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Information technology — Data recording format DD-1 for magnetic tape cassette conforming to ISO/IEC 1016

Technologies de l'information — Format d'enregistrement des données DD-1 pour cassette à bande magnétique conforme à l'ISO/CEI 1016

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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. 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 14417 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 11, *Flexible magnetic media for digital data interchange*.

Annexes A to C form an integral part of this International Standard. Annexes D to I are for information only.

Information technology - Data recording format DD-1 for magnetic tape cassette conforming to IEC 61016

1 Scope

This International Standard specifies the media characteristics, the recorded tape format and file structure requirements to enable information interchange between information processing systems using 19,0 mm wide magnetic tape and cassette conforming to IEC 61016 Section 2.

1.1 Purpose

The purpose of this International Standard is to define the format necessary to ensure information interchange at acceptable performance levels.

The interchange parties complying with the applicable standards should be able to achieve compatibility without the need for additional exchange of technical information.

2 Conformance

2.1 Magnetic tape cassettes

Each size / capacity of magnetic tape cassette shall be in conformance with this International Standard if it satisfies all mandatory requirements of this International Standard and IEC 61016 Section Two. If both Standards specify the same subjects differently, then this International Standard shall prevail. The tape requirements shall be satisfied throughout the extent of the tape.

2.2 Generating systems

A system generating a magnetic tape cassette for interchange shall be entitled to claim conformance with this International Standard if all the recordings that it makes on a tape according to 2.1 meet the mandatory requirements of this International Standard. If there is a choice, e.g. cassette size, at least one shall meet the mandatory requirements of this International Standard.

2.3 Receiving systems

A system receiving a magnetic tape cassette for interchange shall be entitled to claim conformance with this International Standard if it is able to handle any recording made on the tape according to 2.1. If there is a choice, e.g. tape thickness, at least one shall meet the mandatory requirements of this International Standard.

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

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

IEC 61016, *Helical-scan digital component video cassette recording system using 19 mm magnetic tape (format D-1), Section 2 — Videotape cassette.*

4 Definitions

4.1 Auxiliary data

Optional information of secondary importance.

4.2 Annotation record

The magnetization pattern or associated information recorded in the annotation track.

4.3 Annotation tracks

Two longitudinal tracks one each at each tape edge.

4.4 Average Signal Amplitude (ASA)

The average peak-to-peak value of the signal output of the read head measured over a minimum of 280 000 flux transitions, exclusive of dropouts.

4.5 azimuth

The angular deviation, in degrees and minutes of arc, of the recorded flux transitions on a track from the line perpendicular to the track centerline.

4.6 block

A group of bytes transported between host and controller as a unit and considered a minimum locatable unit; containing one or more logical records or portions of logical records.

4.7 byte

An ordered set of 8 bits acted on as a unit.

4.8 Codeword Digital Sum (CDS)

The digital sum variation from the beginning to the end of a NRZI(1) symbol's waveform. The CDS is calculated assuming that the NRZI(1) waveform starts at a negative level, the binary -1 and +1, and the waveform transitions are centred relative to the corresponding bit cells.

4.9 Data area

An area on tape that is defined by the end points of all possible helical track center lines.

4.10 Data area reference line

A basic dimension which shall be exactly 1,8075 mm from the tape reference edge (no tolerence).

4.11 Data area reference point

The point on the centreline of a helical track at the boundry between preamble run-up and preamble sync pattern.

4.12 Data field

A continuous string of bits that is error protected.

4.13 Digital Sum Variation (DSV)

The accumulated sum of the CDS values of the NRZI(1) symbols.

4.14 Dropout

The point of read signal amplitude below a given threshold.

4.15 Erase

The removal of all magnetically recorded information from the tape.

4.16 Erasing field

An a. c. magnetic field of sufficient strength to remove the recorded signals from the tape.

4.17 Equivalent reference edge

For measurement of the recorded track format, the average location of the reference edge over a given length.

4.18 flux transition spacing

The distance along a track between successive flux transitions. The spacing is derived from the inverse of flux transitions per millimeter (ftpmm) (See physical record density.)

4.19 Helical (data) record

The magnetization pattern or associated information recorded in all possible helical tracks.

4.20 Helical track

An area on tape, inclined at a small angle to the reference edge of the tape.

4.21 Home track ID

A recorder manufacturer defined field used to identify the scanner head recording the first track of a track set.

4.22 Inner code

Of the sequential error detection and correction codes, the first encountered on playback from tape (C1).

4.23 Leader

A nonmagnetic length of transparent tape joined to each end of the magnetic tape to provide strength and convenience. At the beginning of the tape, it identifies the storage position of the tape. At the end of the tape, it indicates that the permissible recording area has been exceeded.

4.24 Logical volume

A collection of related files, without regard to physical container size.

4.25 magnetic tape

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

4.26 Master Standard Reference Tape

The tape selected to establish the standard for tape properties essential to data interchange.

Note - A master standard reference tape has been established. It has been agreed that Sony Corporation will maintain the master standard reference tape. (See secondary standard reference tape.)

4.27 Outer code

Of the sequential error detection and correction codes, the second encountered on playback from tape (C2).

4.28 physical recording density

The number of recorded flux transitions per unit length of track, e.g., flux transitions per millimeter (ftpmm).

4.29 Postamble

A sequence of bits recorded at the end of each helical track on a magnetic tape to provide flux transitions and special padding area to clear the decoding circuitry and provide tolerance area.

4.30 Preamble

A sequence of bits recorded at the beginning of each helical track on a magnetic tape to provide electronic synchronization.

4.31 reference edge

The lower edge of the tape when viewing the recording surface with the supply reel to the observer’s right.

4.32 reference field

The typical field of the master standard reference tape.

4.33 Resolution

The ratio of the average signal amplitude at the physical recording density of 2252 ftpmm to that at the physical recording density of 280 ftpmm.

4.34 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 - A master standard reference tape has been established. The Sony Corporation will make available for purchase, secondary standard reference tapes that can be ordered (P/N C2B-D1) until the year 2007. For information contact:

Sony Corporation, Magnetic Products Group, Major Customer Sales Division,
6-7-35 Kitashinagawa, Shinagawa-ku, Tokyo 141, Japan,
Tel: 81-3-5448-3560, Fax: 81-3-5448-7701, Tlx: SONYCORPJ22262

4.35 Sector

The helical record pertaining to a single helical track.

4.36 Sector recording tolerance

The maximum allowable distance of the data area reference point from the intersection of track center line and data area reference line.

4.37 Standard Reference Amplitude

The average peak-to-peak signal amplitude output from the master standard reference tape when it is recorded with the standard reference current. The signal amplitude shall be averaged over at least 280 000 flux transitions. Traceability to the standard reference is provided by the secondary standard reference tape.

4.38 Standard Reference Current

The current required to produce the reference field.

4.39 Sync pattern

A magnetization pattern defining the start of each sync block and the postamble or, following the preamble run-up.

4.40 Tape mark

A special block recorded on magnetic tape to serve as a separator between files and file labels, or to define the end of recorded data.

4.41 Tolerance zones

Narrow zones established to contain completely the track center lines of six consecutive helical tracks.

4.42 track

A narrow, defined area on tape along which a series of magnetic signals may be recorded.

4.43 track angle

The angular deviation, expressed in degrees and minutes of arc calculated from arcsine of (16/170), of the centerline of the recorded helical track from the equivalent reference edge of the tape.

4.44 Track Set

Four consecutive helical tracks uniquely identified by a track set ID.

4.45 Track Set ID (TSID)

A 23 bit binary field which is a common identifier for a set of four consecutive helical tracks. Each track set ID is recorded at the start of the helical tracks as part of the control record, and also recorded on the control track.

4.46 Volume set

A collection of logical volumes.

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 (inclusive) to 1,275 (exclusive).
- 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 0s and 1s. Within such strings, X may be used to indicate that the setting of a bit is not specified within the string.
- Numbers in binary notation and bit combinations are shown as Words with the MSB to the left, and with the msb in each byte to the left.
- Negative values of numbers in binary notion are given in TWOs complement.

5.2 Names

Proper names and basic elements are written with a capital initial letter.

5.3 Acronyms

ASA Average Signal Amplitude

CRC Cyclic Redundancy Check

DIT Directory Information Table

DM Dummy

DSV Digital Sum Variation

ECC Error Correction Code

EOD End of Data

FIT File Information Table

LBOT Logical Beginning of Tape

LEOT Logical End of Tape

ELD End of Label Data

LSB Least Significant Byte

lsb least significant bit

MSB Most Significant Byte

msb most significant bit

NEOT Near End of Tape

PBOT Physical Beginning of Tape

PEOT Physical End of Tape

TM Tape Mark

TSID Track Set Identification

UD User Data

UHL User Header Label

UIT User Information Table

UT Update Table

VEOV Virtual End of Volume

VIT Volume Information Table

VSIT Volume Set Information Table

6 Environmental and safety

6.1 Testing environment

Tests and measurements made on the tape to check the requirements of this standard shall be made under the following conditions unless otherwise specified:

temperature:	20 °C ± 1 °C (Ref. ISO/IEC 1016);
relative humidity:	48% to 52%;
barometric pressure:	96 kPa ± 10 kPa;
tape tension:	0,80N ± 0,05N;
conditioning before testing:	cassette shall be exposed to the test environment for 24 h min.

6.2 Operating environment

Cassettes used for data interchange shall be operated under the following conditions:

temperature:	5 °C to 45 °C;
relative humidity:	20% to 80% non-condensing;
wet bulb temperature:	26 °C max.

6.3 Cassette conditioning

For interchange, the cassette shall be conditioned by exposure to the operating environment for a time equal to or greater than the time away from the operating environment (up to maximum of 24 hours).

Conditioning of the tape stock before recording and testing for compliance to this standard shall be as follows:

storage conditioning:	not less than 24 hours;
environmental:	stabilized to the conditions specified in 6.1;
tape tension:	wound on a reel at a tension of 0,6 N to 1,5 N.

6.4 Storage environment

Cassettes shall be stored under the following conditions:

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

6.5 Safety

6.5.1 Safeness

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

6.5.2 Flammability

Tape or cassette components that will ignite from a match flame, and when so ignited will continue to burn in a still carbon dioxide atmosphere, shall not be used.

6.5.3 Toxicity

Tape or cassette components that may cause bodily harm by contact, inhalation, or ingestion during normal use of the cassette shall not be used.

7 Cassette

7.1 General description

The cassette is a coplanar design in three sizes with the tape and hubs completely enclosed by the case, except for the hinged door opening. The drive is via hub couplings which are mechanically connected to external reeling motors. Tape velocity is stabilized by an external capstan. A clear plastic window allows visual monitoring of the tape from the top of the cassette.

7.2 Dimensions

Dimensions of the three sizes of cassettes are defined in normative reference IEC 1016. section 2.

7.3 Identification holes

There shall be two sets of identification holes, one for the use of the manufacturer and the other for the user. Manufacturers' coding holes, detailed in normative reference IEC 1016 are further defined in the following clauses.

7.3.1 Manufacturer coding holes

7.3.1.1 Media thickness

Manufacturer holes 1 and 2 shall be used in combination to indicate tape thickness according to the following logic table:

Hole #1	Hole #2	Meaning
0	0	16 µm tape
0	1	13 µm tape
1	0	Undefined/reserved
1	1	Reserved, cleaning cassette only

Note - A 0 in the above tables indicates that the indicator tab is removed or open, denoting an undetected status (0 state) by the recorder/player sensor mechanism.

7.3.1.2 Media coercivity

Manufacturer holes 3 and 4 shall be used to indicate the coercivity of the magnetic recording tape according to the following table:

Hole #3	Hole #4	Meaning
0	0	Class 68kA/m
0	1	Reserved
1	0	Undefined/reserved
1	1	Reserved, cleaning cassette only

Note - A 0 in the above tables indicates that the indicator tab is removed or open, denoting an undetected status (0 state) by the recorder/player sensor mechanism

7.3.2 User coding holes

The user plug mechanism shall withstand a minimum axial force of 0,5 N
The dimensions and location of the users' holes specified in normative reference IEC 1016 are defined as follows:

When a *0* state exists, the user holes shall identify the following conditions:

Hole	Condition
1	Total record lock out (data/auxiliary/time code/control track)
2	Reserved and undefined
3	Reserved and undefined
4	Reserved and undefined

8 Tape mechanical and electrical properties

8.1 Materials

The tape shall consist of a base film 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. A backcoating material may be used.

8.2 Tape width and tolerance

8.2.1 Requirement

The tape width shall be 19,010 mm ± 0,015 mm.

8.2.2 Procedure

The tape, covered with a glass plate, shall be measured without tension at a minimum of five different positions along the tape using a calibrated microscope or profile projector having an accuracy of at least 2,5 mm. Tape width is defined as the average of the five readings.

8.3 Delta width

8.3.1 Requirement

Delta width (width fluctuation) shall not exceed 6 mm peak to peak.

8.3.2 Procedure

Measurement of delta width shall be over a minimum tape length of 230 mm with a tension of 1,39 N ± 0,28 N.

8.4 Reference edge straightness

Reference edge straightness is 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.

8.4.1 Requirement

The reference edge straightness maximum deviation is 6 mm peak to peak.

8.4.2 Procedure

Edge straightness fluctuation is measured at the edge of a moving tape guided by two guides having contact to the same edge and separated at a distance of 115 mm. Edge measurements are averaged over 10 mm lengths and are made at the mid-point between the first and second guide at a tension of 1,00 N ± 0,28 N.

8.5 Tape thickness

Use of tapes with various thicknesses is permitted with the total tape thickness being within the following values:

- nominal 16 µm tape shall have a thickness between 13,5 µm - 16,0 µm;
- nominal 13 µm tape shall have a thickness between 11,0 µm - 13,0 µm.

8.6 Magnetic recording surface coating thickness

The magnetic recording surface coating thickness shall be 2,0 µm - 3,6 µm

Backcoating surface thickness is not specified.

8.7 Tape length

The minimum length of magnetic tape between leader and header tapes shall be

Cassette \ Tape Thickness	16mm	13mm
Small	190 m	225 m
Medium	587 m	708 m
Large	1311 m	1622 m

The maximum lengths of tape shall be determined by the maximum diameter of the tape pack permitted in their respective cassettes.

8.8 Discontinuity

There shall be no discontinuities in the tape between the beginning of tape (BOT) and end of tape (EOT) leaders such as those produced by tape splicing or perforations except those caused by leader or trailer attachment.

8.9 Longitudinal curvature

Longitudinal curvature is 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.

8.9.1 Requirement

Any deviation of the reference edge from a straight line must be gradual and shall not exceed 0,04 mm within a 229 mm span of tape.

8.9.2 Procedure

Measure at a tension of 1,39 N ± 0,28 N in a test fixture equipped with two guides spaced at 229 mm ± 1 mm. The two guides shall be spring loaded to position the reference edge of the tape against two edge control surfaces. Measure the maximum deviation of the reference edge of the tape from the line drawn between the two control surfaces.

8.10 Out-of-plane distortions

Out-of-plane distortions are local deformations that 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. All visual evidence of out-of-plane distortion shall be removed when the tape is subjected to a uniform tension of 0,6 N ± 0,03 N.

8.11 Leaders, trailers and splices

8.11.1 Leaders and trailers

The cassette shall include leader and trailer tape. When attached to the hub, there shall be a length of 300 mm ± 30 mm between the splice point and the outside of the cassette shell. The leader/trailer tape material shall be polyester or equivalent having a transmissivity of at least 60% when measured with a 700 nm - 900 nm light source. When attached to the hub, the leader/trailer tape shall not separate from the hub when subjected to a force of 22 N or less. The width of the leader/trailer tape shall be 19,010 mm ± 0,025 mm The thickness of the leader/trailer tape shall be 10 mm to 40 mm. The break tensile strength of the leader/trailer tape shall be at least 22 N.

8.11.2 Splices

The splicing tape to attach the leader and trailer shall be of a polyester material which may be with a metal foil backing. The splicing tape width shall be 19,010 mm ± 0,025 mm The splice shall not separate when subjected to a force of 22 N or less.

8.12 Tape wind

The tape shall be wound on the hubs with the magnetic coating out, and in such a way that during forward read/write operations the tape is unwound in a counterclockwise direction (reel turns clockwise) viewed from the top of the cassette.

8.13 Tensile yield force

The tensile yield force shall be taken as the force required to elongate the sample by 3% (tape or leader/trailer).

8.13.1 Requirement

The tensile yield force at 3% elongation shall be a minimum of 13,4 N.

8.13.2 Procedure

Use a static weighting, constant rate-of-separation tester capable of indicating the load to an accuracy of ±2%. Clamp a specimen of at least 178 mm in length, with an initial 102 mm separation between the jaws. Elongate the specimen at a rate of 51 mm per minute until a minimum of 10% is reached. The force required to produce an elongation of 3% is the tensile yield force.

8.14 Inhibitor tape

An inhibitor tape is a tape that degrades the performance of the tape drive or other tapes.

Certain tape characteristics can contribute to poor tape drive performance. Tapes that exhibit these characteristics may not give satisfactory performance, can result in excessive errors and can interfere with the subsequent performance of other tapes.