and bit combinations are represented by strings of ZEROs and ONEs.
- Numbers in binary notation and bit combinations are shown with the most significant byte to the left, and with the most significant bit in each byte to the left.
- Negative values of numbers in binary notation are given in TWO's complement.
- In each field the data is processed so that the most significant byte (byte 0) is processed first. Within each byte the least significant bit is numbered 0 and is processed last, the most significant bit (numbered 7 in an 8-bit byte) is processed first.

This order of processing applies also to the data input to the Error Detection and Correction circuits and to their output, unless otherwise stated.

5.2 Names

The names of entities, e.g. specific tracks, fields, etc., are given with a capital initial.

6 Acronyms

ASA	Average Signal Amplitude
BOT	Beginning of Tape
CDS	Codeword Digital Sum
CRC	Cyclic Redundancy Check
DID	Density Identification
DSV	Digital Sum Variation
ECC	Error Correcting Code
EOT	End of Tape
HTC	Helical Time Code
ILH	Internal Leader Header
LDR	Logical Data Record
PDR	Processed Data Record
PEOT	Physical End Of Tape
SGSD	Scan Group Start Data
SEP	Separator
SRA	Standard Reference Amplitude
TF	Typical Field
TRC	Test Recording Current
UDR	User Data Record

7 Environment and Safety

The conditions specified below refer to the ambient conditions immediately surrounding the cartridge.

Cartridges exposed to environments outside these limits may still be able to function usefully; however, such exposure may cause permanent damage.

7.1 Testing environment

Unless otherwise specified, tests and measurements made on the cartridge 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 period before testing	: 24 h

7.2 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	: 25°C max.

The average temperature of the air immediately surrounding the tape shall not exceed 45°C.

Conditioning before operating: If a cartridge has been exposed during storage and/or transportation to conditions outside the above values, it shall be conditioned for a period of at least 24 h.

7.3 Storage environment

For long-term or archival storage the following conditions shall be observed

temperature	: 5°C to 32°C
relative humidity	: 40 % to 60 %

stray magnetic field : shall not exceed 4 000 A/m at any point on the tape

There shall be no deposit of moisture on or in the cartridge.

7.4 Transportation

Recommended limits for the environments to which a cartridge may be subjected during transportation, and the precautions to be taken to minimize the possibility of damage, are provided in annex K.

7.5 Safety

The cartridge shall satisfy the safety requirements of ECMA-129 when used in the intended manner or in any foreseeable use in an information processing system.

7.6 Flammability

The cartridge shall be made from materials that comply with the flammability class for HB materials, or better, as specified in ECMA-129.

Section 2 - Requirements for the Cartridge

8 Dimensional and Mechanical Characteristics of the Cartridge

8.1 Elements of the cartridge

The cartridge shall consist of the following elements:

- a case
- recognition notches
- a write inhibit mechanism
- a reel for magnetic tape
- a locking mechanism for the reel
- a magnetic tape wound on the hub of the reel
- a leader block
- a latching mechanism for the leader block

Dimensional characteristics are specified for those parameters deemed to be mandatory for interchange and compatible use of the cartridge. Where there is freedom of design, only the functional characteristics of the elements described are indicated. In the figures a typical implementation is represented in third angle projection.

Figure 1 is a general view of the cartridge
Figure 2 illustrates the Reference Planes
Figure 3 shows the front side of the case, which lies in Plane Z
Figure 4 shows the top side of the case
Figure 5 shows the rear side of the case
Figure 6 shows the left side of the case, which lies in Plane Y
Figure 7 is Section A-A of figure 4
Figure 8 is Section B-B of figure 3
Figure 9 shows the bottom side of the case, which lies in Plane X
Figure 10 shows the right side of the case
Figure 11 is Detail C of figure 10
Figure 12 is a cross-section of the hub and brake assembly with the cartridge held in the hand
Figure 13 is a cross-section of the hub and brake assembly with the cartridge in the drive
Figure 14 shows a view of the teeth of the locking mechanism
Figure 15 is Detail W of figure 13
Figures 16 to 24 show details of the leader block

8.2 Reference Planes of the case (figure 2)

Where they are purely descriptive, the dimensions are referenced to three orthogonal References Planes - X, Y and Z. Where the dimensions are related to the position of the cartridge mounted in the drive, they may be referenced to another plane of the cartridge, Plane P.

Plane X is defined by three circular locating areas, X_1, X_2 and X_3, in the bottom side of the case. Plane Y is perpendicular to Plane X and is determined by two reference points, Y_1 and Y_2, on the left hand side of the case. Plane Z is perpendicular to Plane X; reference point Z_1 shall lie in Plane Z.

8.3 Dimensions of the case

The dimensions of the case shall be measured in the Test Environment. The dimensions of the case in any operating environment can be estimated from the dimensions specified in this clause.

8.3.1 Overall dimensions (figures 3, 4 and 5)

The total length of the case shall be

$l_1 = 125{,}00 \text{ mm} \pm 0{,}32 \text{ mm}$

The width of the case shall be

$l_2 = 109{,}00 \text{ mm} \pm 0{,}32 \text{ mm}$

The distance from the top of the case to Reference Plane X shall be

$l_3 = 24{,}50 \text{ mm} \pm 0{,}41 \text{ mm}$