INTERNATIONAL STANDARD

ISO/IEC 22050

First edition
2002-10-01

Information technology — Data interchange on 12,7 mm, 384-track magnetic tape cartridges — Ultrium-1 format

Technologies de l'information — Échange de données sur cartouches à bande magnétique 12,7 mm, *384 pistes — Format Ultrium-1*

Reference number
ISO/IEC 22050:2002(E)

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Printed in Switzerland

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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.

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

The main task of the joint technical committee is to prepare International Standards. 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.

ISO/IEC 22050 was prepared by ECMA (as ECMA-319) 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 F form a normative part of this International Standard. Annexes G to I are for information only.

Information technology — Data interchange on 12,7 mm, 384-track magnetic tape cartridges — Ultrium-1 format

Section 1 — General

1 Scope

This International Standard specifies the physical and magnetic characteristics of magnetic tape cartridges, using magnetic tape 12,65 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, 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 a registered algorithm for data compression.

This International Standard specifies four types of cartridges depending on the length of tape contained in the case. These four types are referred to as Type A, Type B, Type C and Type D; their nominal capacity is 100 Gbytes, 50 Gbytes, 30 Gbytes and 10 Gbytes, respectively.

NOTE - One Gbyte contains 1 000 000 000 bytes.

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 labeling of the information on the interchanged cartridge.

This International Standard shall be used only in conjunction with ISO/IEC 22091.

Together with a standard for volume and file structure, e.g. Standard ISO 1001, this document 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 system generating a magnetic tape cartridge for interchange shall be in conformance with this International Standard if all the recordings that it makes meet the mandatory requirements of this International Standard.

2.3 Receiving system

A system 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.

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*
ISO 527 (all parts)	*Plastics — Determination of tensile properties*
ISO 3574:1999	*Cold-reduced carbon steel sheet of commercial and drawing qualities*
ISO 4287:1997	*Geometrical product specification (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*
ISO/IEC 646:1991	*Information technology — ISO 7-bit coded character set for information interchange*

ISO/IEC 11576:1994	*Information technology — Procedure for the registration of algorithms for the lossless compression of data*
ISO/IEC 14443-2:2001	*Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 2: Radio frequency power and signal interface*
ISO/IEC 22091:2002	*Information technology — Streaming Lossless Data Compression algorithm (SLDC)*
IEC 60950-1:2001	*Information technology equipment — Safety — Part 1: General requirements*
ASTM D4065-01:1995	*Standard Practice for Plastics: Dynamic Mechanical Properties: Determination and Report of Procedures*
ASTM D4092-01:1996	*Standard Terminology: Plastics: Dynamic Mechanical Properties*

4 Terms and definitions

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

4.1 Access Point

A point, at the start of a sequence of Processed Records, at which the presentation of Symbols to a reprocessing algorithm is required to start at a known state to enable recovery, regardless of whether the data of interest in a retrieval operation starts at that point or at a subsequent point.

4.2 algorithm

A set of rules for transforming the logical representation of data.

4.3 algorithmically processed data

Data that has been processed by a defined processing algorithm.

4.4 a.c. erase

A process of erasure utilising alternating fields of decaying level.

4.5 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 25,4 mm of track, exclusive of missing pulses.

4.6 back surface

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

4.7 Beginning of Tape (BOT)

The reference point on the tape nearest to the leader pin assembly.

4.8 Beginning of Wrap (BOW)

The Logical Point that indicates the beginning of a wrap: LP3 for forward wraps, LP4 for reverse wraps.

4.9 bit

A single digit in the binary number system, a ZERO or a ONE.

4.10 bit cell

A distance along the track between adjacent RLL encoded bits.

4.11 Broad Band Signal-to-Noise Ratio (BBSNR)

The average read signal power divided by the average integrated broad band (floor) RMS noise power and expressed in dB.

4.12 byte

An ordered set of eight bits (12 Channel bits) that are acted on as a unit.

4.13 cartridge

A case holding a single supply reel of magnetic tape and leader tape with an attached leader pin assembly at the BOT end.

4.14 Channel bit

A bit output from RLL channel encoding.

4.15 Codeword

A set of bytes containing data and the ECC bytes calculated on that data.

4.16 Codeword Pair

An interleaved pair of Codewords.

4.17 Codeword Quad (CQ)

A set of two Codeword Pairs.

4.18 CQ Set

A group of CQs that are written at the same time, i.e. one on each of the active tracks.

4.19 cyclic redundancy check (CRC) character

A mathematically computed code which yields check bytes used for the detection of errors.

4.20 Data Set

The smallest complete unit of information written to, or received from, the tape.

4.21 Data Set Information Table (DSIT)

A table within a Data Set which describes the content of the Data Set.

4.22 End of Data (EOD)

The point on the tape at the end of the last valid Data Set recorded on tape.

4.23 End of Tape (EOT)

The point on a track farthest from BOT up to which recording is allowed.

4.24 End of Wrap (EOW)

The Logical Point that indicates the end of a wrap: LP4 for forward wraps, LP3 for reverse wraps.

4.25 Error Correcting Code (ECC)

A mathematically computed code which yields check bytes used for the detection and correction of errors.

4.26 File Mark

A recorded element requested to be written (or read) by the host that is typically used to mark organisational boundaries in a serial file structure, such as directory boundaries.

4.27 flux transition position

The point on the magnetic tape that exhibits the maximum free-space flux density normal to the tape surface.

4.28 flux transition spacing

The distance along a track between successive flux transitions.

4.29 forward tape motion

The tape is moving forward when it is leaving the reel in the cartridge and being wound onto the reel in the mechanism.

4.30 header

Data that is prefixed to a data entity to provide identification and checking.

4.31 Housekeeping Data Set

A Data Set which contains no user data and which is identified as such by the values in the data fields therein.

4.32 logical forward

The direction of tape motion toward End of Wrap.

4.33 logical reverse

The direction of tape motion away from End of Wrap.

4.34 Logical Point

Defined bound where regions of the tape begin or end.

4.35 magnetic tape

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

4.36 Master Standard Reference Tape (MSRT)

A tape selected as the standard for reference recording current, signal amplitude, resolution, BBSNR, overwrite ratio, servo signal amplitude, and servo signal polarity.

NOTE - A Master Standard Reference Tape has been established at Ladas and Parry.

4.37 LTO Cartridge Memory (LTO CM)

A contactless storage device that is mounted in the case, and which can be used to hold information about that specific cartridge, the tape in the cartridge, and the data on the tape.

4.38 Optimum Recording Current

1,15 times the minimum current which, when applied to a magnetic tape, will cause the average signal amplitude to equal 95 % of the maximum average signal amplitude when recorded at density TRD1.

4.39 physical end of tape

Position of the tape farthest from the leader pin assembly at which the tape is cut and wrapped onto the hub during manufacture.

4.40 physical forward

The direction of tape motion from BOT to EOT. This will be logical forward for even numbered wraps.

4.41 physical reverse

The direction of tape motion from EOT to BOT. This will be logical forward for odd numbered wraps.

4.42 pre-record condition

A tape cartridge that has been a.c. erased and subsequently servo-written in preparation for data recording is in a pre-record condition.

4.43 processed data

A sequence of Symbols which results from the application of processing to data.

Data that has been processed by an algorithm.

4.44 Processed Record

A sequence of Symbols which results from the application of processing to a Protected Record.

4.45 Processing (Compression)

The use of an algorithm to transform host data into Symbols.

4.46 Protected Record

A Record with a 4-byte CRC added to the end. The CRC is checked during the deformatting process to ensure that the Record is uncorrupted.

4.47 Record

A Record is the smallest distinct set of data bytes supplied, e.g. from a host, for processing and recording by a tape drive system, and the smallest distinct set of data to be read from tape, reprocessed and made available, e.g. to a host, by a tape drive system.

4.48 recorded element

A File Mark or Record.

4.49 Reference Recording Current

The Optimum Recording Current of the Master Standard Reference Tape.

4.50 Reprocessing (Decompression)

The use of an algorithm to transform Symbols into data as required by the host.

4.51 reverse tape motion

The tape is moving in reverse when it is leaving the reel in the mechanism and being wound onto the reel in the cartridge.

4.52 run length limited encoding (RLL)

An algorithmic process applied to an arbitrary input binary sequence that produces an output binary sequence that has a specified minimum number of ZEROs between ONEs, and a specified maximum number of ZEROs between ONEs.

4.53 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 as "Ultrium Format Specification Generation 1 SSRT" from Ladas and Parry, 5670 Wilshire Blvd., 21st Floor, Los Angeles, CA 90036. In principle such tapes will be available for a period of 10 years from the publication of the first edition of this International Standard. However, by agreement between ECMA and Ladas and Parry, 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.

4.54 servo acquisition region

A region on tape that may be used by the servo circuitry.

4.55 Standard Reference Amplitude (SRA)

The average signal amplitude from the Master Standard Reference Tape when it is recorded with the Reference Recording Current at density TRD1. Traceability to the Standard Reference Amplitude is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

4.56 Symbol

An associated string of bits generated by a processing (compression) algorithm, which represents a byte of data, a string of bytes of data, or control information.

4.57 Synchronised Codeword Quad (SCQ)

A serial bit stream formed by inserting synchronisation patterns into an RLL encoded Codeword Quad.

4.58 Test Recording Density (TRD)

The recording density at which specific tests are performed. There are three test recording densities: TRD1, TRD2 and TRD3. See 12.1.

4.59 wrap

A track group recorded in the physical forward or physical reverse direction.

4.60 write equalisation

An algorithmic process that linearly transforms an input binary sequence into another binary sequence.

4.61 (1,7) RLL code

A run length limited encoding scheme the output of which has no fewer than one ZERO between ONEs and no more than seven ZEROs between ONEs.