INTERNATIONAL STANDARD

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Information technology — 3,81 mm wide magnetic tape cartridge for information interchange — Helical scan recording — DDS-4 format

Technologies de l'information — Cartouche à bande magnétique de 3,81 mm de large pour l'échange d'information — Enregistrement par balayage en spirale — Format DDS-4

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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.

This International Standard was prepared by collaboration between the JISC and the ECMA Standard Bodies (as Standard JIS X 6137 and ECMA-288) 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, D, E, F, G, H and J form a normative part of this International Standard. Annexes K, L, M, N and P are for information only.

Information technology – 3,81 mm wide magnetic tape cartridge for information interchange - Helical scan recording - DDS-4 format

Section 1 - General

1 Scope

This International Standard specifies the physical and magnetic characteristics of a 3,81 mm wide magnetic tape cartridge to enable physical interchangeability of such cartridges between drives. It also specifies the quality of the recorded signals, the recording method and the recorded format - called Digital Data Storage 4 (DDS-4) - thereby allowing data interchange between drives by means of such magnetic tape cartridges.

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

Under information interchange circumstances in which a processing algorithm, e.g. for lossless data compression as specified in ISO/IEC 11558, is applied to the host data prior to recording on the tape and a complementary reprocessing algorithm is applied after the data is read from the tape, agreement upon these by the interchange parties is also required.

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.

For each recorded Entity any algorithm for lossless data compression used for processing the data therein shall have been registered, and according to ISO/IEC 11576 the corresponding numerical identifier shall be recorded in Byte No. 3 of the Entity Header.

2.2 Generating drive

A drive generating a magnetic tape cartridge for interchange shall be in conformance with this International Standard if all recordings on the tape meet the mandatory requirements of this International Standard, and if either or both methods of appending and overwriting are implemented.

A claim of conformance shall state which of the following optional features are implemented and which are not

— the performing of a Read-After-Write check and the recording of any necessary repeated frames;
— the generation of ECC3 Frames.

In addition a claim of conformance shall state

— whether or not one, or more, registered algorithm(s) are implemented within the system and are able to process data received from the host prior to collecting the data into Basic Groups, and
— the algorithm registration identification number(s) of the implemented algorithm(s).

2.3 Receiving drive

A drive receiving a magnetic tape cartridge for interchange shall be in conformance with this International Standard if it is able to handle any recording made on the tape according to this International Standard. In particular it shall

— be able to recognize repeated frames and to make available to the host, data and Separator Marks from only one of these frames;
— be able to recognize an ECC3 frame, and ignore it if the system is not capable of using ECC3 check bytes in a process of error correction;
— be able to recognize processed data within an Entity, identify the algorithm used, and make the algorithm registration number available to the host;
— be able to make processed data available to the host.

In addition a claim of conformance shall state

— whether or not the system is capable of using ECC3 check bytes in a process of error correction;
— whether or not one or more reprocessing algorithm(s) are implemented within the system, and are able to be applied to processed data prior to making such data available to the host;

— the algorithm registration number(s) of the processing algorithm(s) for which a complementary reprocessing algorithm is implemented.

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 527-1:1993	*Plastics - Determination of tensile properties - Part 1: General principles.*
ISO 1302:1992	*Technical drawings - Method of indicating surface texture.*
ISO/IEC 11576:1994	*Information technology - Procedure for the registration of algorithms for the lossless compression of data.*
IEC 60950:1996	*Safety of information technology equipment.*

4 Definitions

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

4.1 Absolute Frame Number (AFN): A sequence number, encoded in the Frame.

4.2 a.c. erase: A process of erasure utilising magnetic fields of decaying intensity.

4.3 Access Point: A point, at the start of a Processed Record Sequence, at which the presentation of Codewords to a reprocessing algorithm is required to start, regardless of whether the data of interest in a retrieval operation starts at that point or at a subsequent point.

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

4.5 Area ID: An identifier defining the area of the tape and specifying the types of Frame written.

4.6 Average Signal Amplitude: The average peak-to-peak value of the output signal from the read head at the fundamental frequency of the specified physical recording density over a minimum of 7,8 mm of track, exclusive of missing pulses.

4.7 azimuth: The angle, in degrees, minutes and seconds of arc, made by the mean flux transition line with a line normal to the centreline of the recorded track.

4.8 back surface: The surface of the tape opposite to the magnetic coating which is used to record data.

4.9 byte: An ordered set of bits acted upon as a unit.

4.10 cartridge: A case containing a magnetic tape wound on twin hubs.

4.11 Channel bit: A bit after 8-10 transformation.

4.12 Codeword: A word which is generated by a processing algorithm.

4.13 Data Format ID: An identifier specifying which data format is being used on the tape.

4.14 Early Warning Point (EWP): A point along the length of the tape at which warning is given of the approach, in the forward direction of tape motion, of the Partition Boundary or of the Physical End of Tape.

4.15 End of Data (EOD): The point on the tape at the end of the group which contains the last user data.

4.16 Entity: A unit of recorded data, comprising an Entity header and a Processed Record Sequence.

4.17 Error Correcting Code (ECC): A mathematical computation yielding check bytes used for the detection and correction of errors.

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

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

4.20 Fragment: A collection of bytes acted upon as a unit for recording, read back and error correction purposes.

4.21 **Frame:** A pair of adjacent tracks with azimuths of opposite polarity, in which the track with the positive azimuth is recorded first.

4.22 **Housekeeping Frame:** A Frame which contains no user data and which is identified as such by the values in the data fields therein.

4.23 **Logical Beginning of Tape (LBOT):** The point along the length of the tape where a recording of data for interchange commences.

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

4.25 **Master Standard Amplitude Calibration Tape:** A pre-recorded tape on which the standard signal amplitudes have been recorded in the tracks of positive azimuth, 21,0 µm wide, recorded at a track pitch of 27,2 µm, on an a.c. erased tape.

Note 1 - The tape is recorded with the nominal physical recording densities of 4 499,8 ftpmm, 2 999,9 ftpmm, 1 999,9 ftpmm and 1 499,9 ftpmm.

Note 2 - The Master Standard Amplitude Calibration Tape has been established by Sony Corporation.

4.26 **Master Standard Reference Tape:** A tape selected as the standard for Reference Recording Field, Signal Amplitude, Resolution, Overwrite and Signal-to-Noise Ratio.

Note - The Master Standard Reference Tape has been established by Sony Corporation

4.27 **Optimum Recording Field:** In the plot of Average Signal Amplitude against the recording field at the physical recording density of 2 999,9 ftpmm, the field that causes the maximum Average Signal Amplitude.

4.28 **Partition Boundary:** The point along the length of a magnetic tape at which partition 1 ends and partition 0 commences.

4.29 **Physical Beginning of Tape (PBOT):** The point where the leader tape is joined to the magnetic tape.

4.30 **Physical End of Tape (PEOT):** The point where the trailer tape is joined to the magnetic tape.

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

4.32 **pre-recording condition:** The recording levels above which a tape intended for interchange shall not previously have been recorded.

4.33 **processing:** The use of an algorithm to transform host data into Codewords.

4.34 **processed data:** A sequence of Codewords which results from the application of processing to data.

4.35 **Processed Record:** A sequence of Codewords which results from the application of processing to an Unprocessed Record.

4.36 **Processed Record Sequence:** A sequence of one or more Processed Records which starts on an 8-bit boundary and ends on a subsequent 8-bit boundary.

4.37 **record:** Related data treated as a unit of information.

4.38 **Reference Recording Field:** The Optimum Recording Field of the Master Standard Reference Tape.

4.39 **reprocessing:** The use of an algorithm to transform Codewords into data as required by the host.

4.40 **Secondary Standard Amplitude Calibration Tape:** A tape pre-recorded as defined for the Master Standard Amplitude Calibration Tape; the outputs are known and stated in relation to those of the Master Standard Amplitude Calibration Tape.

Note - Secondary Standard Amplitude Calibration Tapes can be ordered from Sony Corporation, 6-7-35, Kitashinagawa, Shinagawa-ku, Tokyo, 141-0001, Japan, under Part Number TY 10000 G. It is intended that these tapes be used for calibrating tertiary reference tapes for use in routine calibration.

In principle, these Secondary Standard Amplitude Calibration Tapes will be available for a period of ten years from the first publication of this International Standard. However, this period may be changed to take into account the demand for such Secondary Standard Amplitude Calibration Tapes.

4.41 **Secondary Standard Reference Tape:** 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 Sony Corporation, 6-7-35, Kitashinagawa, Shinagawa-ku, Tokyo, 141-0001, Japan, under Part Number RSD 1098. It is intended that these tapes be used for calibrating tertiary reference tapes for use in routine calibration.

In principle, these Secondary Standard Reference Tapes will be available for a period of ten years from the first publication of this International Standard. However, by agreement between ISO/IEC and Sony Corporation, this period may be changed to take into account the demand for such Secondary Standard Reference Tapes.

4.42 **Separator Mark:** A record containing no user data, which is used to separate data.

4.43 **Standard Reference Amplitude:** The Average Signal Amplitude from the tracks of positive azimuth of the Master Standard Amplitude Calibration Tape at a specified physical recording density.

4.44 **Tape Reference Edge:** The bottom edge of the tape when viewing the recording side of the tape, with the PEOT to the observer's right.

4.45 **Test Recording Current:** The current that produces the Reference Recording Field.

4.46 **track:** A diagonally positioned area on the tape along which a series of magnetic signals may be recorded.

4.47 **Unprocessed Record:** A record of unprocessed data, comprising an integral number of bytes.

4.48 **Virtual End of Tape (VEOT):** The point along the length of the magnetic tape within partition 1 which defines the end of the part of partition 1 which is usable for recording data for interchange.

5 Conventions and Notations

A measured value is rounded off to the least significant digit of the corresponding specified value. This implies that, for example, 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.

The setting of a bit is denoted by ZERO or ONE.

Bit patterns and numbers in binary notation are represented by strings of digits 0 and 1. Within such strings, X may be used to indicate that the setting of a bit is not specified within the string.

Bit patterns and numbers in binary notation are shown with the most significant bit to the left and the least significant bit to the right.

The most significant bit of an 8-bit byte is denoted by b8 and the least significant by b1.

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

6 Acronyms

AEWP	After Early Warning Point
AFN	Absolute Frame Number
BAT	Block Access Table
DF-ID	Data Format Identifier
ECC	Error Correcting Code
EOD	End of Data
EWP	Early Warning Point
GIT	Group Information Table
LBOT	Logical Beginning of Tape
LSB	Least Significant Byte
LF-ID	Logical Frame Identifier
MRS	Media Recognition System
MSB	Most Significant Byte
MSRT	Master Standard Reference Tape
PBOT	Physical Beginning of Tape
PEOT	Physical End of Tape
RAW	Read-After-Write
SNR	Signal-to-Noise Ratio
VEOT	Virtual End of Tape

7 Environment and safety

7.1 Testing environment

Tests and measurements made on the tape cartridge to check the requirements of this International Standard shall be carried out in the following ambient conditions of the air immediately surrounding the drive :

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

7.2 Operating environment

Cartridges used for data interchange shall be capable of operating under the following conditions, as measured within 10 mm of the tape exit from the drum of the generating or receiving drive :

temperature : 15 °C to 55 °C
relative humidity : 10 % to 80 %
wet bulb temperature : 26 °C max.

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

The above conditions include any temperature rise that may occur while operating the drive.

Conditioning before operating:

If a cartridge has been exposed during storage and/or transportation to a condition outside the above values, before use the cartridge shall be conditioned in the operating environment for a time at least equal to the period during which it has been out of the operating environment, up to a maximum of 24 h.

Note - Rapid variations of temperature should be avoided.

7.3 Storage environment

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

temperature : 5 °C to 32 °C
relative humidity : 20 % to 60 %
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.

7.4 Transportation

Recommended limits for the environment 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 M.

7.5 Safety

The cartridge and its components shall satisfy the requirements of IEC 60950.

7.6 Flammability

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

Section 2 - Requirements for the case

8 Dimensional and mechanical characteristics of the case

8.1 General

The case of the cartridge shall comprise

— an upper half,
— a lower half,
— a slider movably mounted on the lower half,
— a lid pivotally mounted on the upper half.

In the drawings, using third angle projection, an embodiment of the cartridge is shown as an example.

Figure 1 is a perspective view of the cartridge seen from top.
Figure 2 is a perspective view of the cartridge seen from bottom.
Figure 3 is a partial view of the rear side.
Figure 4 is a schematic view showing the Reference Planes X, Y and Z.
Figure 5 shows the front side.
Figure 6 shows the top side with the lid in closed position.
Figure 7 shows the left side.
Figure 8 shows the top side with the lid in open position.
Figure 9 shows the left side with the lid in open position.
Figure 10 shows the bottom side with the lid and the slider in closed position.
Figure 11 shows the bottom side with the lid and the slider in open position.
Figure 12 is a view from the top of the inside of the lower half with the upper half removed.
Figure 13 is a view of the bottom half with the lid and the slider in open position.
Figure 14 is a view of the left side with the lid and the slider in open position.
Figure 15 is a top view of a hub.
Figure 16 is a side view of a hub with partial cross-section.
Figure 17 is a partial cross-section through a hub and both halves of the case showing the interface with the drive spindle.
Figure 18 shows at a larger scale the lid in the open position.
Figures 19, 20 show at a larger scale the functional relationship between the lid and the locking mechanism of the hubs.
Figures 21, 22 show the label areas on the top and the rear side.
Figure 23 shows both corners of the bottom side, for autoloaders
Figure 24 shows the slider bowdown, for autoloaders.

The dimensions are referred to three orthogonal Reference Planes X, Y and Z (figure 4).

Plane X is perpendicular to Plane Z and passes through the centres of both the circular and elongated Datum Holes, revealed when the slider is opened (see 8.8.4 and figure 11).

Plane Y is perpendicular to Plane X and Plane Z and passes through the centre of the circular Datum Hole.

Plane Z is the plane on which the slider moves (see figure 7).

8.2 Overall dimensions (figures 6 and 7)

The overall dimensions of the case with the lid in the closed position shall be

l_1 = 73,0 mm ± 0,3 mm

l_2 = 54,0 mm ± 0,3 mm

l_3 = 10,5 mm ± 0,2 mm

Where the shell meets the lid on the top side of the cartridge, the angle of the chamfer shall be

θ = 45° ± 8° (see figure 21)

The edges formed by the rear side and the left and right sides shall be rounded off with a radius

r_1 = 1,0 mm ± 0,5 mm

The two edges of the lid shall be rounded off with a radius

r_2 = 0,5 mm max.

8.3 Loading grip (figure 6)

The top side shall have a loading grip for loading and positioning the cartridge into the drive. The position and dimensions of the loading grip shall be

l_4 = 25,5 mm ± 0,2 mm

l_5 = 11,0 mm ± 1,0 mm

l_6 = 5,0 mm ± 0,2 mm

l_7 = 2,3 mm ± 0,3 mm

The depth of the loading grip below the surface of the top side shall be

$$0{,}5 \text{ mm} \begin{array}{l} +\ 0{,}2 \text{ mm} \\ -\ 0{,}0 \text{ mm} \end{array}$$

8.4 Holding areas (figure 6)

The two areas shown shaded in figure 6 shall be the areas along which the cartridge shall be held down when inserted in the drive. Their positions and dimensions shall be

l_8 = 6,0 mm ± 0,1 mm

l_9 = 5,0 mm ± 0,1 mm

8.5 Notches of the lid (figures 5 and 8)

The lid shall have two pairs of notches.

The first pair of notches, the slider lock release notches, allows elements of the drive to release the locking mechanism of the slider (see also 8.8.1). The positions and dimensions of these notches shall be

l_{10} = 0,4 mm max.

l_{11} = 3,0 mm min.

l_{12} = 1,2 mm ± 0,1 mm

l_{13} = 49,8 mm ± 0,2 mm

The second pair of notches, the slider movement notches, allows elements of the drive to move the slider from the closed to the open position (see also 8.8.1). The positions and dimensions of these notches shall be

l_{11} = 3,0 mm min.

l_{14} = 0,9 mm min.

l_{15} = 7,5 mm ± 0,1 mm

l_{16} = 36,00 mm ± 0,15 mm

8.6 Lid dimensions (figures 6 to 8)

The lid is shown in the closed position in figures 6 and 7. Its dimensions shall be

l_{17} = 1,2 mm ± 0,1 mm

l_{18} = 6,8 mm ± 0,4 mm

l_{19} = 1,1 mm ± 0,1 mm

l_{20} = 2,0 mm ± 0,1 mm

l_{21} = 6,4 mm ± 0,2 mm

l_{22} = 1,5 mm ± 0,1 mm

r_3 = 6,8 mm ± 0,4 mm

The lid shall have a chamfer of 45° by