INTERNATIONAL STANDARD

ISO/IEC 14840

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

Technologies de l'information — Cartouche de bande magnétique de 12,65 mm *de large pour l'échange d'information — Enregistrement par balayage en spirale — Format de données-D3-1*

Reference number
ISO/IEC 14840:1996(E)

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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 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.

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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.*

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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.

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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.

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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.

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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 %

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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.

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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

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

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The front vertical edges of the case shall be rounded with a radius

r_1 = 3,81 mm ± 0,25 mm

The rear vertical edges of the case shall be rounded with a radius

r_2 = 3,05 mm ± 0,25 mm

The top left and top right hand edges shall be rounded with a radius

r_3 = 3,05 mm ± 0,25 mm

The bottom left and bottom right hand edges shall be rounded with a radius

r_4 = 3,05 mm ± 0,25 mm

8.3.2 Locating areas (figure 9)

The three circular locating areas X_1, X_2 and X_3 shall lie in the same plane within 0,25 mm.

Area X_1 shall have a diameter

d_1= 14,00 mm ± 0,25 mm

The position of its centre shall be defined by

l_4 = 54,50 mm ± 0,05 mm

l_5 = 31,25 mm ± 0,05 mm

Areas X_2 and X_3 shall have diameters

d_2 and d_3 = 10,00 mm ± 0,25 mm

The positions of their centres shall be defined by

l_6 = 108,50 mm ± 0,05 mm

l_7 = 3,50 mm ± 0,05 mm

l_8 = 101,98 mm ± 0,05 mm

8.3.3 Reference points for Plane Y (figure 6)

The position of Reference Point Y_1 shall be defined by

l_9 = 12,70 mm ± 0,05 mm

l_{10} = 10,41 mm ± 0,05 mm

The position of Reference Point Y_2 shall be defined by

l_{11} = 88,90 mm ± 0,05 mm and l_{10}

8.3.4 Reference point for Plane Z (figure 3)

The position of Reference Point Z_1 shall be defined by

l_{12} = 54,51 mm ± 0,05 mm

l_{13} = 8,13 mm ± 0,25 mm

8.3.5 Locating notches (figures 6, 9, 10 and 11)

There shall be two locating notches, open towards the bottom side. The depth of the notches shall be defined by

l_{14} = 2,50 mm ± 0,25 mm

l_{15} = 104,00 mm ± 0,25 mm

For each notch the side further from Plane Z shall be spaced from Plane Z by

l_{16} = 111,07 mm ± 0,25 mm

the width at Plane X shall be

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l_{17} = 5,21 mm ± 0,08 mm

it shall extend a distance from Plane X

l_{18} = 7,00 ± 0,25 mm

The sides shall have a taper

α_1 = 2°0' ± 30'

which shall start at a distance from Plane X

l_{19} = 2,54 mm ± 0,13 mm.

8.3.6 Mis-insertion protection (figures 4 and 6)

The cartridge shall have a notch in the top side of the case to prevent the cartridge from being inserted into the drive upside-down. This feature further prevents the use of unsuitable cartridges of similar, but not identical, construction.

The depth of the notch shall be determined by

l_{20} = 16,97 mm ± 0,50 mm

Its length, measured from Plane Z shall be

l_{21} = 27,20 mm ± 0,25 mm

Its length, measured from Plane Y shall be

l_{22} = 13,51 mm ± 0,25 mm

The inside corner shall have a radius

r_5 = 54,36 mm ± 0,51 mm

8.3.7 Stacking ribs (figures 5 and 9)

The bottom side of the case shall have two parallel stacking ribs; the dimensions shall be

l_{23} = 5,00 mm ± 0,25 mm

l_{24} = 74,50 mm ± 0,25 mm

l_{25} = 1,00 mm ± 0,16 mm

The corners shall have a radius

r_6 = 0,89 mm ± 0,25 mm

The locations shall be defined by

l_{26} = 7,50 mm ± 0,25 mm

l_{27} = 31,00 mm ± 0,25 mm

l_{28} = 79,50 mm ± 0,25 mm

8.3.8 Recognition notches (figures 3 and 4)

Five locations for cartridge recognition notches, numbered 1 to 5, are defined in the front side of the case.

The width of each location shall be

l_{29} = 3,81 mm ± 0,08 mm

The overall width of the five locations shall be

l_{30} = 19,05 mm ± 0,08 mm

The distance of location 5 from Plane Y shall be

l_{31} = 46,88 mm ± 0,64 mm

The depth of a notch, measured from the top of the case shall be

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l_{32} = 7,09 mm ± 0,25 mm

The depth of a notch, measured from Plane Z shall be

l_{33} = 3,30 mm ± 0,38 mm

In table 1 the presence of a notch is represented by 0 and the absence of a notch by 1.

Table 1 - Assignment of Recognition Notches

	Notch condition				
Cartridge Type	1	2	3	4	5
Type A	0	1	0	0	0
Type B	0	1	0	0	1
Type C	0	1	0	1	0

Note 2 - Notch condition 0 1 1 0 0 is assigned to a cleaning cartridge.

8.3.9 Write-inhibit mechanism (figures 3 and 4)

The write-inhibit mechanism occupies the space of two further notch locations, 6 and 7. It extends beyond notch location 5 a distance

l_{34} = 7,62 mm ± 0,08 mm

The mechanism shall enable notch location 6 to be open or closed, as required. When the notch is closed, writing is permitted and a suitable visual indication shall be displayed. When the notch is open, writing is inhibited and an alternative visual indication shall be displayed.

The mechanism to close or open the notch shall operate when a force of between 2,0 N and 9,0 N is applied parallel to the front side of the cartridge.

The surface of the closure shall not protrude outside the front side of the cartridge, nor be recessed more than 0,13 mm behind it.

8.3.10 Label areas of the top side (figure 4)

There shall be two label areas, 1 and 2, on the top side of the case.

8.3.10.1 Label area 1 is provided for the user.

Its dimensions shall be

l_{35} = 75,00 mm ± 0,20 mm

l_{36}= 80,06 mm ± 0,25 mm

Its distance from Reference Plane Z shall be

l_{37} = 31,00 mm ± 0,25 mm

Its distance from Reference Plane Y shall be

l_{38} = 6,88 mm ± 0,13 mm

8.3.10.2 Label area 2 is reserved for use by the manufacturer.

Its dimensions shall be l_{36} and

l_{39} =11,58 mm ± 0,20 mm

Its distance from Reference Plane Z shall be

l_{40} = 120,37 mm ± 0,30 mm

Its distance from Reference Plane Y shall be l_{38}

Both label areas shall be recessed from the top side by

l_{41} = 0,51 mm ± 0,25 mm

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The corners of both label areas shall have a radius

$r_7 = 0{,}84 \text{ mm} \pm 0{,}13 \text{ mm}$

8.3.11 Label areas of the rear side (figure 5)

There shall be two label areas, 3 and 4, on the rear side of the case.

They shall extend from the top of the case for a distance

$l_{42} = 12{,}29 \text{ mm} \pm 0{,}25 \text{ mm}$

They shall be recessed from the rear side by l_{41}.

They shall be tapered at an angle

$\alpha_2 = 2°0' \pm 30'$

The radii of the four lower corners shall be

$r_8 = 0{,}89 \text{ mm} \pm 0{,}10 \text{ mm}$

The distance of the right hand edge of label area 3 (as shown in figure 5) from the right side of the case shall be

$l_{43} = 21{,}97 \text{ mm} \pm 0{,}31 \text{ mm}$

The width of label area 3 shall be

$l_{44} = 17{,}55 \text{ mm} \pm 0{,}13 \text{ mm}$

Label area 4 shall be separated from label area 3 by a barrier of width

$l_{45} = 2{,}41 \text{ mm} \pm 0{,}13 \text{ mm}$

The width of label area 4 shall be

$l_{46} = 80{,}09 \text{ mm} \pm 0{,}23 \text{ mm}$

A label bearing a letter and its associated bar code, and complying with the requirements of annex G, shall be affixed to label area 3, as shown in figure 5.

The letter shall be : for Type A : A
for Type B : B
for Type C : C

8.3.12 Label area on the right hand side (figure 10)

The distance of the bottom edge of label area 5 from Reference Plane X shall be

$l_{47} = 11{,}91 \text{ mm} \pm 0{,}25 \text{ mm}$

The area shall extend to the radius r_3

The distance of the label area from Reference Plane Z shall be

$l_{48} = 30{,}76 \text{ mm} \pm 0{,}25 \text{ mm}$

Its length shall be

$l_{49} = 35{,}18 \text{ mm} \pm 0{,}25 \text{ mm}$

It shall be recessed by

$l_{50} = 0{,}51 \text{ mm} \pm 0{,}25 \text{ mm}$

It shall be tapered at an angle

$\alpha_3 = 2°0' \pm 30'$

The corners shall have a radius

$r_9 = 0{,}89 \text{ mm} \pm 0{,}25 \text{ mm}$

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8.3.13 Label area on the bottom side (figure 9)

Label area 6 is reserved for use by the manufacturer. The distance of one edge of the label area from Reference Plane Z shall be

l_{51} = 105,49 mm ± 0,25 mm

The distance of one end from the right hand stacking rib shall be

l_{52} = 8,76 mm ± 0,25 mm

Its length shall be,

l_{53} = 61,98 mm ± 0,25 mm

Its width shall be

l_{54} = 5,08 mm ± 0,25 mm

Its depth shall be

l_{55} = 0,41 mm ± 0,13 mm

The four corners of the label area shall have a radius

r_{10} = 0,89 mm ± 0,25 mm

8.3.14 Central window (figure 9)

The bottom side of the case shall have a central window to allow penetration of the drive spindle into the hub.

Its diameter shall be

d_4 = 43,50 mm ± 0,23 mm

Its centre shall be defined by

l_{56} = 61,01 mm ± 0,25 mm

l_{57} = 54,51 mm ± 0,25 mm

8.3.15 Case opening (figures 3 and 4)

The case shall have an opening for the tape, into which the leader block can be inserted (see also figure 23).

The opening shall be defined by

l_{58} = 105,16 mm ± 0,13 mm

l_{59} = 6,35 mm ± 0,13 mm

l_{60} = 87,10 mm ± 0,38 mm

l_{61} = 7,72 mm ± 0,38 mm

r_{11} = 3,18 mm ± 0,25 mm

r_{12} = 3,05 mm ± 0,25 mm

α_4 = 45° ± 1°

Figure 7 shows, at a larger scale, details of the case opening at the left hand side of figure 4.

l_{62} = 8,66 mm ± 0,13 mm

l_{63} = 0,76 mm ± 0,13 mm

l_{64} = 15,24 mm ± 0,25 mm

l_{65} = 17,90 mm ± 0,25 mm

l_{66} = 3,33 mm ± 0,13 mm

l_{67} = 4,67 mm ± 0,10 mm

Figure 8 shows, at a larger scale, details of the top left hand corner of figure 3.

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l_{68} = 1,14 ± 0,08 mm

l_{69} = 6,00 mm ± 0,25 mm

l_{70} = 16,18 mm ± 0,25 mm

l_{71} = 32,28 mm ± 0,13 mm

l_{72} = 25,15 mm ± 0,13 mm

r_{13} = 3,05 mm ± 0,25 mm

r_{14} = 3,56 mm ± 0,13 mm

α_5 = 45° ± 2°

8.3.16 Tapers of the case (figure 6)

8.3.16.1 The top and bottom sides of the case shall be tapered at the front by a curve of radius

r_{15} = 145,50 mm ± 0,25 mm

the centres of which are defined by

l_{73} = 26,01 mm ± 0,25 mm

8.3.16.2 The bottom side of the case shall be tapered at an angle

α_6 = 30°0' ± 30'

The taper shall start at a distance from Reference Plane Z

l_{74} = 113,20 mm ± 0,25 mm

The edges of the taper shall be rounded off with radii

r_{16} = 3,05 mm ± 0,25 mm

r_{17}= 1,00 mm ± 0,25 mm

8.3.16.3 The front side of the case shall be tapered each side of the centreline by the angle α_2

The front edges of the case shall be rounded with radius r_{16}.

8.3.16.4 The rear side of the case shall be tapered above the centreline by the angle

α_7 = 3°0' ± 30'

The top edge shall be rounded with the radius r_{16}.

8.4 Flexibility of the case

The flexibility of the top and bottom sides of the case (see figure 1) is the amount of deflection observed when they are submitted to a perpendicular force F.

8.4.1 Requirements

The amount of deflection *d* shall meet the following requirements when applying a force F

where 4,5 N < F < 54,0 N

Deflection of the top side

$d \leq 0{,}38 + 0{,}054\ F$

Deflection of the bottom side

$d \leq 0{,}38 + 0{,}040\ F$

where *d* is the measured deflection in millimetres.

8.4.2 Procedure

The flexibility of the case shall be measured in a universal testing machine operating in the compression mode.

Use a suitable load cell for the test.

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Apply a single point load with a radius of 10 mm ± 1 mm to the top side of the case at the point shown in figure 4 and specified by

l_{75} = 86,9 mm nominal

l_{76} = 54,5 mm nominal

Repeat for the bottom side at the point shown in figure 9 and specified by

l_{75} and l_{76}

8.5 Tape reel (figures 12 and 13)

Figures 12 and 13 show the tape reel mounted within the case. Figure 12 specifies the dimensions of the reel when the cartridge is held in the hand. Figure 13 specifies the dimensions when the cartridge is mounted in a drive. For clarity, the stacking ribs are not shown.

8.5.1 Locking mechanism (figures 14 and 15)

This International Standard does not specify the actual implementation of the locking mechanism. Functionally it shall satisfy the following requirements in the locked position:

- the angular resolution shall not be greater than 6°.
- the reel shall not rotate by more than 10° when a torque not greater than 0,32 N·m is applied in the direction that will cause the tape to unwind,

The button of the locking mechanism shall be made of nylon 6/6 with 2 % ± 1 % molybdenum disulphide. The dimensions of the button shall be

d_5 = 2,0 mm ± 0,5 mm

d_6 = 10,0 mm ± 0,2 mm

α_8 = 15° ± 2°

8.5.2 Axis of rotation of the reel

The axis of rotation of the reel shall be perpendicular to Plane P (see 8.5.7) and pass through the centre of the central window as specified by l_{56} and l_{57}.

8.5.3 Metallic insert (figures 12 and 13)

The reel shall have a metallic insert made of stainless steel (ISO 683/XIII Type 3 or 7).

The thickness shall be

l_{77} = 1,51 mm ± 0,10 mm

The outer diameter shall be

$$d_7 = 35{,}00 \text{ mm} \begin{matrix} +\,0{,}20 \text{ mm} \\ -\,1{,}20 \text{ mm} \end{matrix}$$

The inner diameter shall be

d_8 = 11,15 mm ± 0,51 mm

and shall be concentric with the axis of rotation within 0,15 mm.

The metallic insert shall be parallel to Plane P within 0,15 mm.

It shall withstand a pull out force of 300 N min.

8.5.4 Toothed rim (figure 12)

The reel shall have a toothed rim accessible through the central window; its dimensions shall be

$$d_9 = 36{,}0 \text{ mm} \begin{matrix} +\,0{,}5 \text{ mm} \\ -\,0{,}0 \text{ mm} \end{matrix}$$

d_{10} = 41,0 mm ± 0,25 mm

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$\alpha_9 = 11°3' \pm 5'$

8.5.5 Hub of the reel (figure 12)

The diameter of the hub shall be

$$d_{11} = 50{,}0 \text{ mm} \begin{matrix} +\,0{,}0 \text{ mm} \\ -\,0{,}2 \text{ mm} \end{matrix}$$

The distance between the flanges of the reel, measured at the surface of the hub, shall be

$l_{78} = 12{,}90 \text{ mm} \pm 0{,}05 \text{ mm}$

The distance between the flanges, measured at any other radius, shall be

$l_{79} = 13{,}46 \text{ mm} \pm 0{,}20 \text{ mm}$

The radius at the intersections of the flanges and the outer surface of the hub shall be

$r_{18} = 0{,}08 \text{ mm max.}$

The hub shall meet the following requirements

- the straightness of the hub surface shall be within 0,04 mm
- the perpendicularity to Plane P through the pitch line of the teeth of the rim (see 8.5.7) shall be within 0,07 mm
- for any two sections taken perpendicular to the axis of the hub, the ratio of the differences between the two values of d_{11} to the distances between the sections shall not exceed 0,003 8
- the rate of change across the width of the hub surface shall not exceed 0,025 mm per mm
- the total runout of the hub relative to the cylinder perpendicular to the circular pitch line (see 8.5.7) of the teeth of the toothed rim shall not exceed 0,2 mm total indicator reading (TIR).

8.5.6 Relative positions of hub and case

8.5.6.1 With the cartridge held in the hand (figure 12)

The distance from the tip of the button of the locking mechanism to Reference Plane X shall be

$$l_{80} = 1{,}91 \text{mm} \begin{matrix} +\,1{,}40 \text{ mm} \\ -\,0{,}89 \text{ mm} \end{matrix}$$

The distance from the bottom surface of the metallic insert to Reference Plane X shall be

$$l_{81} = 0{,}41 \text{ mm} \begin{matrix} +\,1{,}00 \text{ mm} \\ -\,0{,}51 \text{ mm} \end{matrix}$$

8.5.6.2 With the cartridge in the hand or in the drive (figures 12 and 13)

The distance from the bottom surface of the metallic insert to Plane P shall be

$l_{82} = 2{,}27 \text{ mm} \pm 0{,}12 \text{ mm}$

The distance from the inside of the lower flange of the reel, measured at the surface of the hub, to Plane P shall be

$l_{83} = 0{,}72 \text{ mm} \pm 0{,}05 \text{ mm}$

When measured at any other radius this distance shall be

$l_{84} = 0{,}43 \text{ mm} \pm 0{,}10 \text{ mm}$

8.5.6.3 With the cartridge in the drive (figure 13)

The distance from the tip of the button of the locking mechanism to Reference Plane X shall be

$l_{85} = 8{,}10 \text{ mm} \pm 0{,}20 \text{ mm}$

The force required to move the button into this position shall not exceed 12,25 N

The distance from the centreline of the tape to Reference Plane X shall be

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l_{86} = 12,24 mm nominal

The distance from Reference Plane X to Plane P (see 8.5.7) shall be

l_{87} = 5,03 mm ± 0,20 mm

8.5.7 Characteristics of the toothed rim (figure 14)

The toothed rim shall comprise 60 teeth spaced at an angle of

6°0' ± 5' non-cumulative

The teeth are specified at the pitch diameter d_{10} such that the planes at which the lines joining the surfaces of teeth intersect are spaced a distance l_{88} apart

Plane P is defined as being spaced equi-distant between these two planes

l_{88} = 4,00 mm ± 0,05 mm

l_{89} = 2,00 mm ± 0,05 mm

α_{10} = 30° nominal

The pitch line is the circumference of the teeth in Plane P.

The blend radius at the bottom of the teeth shall be

r_{19} = 0,25 mm max.

The blend radius at the tips of the teeth shall be defined by

0,10 mm < r_{20} < 0,30 mm

8.6 Magnetic tape

8.6.1 Tape wind

When the cartridge is viewed from the top side, the tape shall be wound clockwise and with the recording surface away from the hub.

The end of the tape shall not be attached to the hub.

8.6.2 Wind tension

The tape shall be wound with a tension of

0,31 N ± 0,05 N

8.6.3 Circumference of the tape reel

The circumference of a wound tape shall be

For	Type A	between	197 mm and 205 mm
	Type B		239 mm and 249 mm
	Type C		297 mm and 314 mm

8.6.4 Moment of inertia

The moment of inertia of the tape reel is the ratio of the torque applied to it (complete with tape, hub and flanges) when it is free to rotate about a given axis, to the angular acceleration thus produced about that axis.

The moment of inertia of the reel and tape shall be:

For the empty reel			$36{,}00 \times 10^{-6}$ kg·m^2 ± $3{,}63 \times 10^{-6}$ kg·m^2
For	Type A	between	48×10^{-6} kg·m^2 and 68×10^{-6} kg·m^2
	Type B		88×10^{-6} kg·m^2 and 112×10^{-6} kg·m^2
	Type C		175×10^{-6} kg·m^2 and 240×10^{-6} kg·m^2

Procedure

Torsionally oscillate the reel on an inertial dynamics unit. The period of oscillation shall be measured electronically with a universal counter. Convert the period of oscillation to its rotational value.

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8.7 Leader block

8.7.1 Dimensions of the leader block (figures 16 to 24)

The leader block shall have the following dimensions

l_{90} = 2,24 mm ± 0,13 mm

l_{91} = 31,85 mm ± 0,25 mm

l_{92} = 3,18 mm ± 0,03 mm

l_{93} = 14,73 mm ± 0,13 mm

l_{94} = 6,35 mm ± 0,05 mm

l_{95} = 1,27 mm ± 0,13 mm

l_{96} = 19,05 mm ± 0,25 mm

l_{97} = 27,83 mm ± 0,13 mm

l_{98} = 25,00 mm ± 0,10 mm

l_{99} = 3,18 mm ± 0,05 mm

l_{100} = 3,30 mm ± 0,05 mm

l_{101} = 2,03 mm ± 0,05 mm

l_{102} = 2,29 mm ± 0,05 mm

l_{103} = 9,65 mm ± 0,08 mm

r_{21} = 3,30 mm ± 0,25 mm

r_{22} = 25,00 mm ± 0,05 mm

r_{23} = 1,27 mm ± 0,05 mm

r_{24} = 5,00 mm ± 0,25 mm

r_{25} = 0,76 mm ± 0,08 mm

r_{26} = 0,51 mm + 0,13 mm

d_{12} = 4,57 mm ± 0,05 mm

μ_1 = 45°0' ± 30'

μ_2 = 45°0' ± 30'

μ_3 = 10°0' ± 30'

μ_4 = 15°0' ± 30'

8.7.2 Attachment of the tape to the leader block (figure 24)

There shall be a rectangular insert for attaching the tape to the leader block. It shall cover the full width of the tape over the distance

l_{104} = 13,97 mm min. but shall not protrude beyond the surfaces of the leader block.

The bottom edge of the tape shall be parallel to the bottom edge of the leader block within 0,12 mm over the distance

l_{105} = 914,00 mm ± 2,54 mm and shall be at a distance

l_{106} = 1,02 mm ± 0,20 mm

from it, when measured whilst the tape is under a tension within the range 0,29 N to 0,33 N.

The leader block shall remain attached to the tape when a force of 10 N is applied at an angle of 0° ± 2°, relative to the plane of the tape.

8.7.3 Latching the leader block

This International Standard does not specify the actual implementation of the latching mechanism for the leader block. It specifies the position of the leader block when latched and the forces required to pull out and insert it.

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8.7.3.1 Leader block pickup position

When the leader block is latched into the case, the point defined by l_{98} and l_{99} (see figure 17) shall fall within a circle of radius 0,5 mm max., the centre of which is defined by the intersection of the two lines specified by l_{60} and l_{61} (see figure 4).

8.7.3.2 Leader block insertion force

The insertion force is the force required to push the leader block into its latched position in the case. Its value shall be 4,45 N ± 2,20 N

throughout the insertion angle

$\mu_5 = 45° \pm 2°$ (see figure 23).

Procedure

Clamp the cartridge in a fixture such that the leader block can be inserted by a universal testing machine at values of μ_5 from 43° to 47° (see figure 23).

The universal testing machine shall have a pin that fits into diameter d_{12} and the slot width l_{100} (see figure 17). The leader block shall pivot freely on the pin.

Seat the r_{22} end of the leader block (figure 20) in the opening of the case and latch the r_{21} end of the leader block using a jaw speed of 10 mm/min.

Measure the force required.

8.7.3.3 Leader block pull-out force

The pull-out force is the force required to unlatch the leader block from the case. Its value shall be 4,45 N ± 2,20 N.

Procedure

Clamp the cartridge in a fixture such that the leader block can be extracted by a universal testing machine at values of μ_5 from 43° to 47°.

The universal testing machine shall have a pin that fits into diameter d_{12} and the slot width l_{100}. The leader block shall pivot freely on the pin.

Set the jaw separation speed to 10 mm/min. and pull the leader block out of the case.

Measure the force required.

8.8 Reflection density of the case

8.8.1 Requirement

The reflection density shall be greater than 1,20 D. (see annex H)

8.8.2 Test Equipment

Measurements shall be made using a colour reflection densitometer4, which has the following general specification :

- bandwidth Status T bandwidth (380 nm to 780 nm)
- measuring range 0,00 D to 2,50 D
- accuracy ± 0,02 D
- repeatability ± 0,01 D
- aperture diameter 3,4 mm
- filter Visual

Note 3 - A suitable densitometer is available from X-Rite, Incorporated, 3100 44th Street, S.W., Grandville, Michigan 49418 USA.

Tel. +1-616-534-7663
Fax. +1-616-534-9212

8.8.3 Test method

a) Using the colour reflection reference, check that the densitometer is correctly calibrated,

white shall measure 0,08 D ± 0,02 D
black shall measure 1,78 D ± 0,02 D

If these figures are not achieved, recalibrate the densitometer according to the manufacturer's instructions.

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The colour reflection reference shall be stored in its protective envelope when not in use.

b) Take three measurements in label area 4, before a label is affixed, and calculate the average.

Consecutive measurements shall not vary by more than 0,10 D for translucent cartridges or by more than 0,05 D for non-translucent cartridges.

8.9 Colour (figures 3 and 4)

In the areas defined, on the top side by

$l_{126} = 36{,}83 \pm 0{,}25$ mm

$l_{107} = 35{,}56$ mm $\pm 0{,}25$ mm

$l_{108} = 7{,}62$ mm $\pm 0{,}25$ mm

and on the front side by l_{107}, l_{126} and

$l_{109} = 14{,}43$ mm $\pm 0{,}25$ mm

the colour shall be red according to PMS 187C (Pantone matching system for colours). The write-inhibit mechanism shall be 100 % Pantone Process Black.

In other areas the colour is not specified, except that the reflection density shall meet the requirements specified in 8.8.

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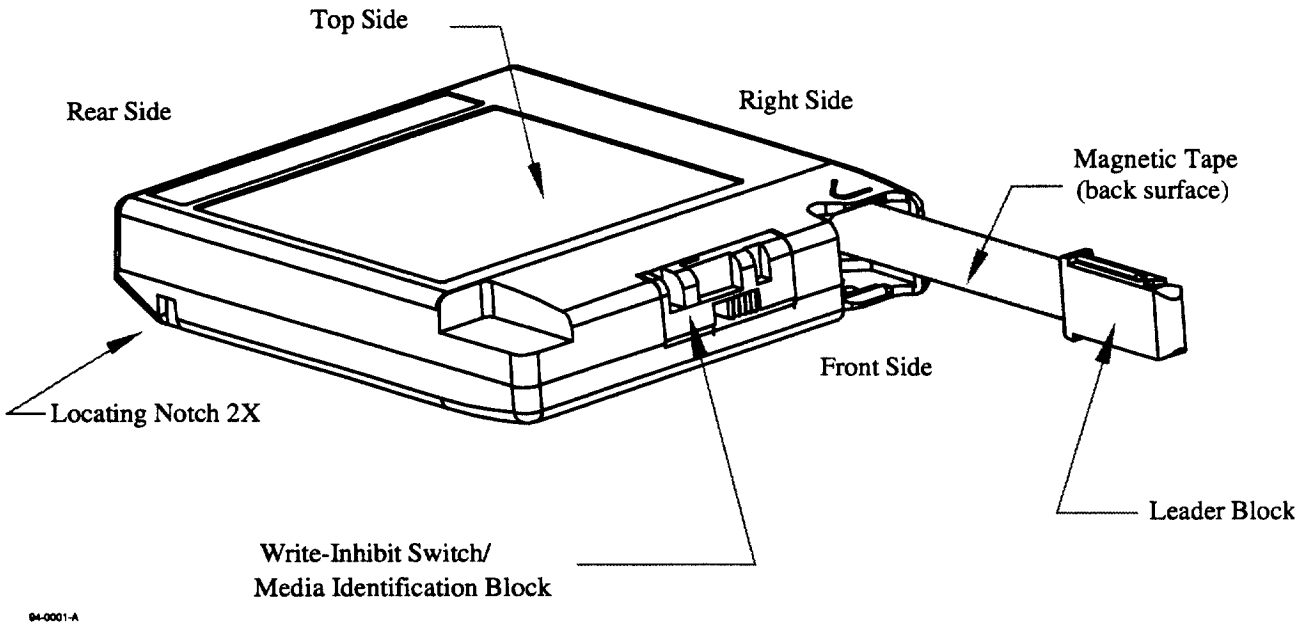


Figure 1 - General view of the cartridge

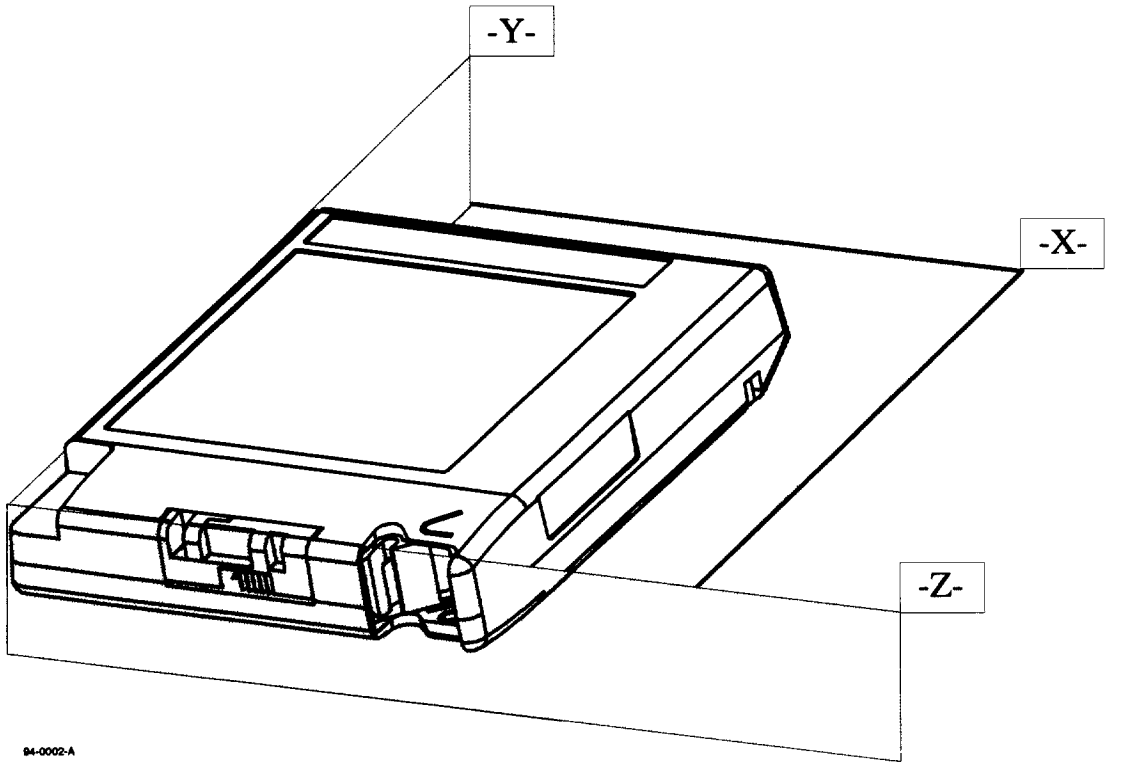


Figure 2 - Reference planes

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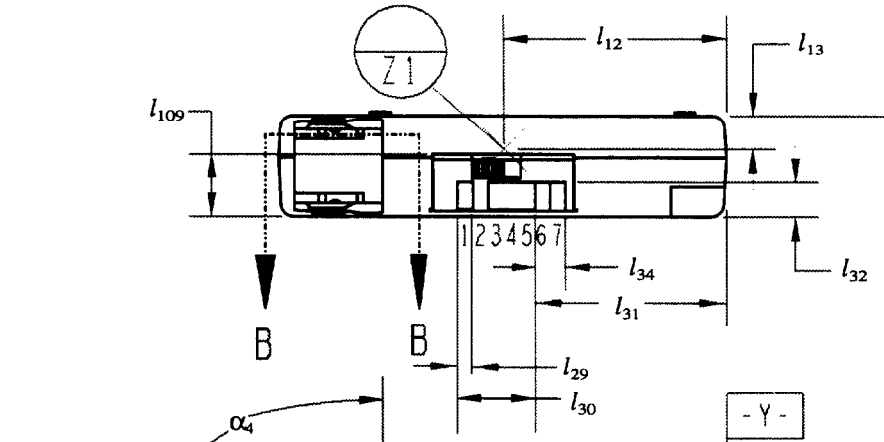


Figure 3 - Front side of case

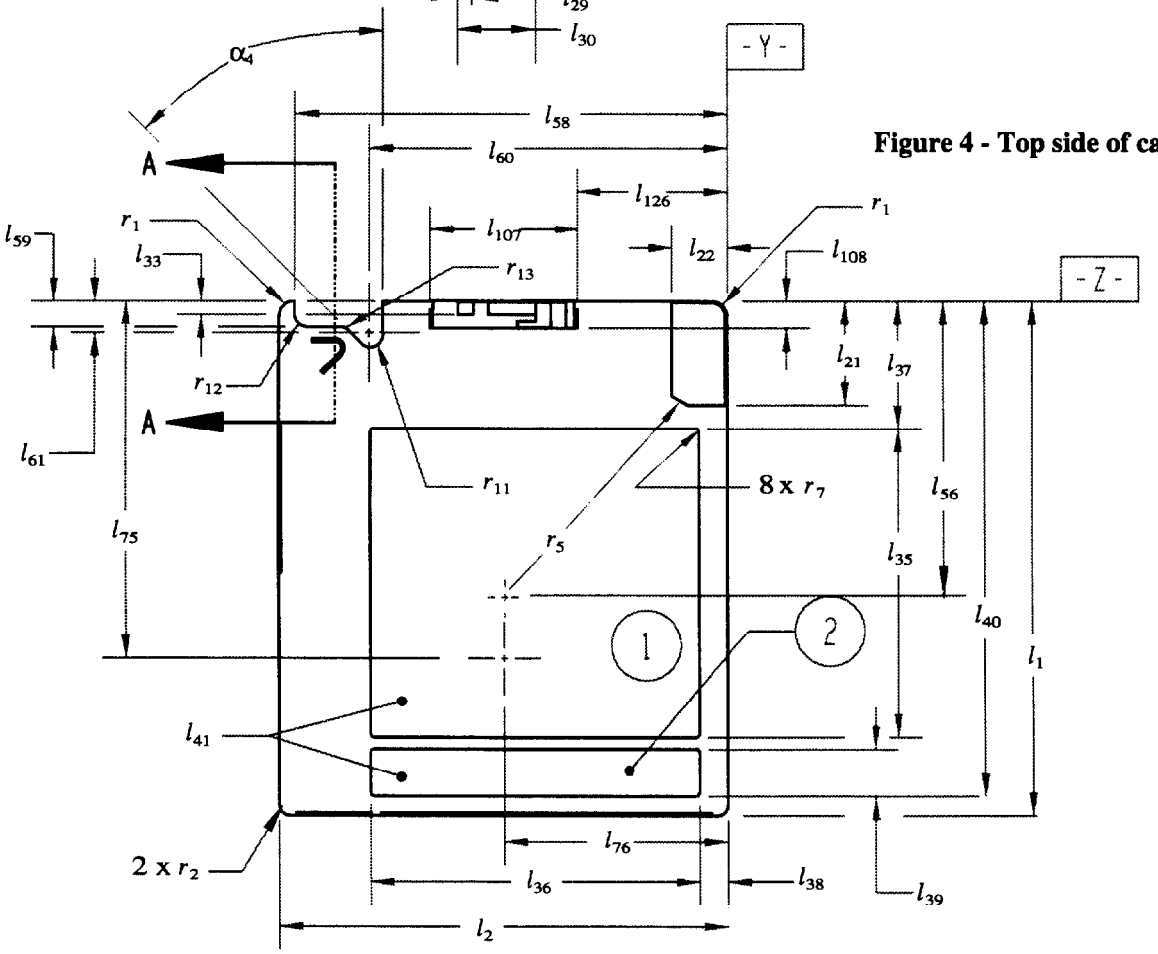


Figure 4 - Top side of case

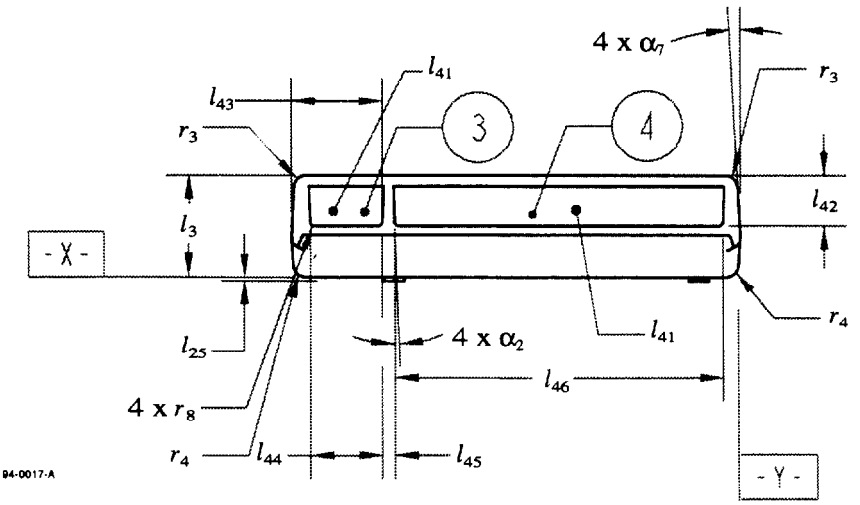


Figure 5 - Rear side of case

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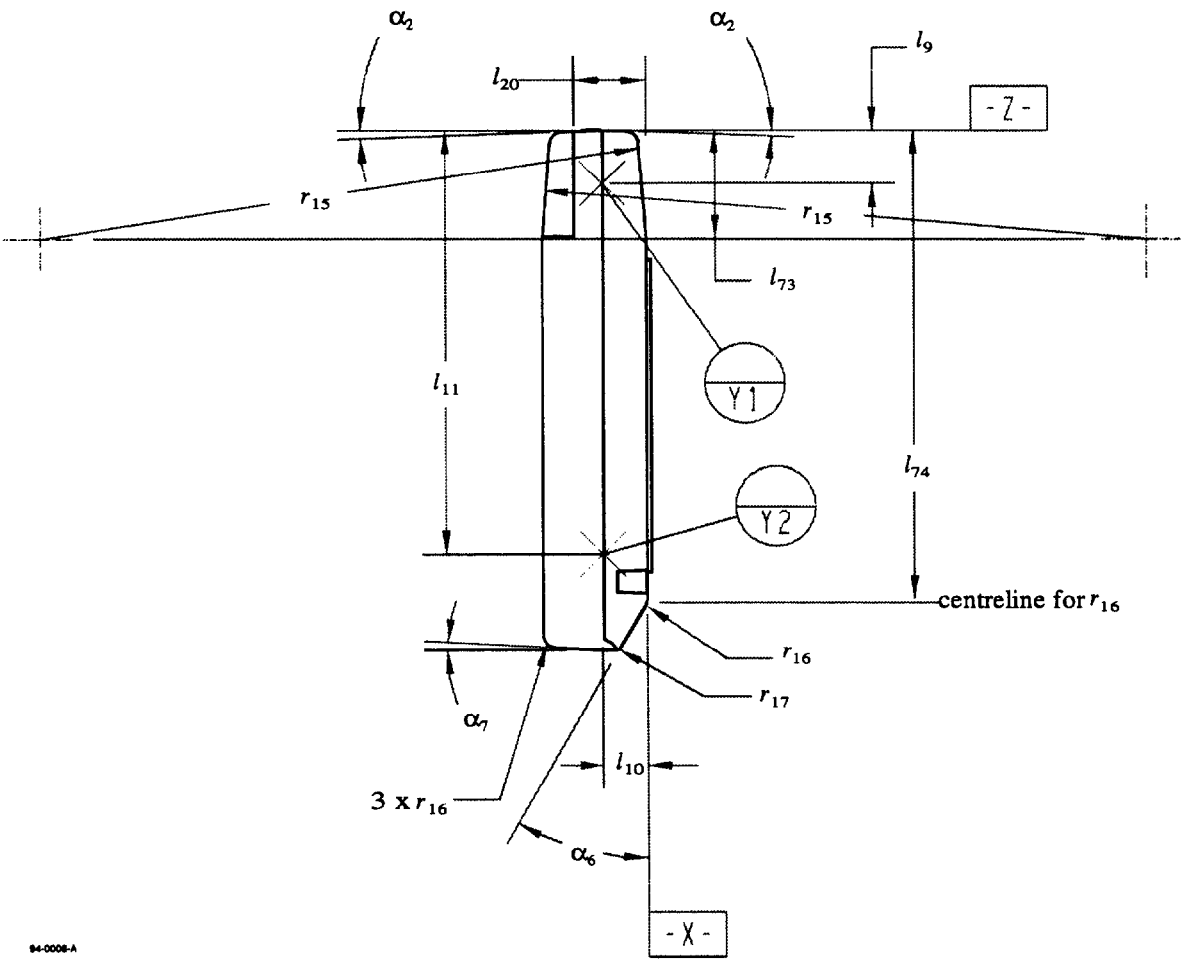


Figure 6 - Left side of case

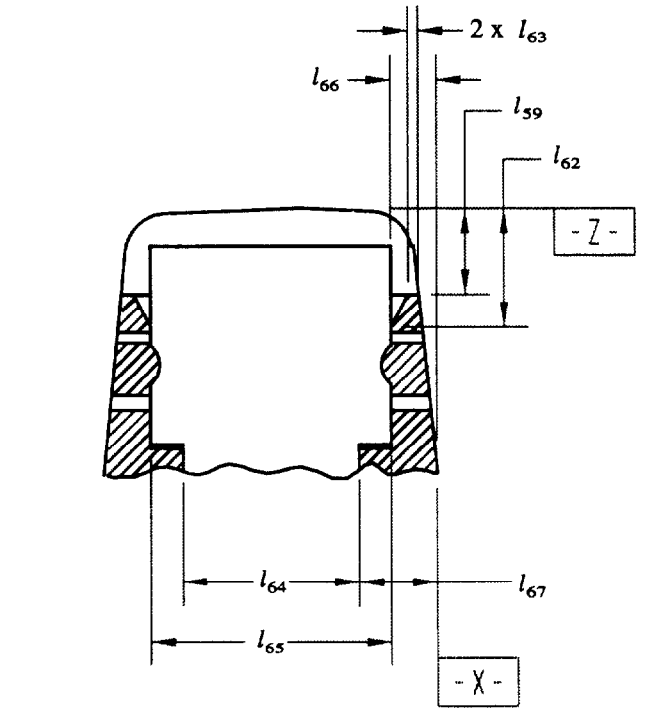


Figure 7 - Section A-A in figure 4

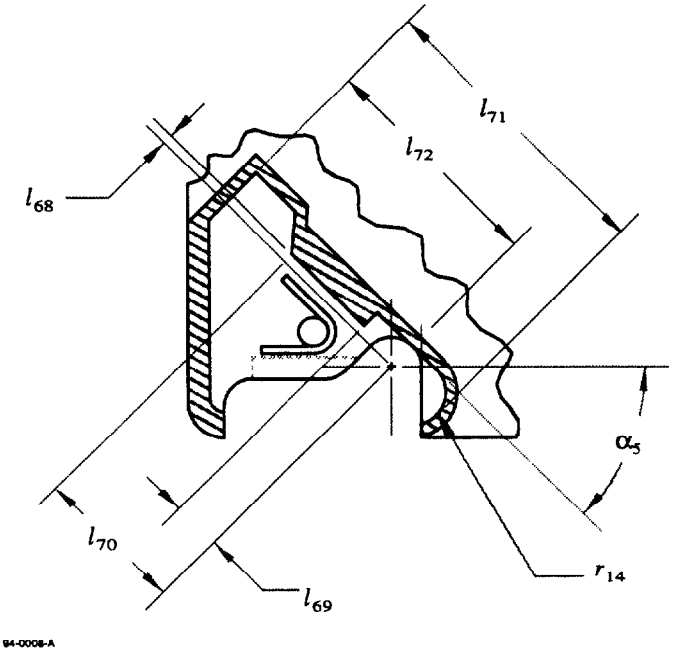


Figure 8 - Section B-B in figure 3

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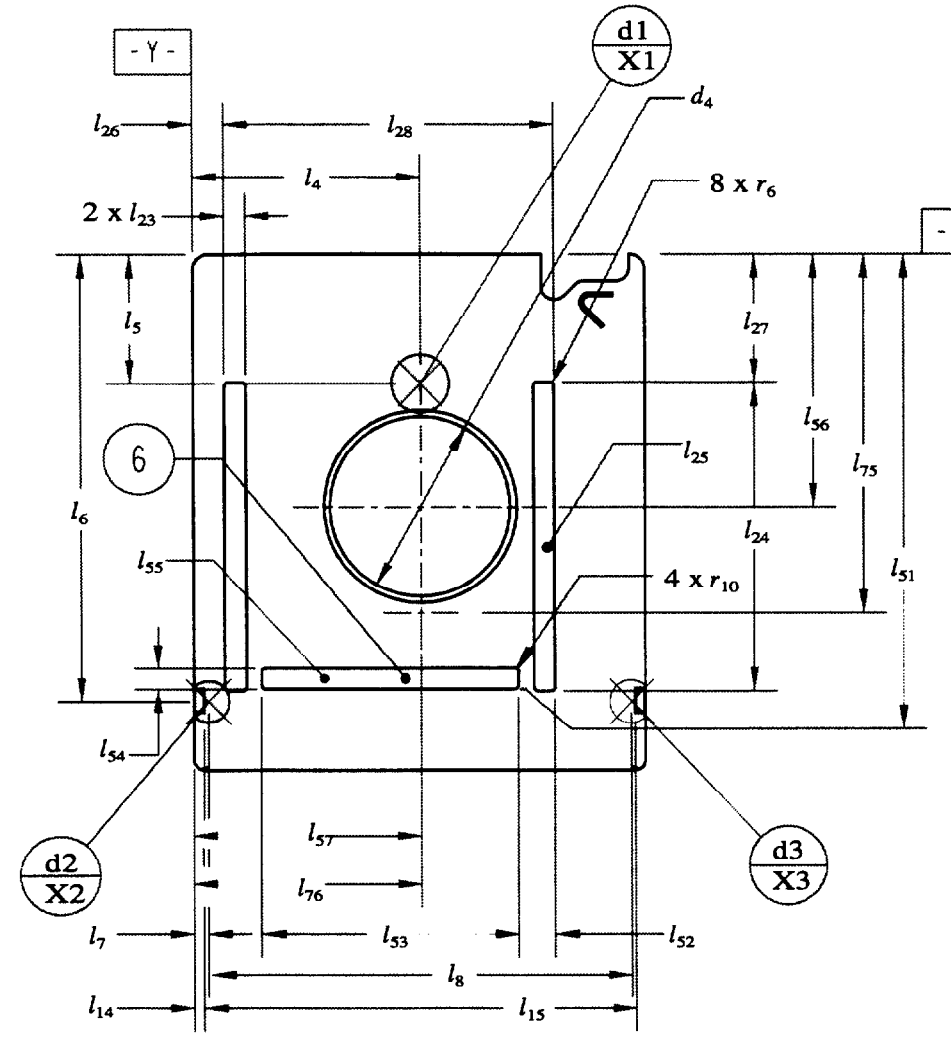


Figure 9 - Bottom side of case

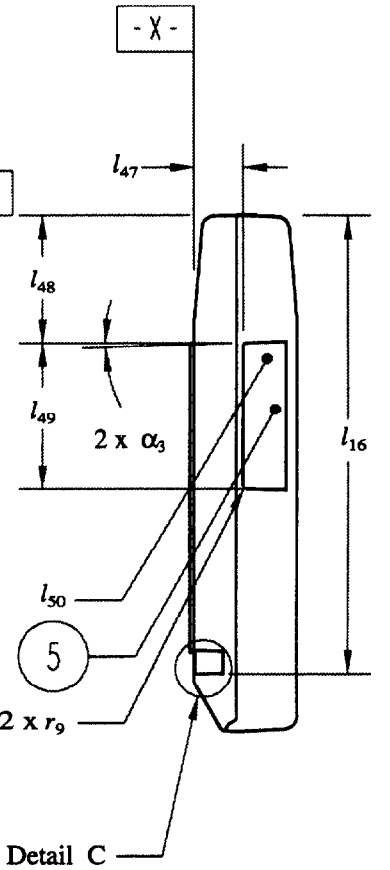


Figure 10 - Right side of case

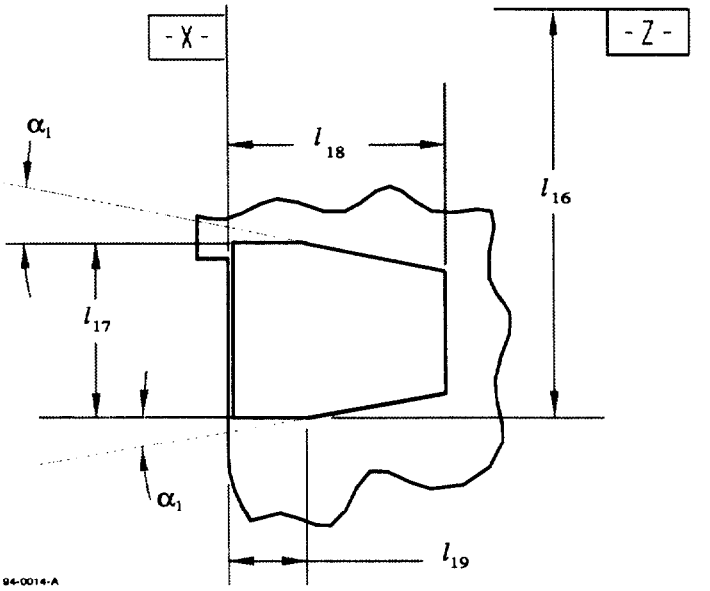


Figure 11 - Detail C of figure 10

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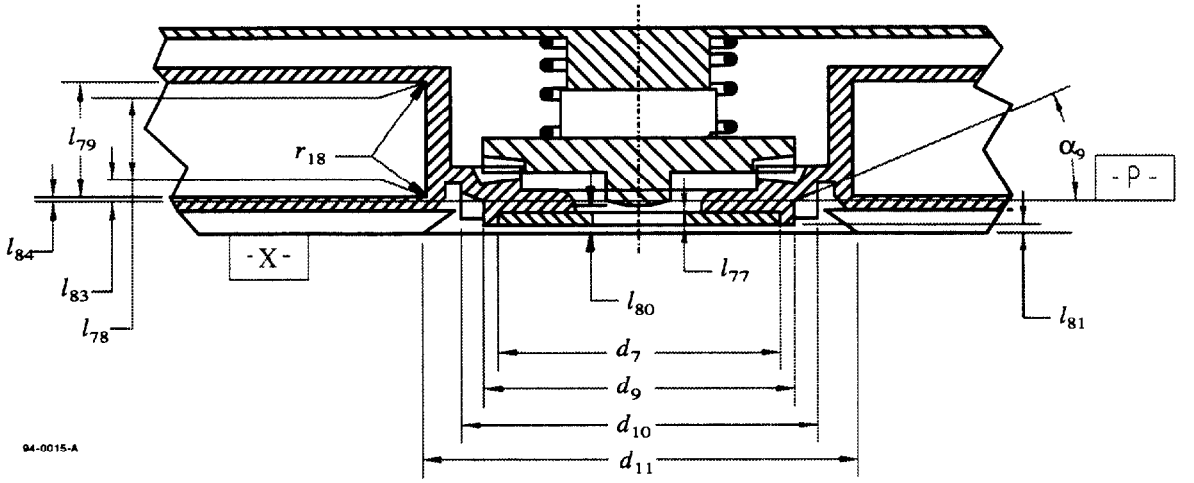


Figure 12 - Cross-section of the cartridge held in the hand

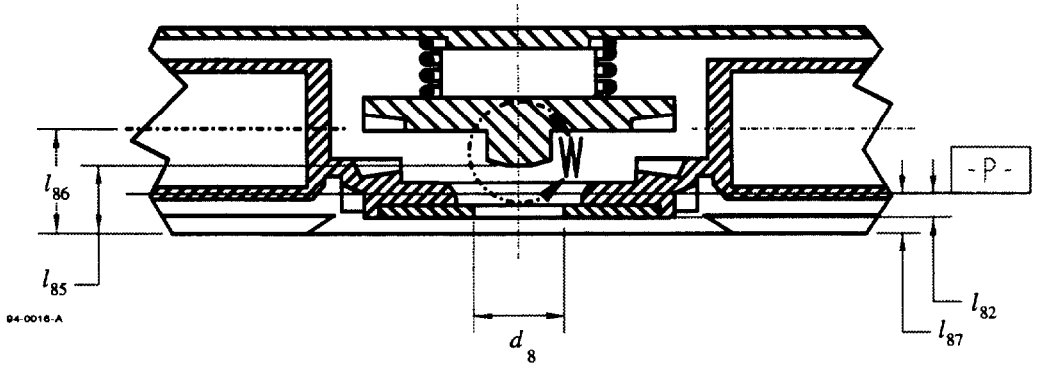


Figure 13 - Cross-section of the cartridge in the drive

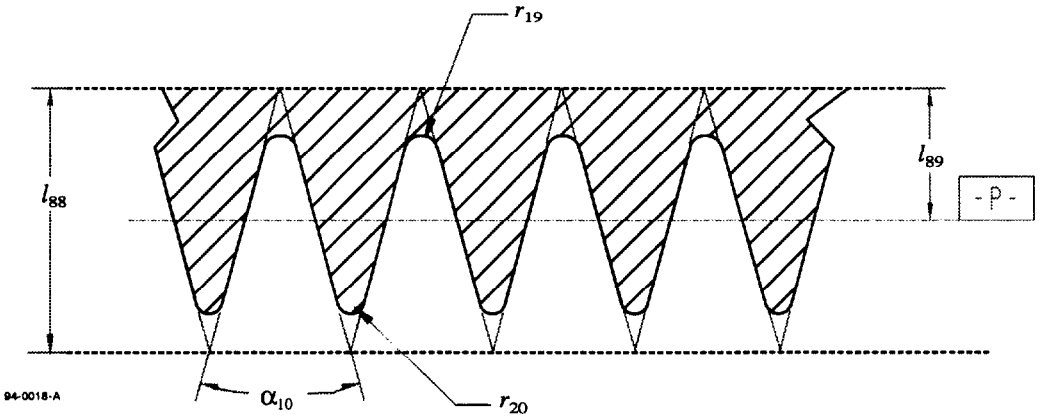


Figure 14 - View at the 41 mm reference diameter showing profile of gear teeth

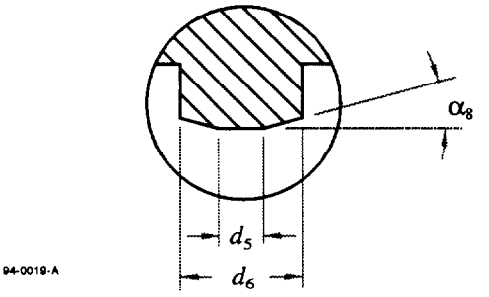


Figure 15 - Detail W of figure 13

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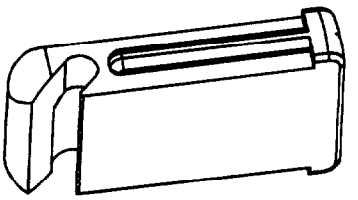


Figure 16 - General view of the leader block

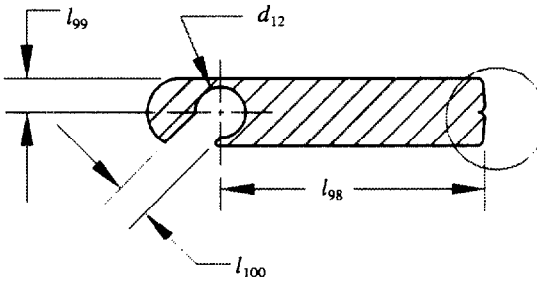


Figure 17 - Section A-A of figure 18

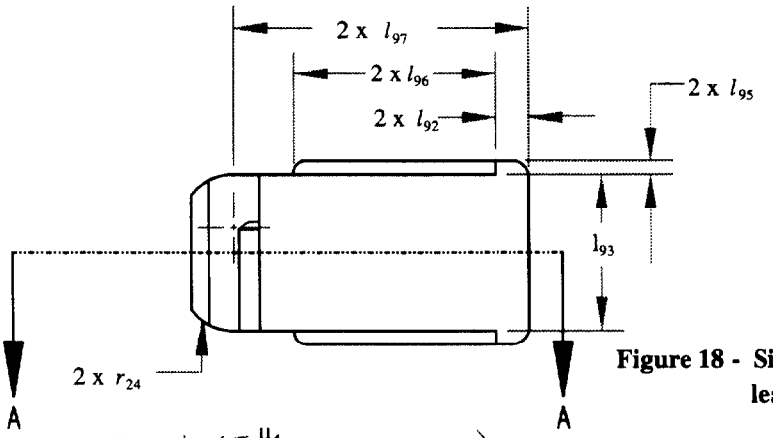


Figure 18 - Side view of leader block

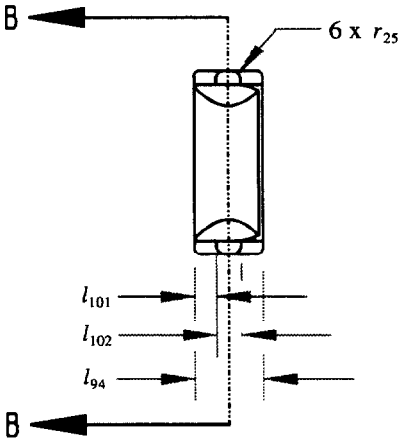


Figure 19 - Front view of leader block

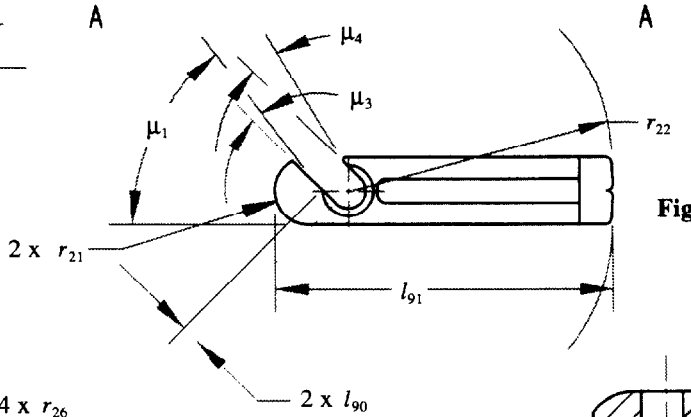


Figure 20 - Bottom view of leader block

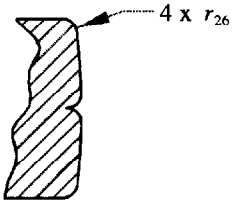


Figure 22 - Detail C of figure 17

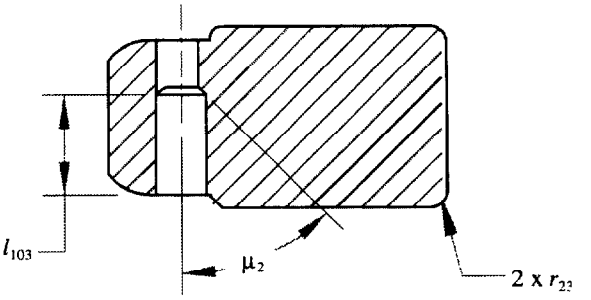


Figure 21 - Section B-B of figure 19

94-0020-A

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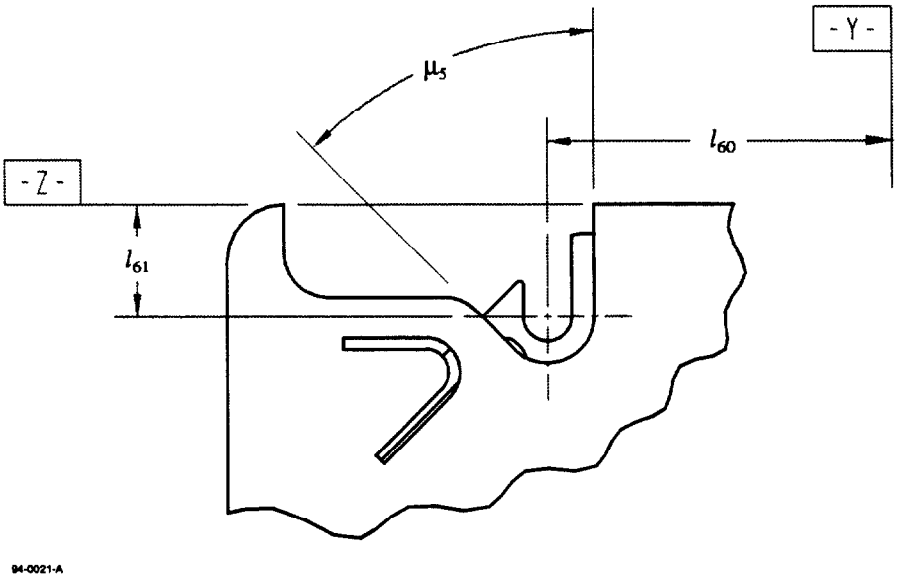


Figure 23 - Details of leader block inserted into the case

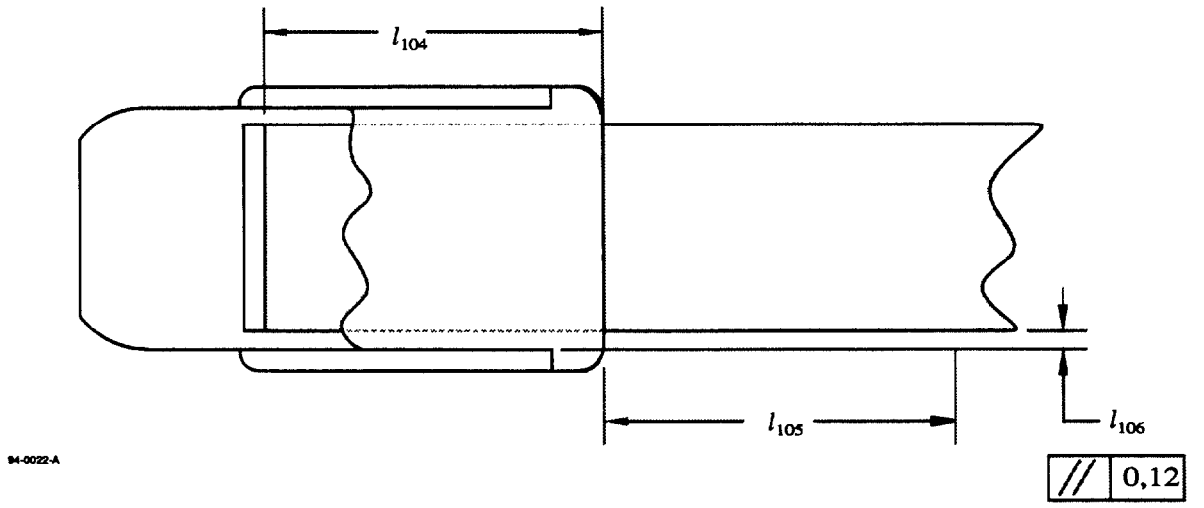


Figure 24 - Mechanical requirements of the leader block assembly

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Section 3 - Requirements for the Unrecorded Tape

9 Mechanical, physical and dimensional characteristics of the tape

9.1 Materials

The recordable area of the tape shall consist of a base material (oriented polyethylene terephthalate film or an equivalent) coated on one side with a strong yet flexible layer of ferromagnetic material dispersed in a suitable binder. If the back surface of the tape is coated, only a non-magnetic material shall be used.

9.2 Tape length

The length of magnetic tape between the leader block and the hub shall be in the range

For Type A : 91,00 m to 95,55 m
For Type B : 204,00 m to 214,20 m
For Type C : 392,00 m to 411,60 m

9.3 Tape width

The width shall be measured across the tape from edge to edge. The width of the magnetic tape shall be $W = 12{,}650$ mm ± 0,008 mm. The fluctuations of the tape width shall be no more than 5 µm peak-to-peak.

Procedure for measuring the width of the tape.

i. Cover a section of the tape with a glass microscope slide.

ii. Measure the width with no tension applied to the tape, using a calibrated microscope, profile projector, or equivalent, having an accuracy of at least 1 µm.

iii. Repeat the measurement at five or more different positions along a length of tape of 1 m min.

iv. The tape width is the average of the widths measured.

Procedure for measuring the fluctuations in the width of the tape.

i. Cover a section of the tape at BOT with a glass microscope slide, apply a tension of 0,31 N ± 0,05 N and measure the width as above.

ii. Repeat 9 times at points separated by 100 mm over the first 900 mm of tape.

iii. Reject the maximum and minimum values.

iv. The fluctuation of the tape width is the difference between the maximum and minimum of the remaining 8 measurements.

9.4 BOT and EOT Sense Slots

The BOT and EOT Sense Slots are located as shown in figure 45. The distance of the centreline of the slots from the Tape Reference Edge shall be

$l_{127} = 6{,}35$ mm ± 0,25 mm

The dimensions of the slots shall be

$l_{110} = 4{,}74$ mm ± 0,10 mm
$l_{111} = 3{,}18$ mm ± 0,20 mm
$r_{27} = 1{,}590$ mm ± 0,050 mm

9.5 Discontinuities

There shall be no discontinuities in the tape between the BOT and EOT Sense Slots, such as those produced by tape splicing or perforations.

9.6 Thickness

The total thickness of the tape is made up of the base film, the magnetic coating, and the back coating if present.

The total thickness at any point along the length of the tape shall be between 13,0 µm and 14,0 µm.

9.7 Longitudinal curvature

The radius of curvature of the edge of the tape shall not be less than 33 m.

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Procedure

Allow a 1 m length of tape to unroll and assume its natural curvature on a smooth flat surface. Measure the deviation from a 1 m chord. The deviation shall not be greater than 3,8 mm. This deviation corresponds to the minimum radius of curvature of 33 m if measured over an arc of a circle.

9.8 Straightness

The deviation of the straightness of the Tape Reference Edge shall not exceed 6 µm peak-to-peak.

Procedure

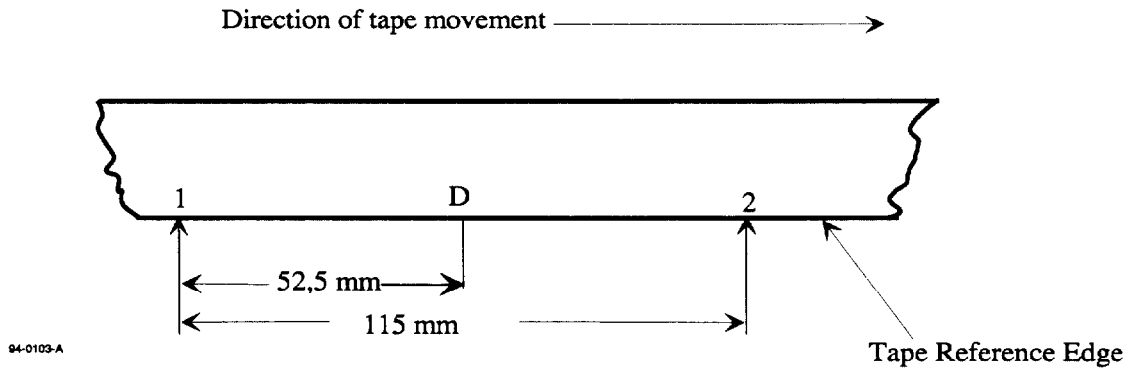


Figure 25 - Straightness

Two edge guides shall be set up, spaced 115 mm apart.

The tape shall be drawn past the guides at a constant speed.

Deviations of the Reference Edge shall be measured at point D, 52,5 mm after guide 1, and shall be averaged over 10 mm of tape movement.

9.9 Cupping

The departure of the surface of the tape, across the width of the tape, from a flat surface shall not exceed 1,5 mm.

Procedure

Cut a 1,0 m ± 0,1 m length of tape. Condition it for a minimum of 3 h in the Test Environment by hanging it so that the recording surface is freely exposed to the Test Environment. From the centre portion of the conditioned tape cut a test piece of length 25 mm. Stand the test piece on its end in a cylinder which is at least 25 mm high and has an inside diameter of 13,0 mm ± 0,2 mm. With the cylinder standing on an optical comparator measure the cupping by aligning the edges of the test piece to the reticle and determining the distance from the aligned edges to the corresponding surface of the test piece at its centre.

9.10 Out-of-plane distortions

All visual evidence of out-of-plane distortion shall be removed when the tape is subjected to an uniform tension of 0,31 N ± 0,05 N.

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

9.11 Coating adhesion

The force required to peel any part of the coating from the tape base material shall not be less than 0,96 N.

Procedure

a) 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.

b) Using a double-sided pressure sensitive tape, attach the full width of the test piece to a smooth metal plate, with the recording surface facing the plate, as shown in figure 26.

c) Fold the test piece over 180°, 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/min.

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d) Note the force at which any part of the coating first separates from the base material. If this is less than 0,96 N, the tape has failed the test. If the test piece peels away from the double-sided pressure sensitive tape before the force exceeds 0,96 N, an alternative type of double-sided pressure sensitive tape shall be used.

e) If the back surface of the tape is coated, repeat a) to d) for the back coating.

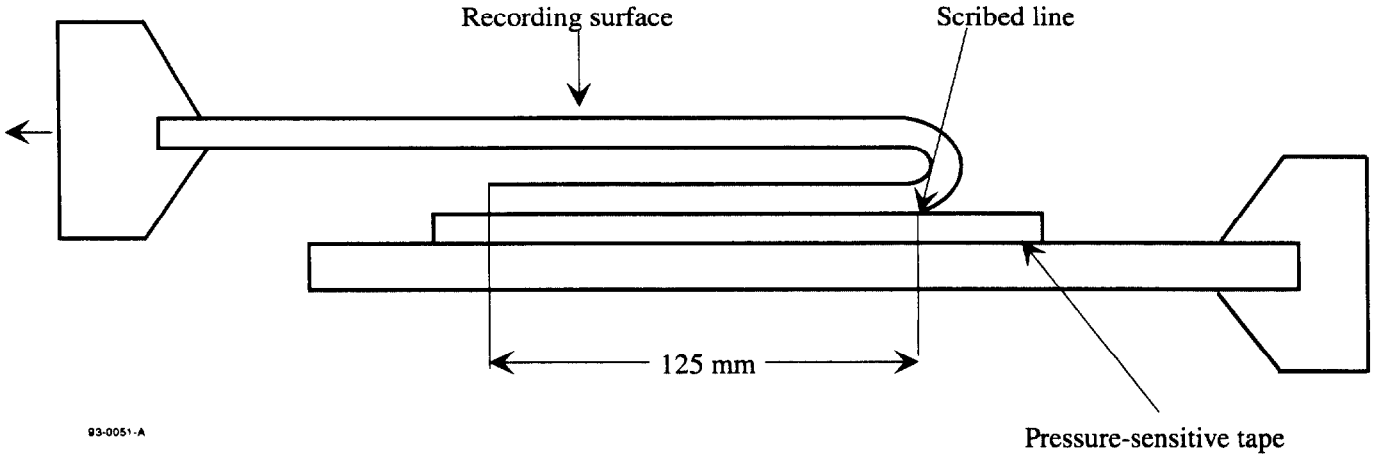


Figure 26 - Coating adhesion

9.12 Layer-to-layer adhesion

There shall be no tendency for the test piece to stick or for the coating to peel.

Procedure

i. Attach one end of a test piece of magnetic tape of length 1 m to the surface of a glass tube of external diameter 36 mm.

ii. Wind the test piece onto the tube with a tension of 0,9 N.

iii. Store the wound test piece in a temperature of 45°C ± 3°C and a relative humidity of 80 % for 4 h.

iv. Store for a further 24 h in the Test Environment.

v. Apply a force of 0,1 N to the free end of the test piece and allow it to unwind slowly.

9.13 Young's Modulus for the tape

Young's Modulus is the ratio of stress to strain; it is measured in the longitudinal direction.

The value for the tape shall be between 5 500 N/mm^2 and 8 500 N/mm^2.

Procedure

Clamp a test piece of tape in a universal testing machine, allowing a 200 mm separation between the jaws of the machine. Set the speed of separation of the jaws to 100 mm/min.

Plot force against distance.

Calculate the change in force required to cause a change in length of 1,0 %.

$$\text{Young's modulus} = \frac{\Delta F / WT}{\Delta L / L}$$

where ΔF is the change in force in newtons

T is the measured thickness of the test piece in millimetres

W is the measured width of the test piece in millimetres

$\Delta L/L$ is the change in the length of the test piece between the jaws divided by the original length of the test piece between the jaws.

9.14 Surface roughness

The surface roughness of the recording surface shall be between 2 nm and 12,5 nm rms.

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The surface roughness of the back surface shall be between 2 nm and 25 nm rms (ISO 1302: N1), with or without a back coating.

The measurements of surface roughness shall be made using non-contacting measuring equipment.

9.15 Electrical resistance of coated surfaces

Requirement

The electrical resistance of the recording surface of the magnetic tape, measured on any square area of the tape, shall be within the range

$10^5\ \Omega$ to $5 \times 10^{12}\ \Omega$

The electrical resistance of the back coating, if present, shall be less than

$9 \times 10^8\ \Omega$

Procedure

Condition a test piece in the Test Environment for 24 h. Position the test piece over two 24-carat gold-plated, semicircular electrodes having a radius $r = 25{,}4$ mm and a finish of at least N4, so that the recording surface is in contact with each electrode (see figure 27). These electrodes shall be placed parallel to the ground and parallel to each other at a distance $d = 12{,}65$ mm between their centres. Apply a force of 1,62 N to each end of the test piece. Apply a dc voltage of 500 V ± 10 V across the electrodes and measure the resulting current flowing. From this value determine the electrical resistance.

Repeat for a total of five positions along the test piece and average the five resistance readings. For back-coated tape repeat the procedure with the back surface in contact with the electrodes.

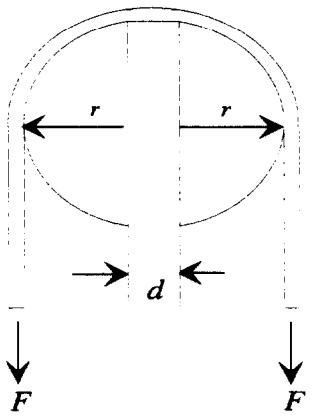


Figure 27 - Position of test piece over two semi-circular electrodes

When mounting the test piece, make sure that no conducting path exists between the electrodes except that through the coating under test.

Note 4 - Particular attention should be given to keeping the surfaces clean.

9.16 Tensile strength

Measurements shall be made in accordance with ISO/R 527. The length of the test piece shall be 200 mm. The rate of elongation shall be 100 mm/min. (ISO/R527 Rate D).

9.16.1 Breaking strength

Load the test piece until the breaking point is reached. The force required to reach that point is the breaking strength of the tape.

Requirement

The breaking strength shall be greater than, or equal to, 27,8 N.

9.16.2 Offset yield strength

The offset yield strength is the force required to produce a 0,2 % elongation of the tape.

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Requirement

The offset yield strength shall be greater than 10 N.

9.17 Residual elongation

Requirement

The residual elongation, expressed as a percentage of the original length, shall be less than 0,03 %.

Procedure

Measure the initial length of a test piece of length approximately 1 m with an applied tensile force of less than 0,20 N.

Apply for 10 minutes an additional force of 3,5 N.

Remove the additional force and measure the length after a further 10 minutes.

9.18 Light transmittance of the tape

The light transmittance of the magnetic tape shall be less than or equal to 5 % when measured as specified in annex J.

10 Magnetic Recording Characteristics

10.1 General

The magnetic tape shall have a coating of metal particles or equivalent.

10.2 Basis for measuring the magnetic recording characteristics of the unrecorded tape.

The requirements of the helically recorded tracks are more demanding than those of the longitudinal tracks; it is deemed to be sufficient to carry out tests on the helically recorded tracks only.

The magnetic recording characteristics shall be as defined by the test requirements given below.

The posititive azimuth tracks shall be used.

When performing these tests, the output or resultant signal shall be measured on the same relative pass for both a tape calibrated to the Master Standard Reference Tape and the tape under test (i.e. read-while-write or first forward-read-pass) on the same equipment.

10.3 Test conditions

The following conditions shall apply to all tests of magnetic recording performance specified in this clause and in clauses 12 to 15, unless otherwise stated.

tape condition	:	a.c. erased to 2 % or less of SRA1
tape tension	:	0,26 N to 0,36 N
helical tracks		
head-to-tape speed	:	21,40 m/s ± 0,04 m/s
read gap width	:	25,0 µm to 35,0 µm
write track width	:	20,0 µm ± 1,0 µm
track angle	:	4,9192° ± 0,0103°
gap azimuth	:	positive orientation of 20,019° ± 0,150°
write gap length	:	0,22 µm ± 0,05 µm
read gap length	:	0,22 µm ± 0,05 µm
recording current	:	TRC1
servo control track		
track width	:	400 µm ± 50 µm
write gap length	:	1,5 µm
recording current	:	TRC2
time code track		
track width	:	450 µm ± 50 µm
write gap length	:	1,5 µm

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recording current : TRC3

10.4 Typical Field

TF1 of the tape shall be between 80 % and 120 % of RF1.

Traceability to RF1 is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

10.5 Signal Amplitude

The Average Signal Amplitude at the physical recording density of 2 597 ftpmm shall be between 80 % and 120 % of SRA1.

Traceability to SRA1 is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

10.6 Resolution

The ratio of the Average Signal Amplitude at the physical recording density of 2 597 ftpmm to that at the physical recording density of 742 ftpmm shall be between 80 % and 120 % of that for the Master Standard Reference Tape.

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

10.7 Ease of Erasure

When the tape has been recorded at 742 ftpmm with TRC1 and then passed through a longitudinal a.c. erasing field of 382 000 A/m, any remaining signal shall not exceed 2 % of SRA1.

10.8 Narrow-band Signal-to-Noise Ratio (NB-SNR)

10.8.1 The NB-SNR is the average signal amplitude rms power divided by the average integrated (side band) rms noise power and is expressed in dB.

Requirement

When measured at a track width of 20 µm the NB-SNR shall be equal to, or greater than, 43 dB.

If measurements are made at any other track width W, the normalised result

$dB(W) + 10\log\frac{20}{W}$ shall be equal to, or greater than, 43 dB.

10.8.2 Procedure

The NB-SNR shall be measured using a spectrum analyzer with a resolution bandwidth of 17 kHz and a shape factor of 4:1. The shape factor is the ratio of the resolution bandwidth at -60 dB to that at -3 dB.

a) erase the tape to be tested.

b) Record the tape at 2 597 ftpmm.

c) On the next pass (read only) measure the read signal amplitude (amp sig) using the spectrum analyzer.

d) On the next pass (read only) over the same section of tape, exclude the recorded signal and measure the total system noise (n_{total}), integrating the rms noise (normalizing for the actual bandwidth) over the range 27,44 MHz to 28,14 MHz.

e) Unload the tape and, with power on, measure the transport rms noise ($n_{transport}$) and integrate the rms noise (normalized for the actual bandwidth) over the range 27,44 Mhz to 28,14 Mhz.

f) Calculate the tape noise as follows:

$$n_{tape} = \sqrt{(n_{total})^2 - (n_{transport})^2}$$

g) Determine the NB-SNR in dB from the values obtained in b) and f) above, as follows:

$$\text{NB-SNR} = 20 \log \left(\frac{\text{amp sig}}{n_{tape}} \right)$$

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10.9 Tape Quality

10.9.1 Missing pulses

A missing pulse is a loss of read signal amplitude. A missing pulse exists when the base-to-peak amplitude is 40 %, or less, of half the Average Signal Amplitude.

10.9.2 Missing pulse zones

A missing pulse zone begins with a missing pulse and ends when 21 consecutive flux transitions, which are not missing pulses, have been detected. If a missing pulse zone continues for a distance exceeding 0,26 mm, a further missing pulse zone is counted.

Requirement

The missing pulse zone rate shall be less than one missing pulse zone per 2×10^6 flux transitions recorded at the physical recording density of 2 597 ftpmm.

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Section 4 - Requirements for an Interchanged Tape

11 Format of a helically recorded track

11.1 General description of the write data path (see figure 28)

In 11.1 a brief description is given of the sequence of operations between receipt of data from the host to writing the processed data on helical tracks. The operations are fully described in 11.2 to 11.4.

11.1.1 Formation of Packets (see 11.2).

LDRs, not exceeding 262 144 bytes, are received from the host. The LDR may be processed by a data compression algorithm, the output of which is a PDR. The processed or unprocessed data, a UDR, is passed to the Packet Generator.

A Packet is formed by the addition of a Packet ID (see 11.2.2) protected by a CRC, and a Packet Trailer (see 11.2.4) containing CRC protection for the UDR and the Trailer.

11.1.2 Formation of Scan Groups (see 11.3).

The total extent of a Scan Group is 195 840 bytes; after further processing it occupies 3 pairs of helical tracks.

11.1.2.1 Data Scan Group

A Data Scan Group is formed from the Scan Group Start Data (SGSD), Helical Time Code (HTC) and Packets. A fixed header and a variable header, each protected by a CRC, are added to complete the Scan Group. If the data part of the Scan Group is incomplete, pad bytes are added as required. A further CRC is added to protect the data bytes and the pad bytes.

11.1.2.2 ECC-3 Scan Group (see 11.3.6.5)

After a maximum of 24 Data Scan Groups, an ECC-3 Scan Group is generated.

11.1.3 Channel separation

The sequence of 195 840 bytes is directed alternately to two Scan Group Sections, which are processed independently in two Write Channels. Each Scan Group Section is divided into 765 groups of 128 bytes, to each of which is added an Outer ECC (11.4.2.2) to form an Outer ECC Code Word.

11.1.4 Interleave buffer (see 11.4.2)

The Outer ECC Code Words fill the 765 vertical columns of the Interleave Buffer in an ordered sequence. The 136 horizontal rows of the Buffer are emptied according to a further ordered sequence.

11.1.5 Sync Blocks (see 11.4.3)

Each of the 136 rows is used to create 9 Sync Blocks, each containing sync bytes, 85 data bytes, an identifier and an Inner ECC (11.4.3.4)

11.1.6 Randomization

The contents of the Sync Blocks are randomized (see 11.4.3.2).

11.1.7 Logical helical track

A logical helical track is formed from a Track Preamble, 24 Outer ECC Sync Blocks, 384 Data Sync Blocks, and a Track Postamble.

11.1.8 Byte translation

Each byte of the logical helical track is translated to a 14-bit pattern by an 8:14 code before recording.

11.1.9 Recording of tracks

Tracks are written alternately from the two channels.

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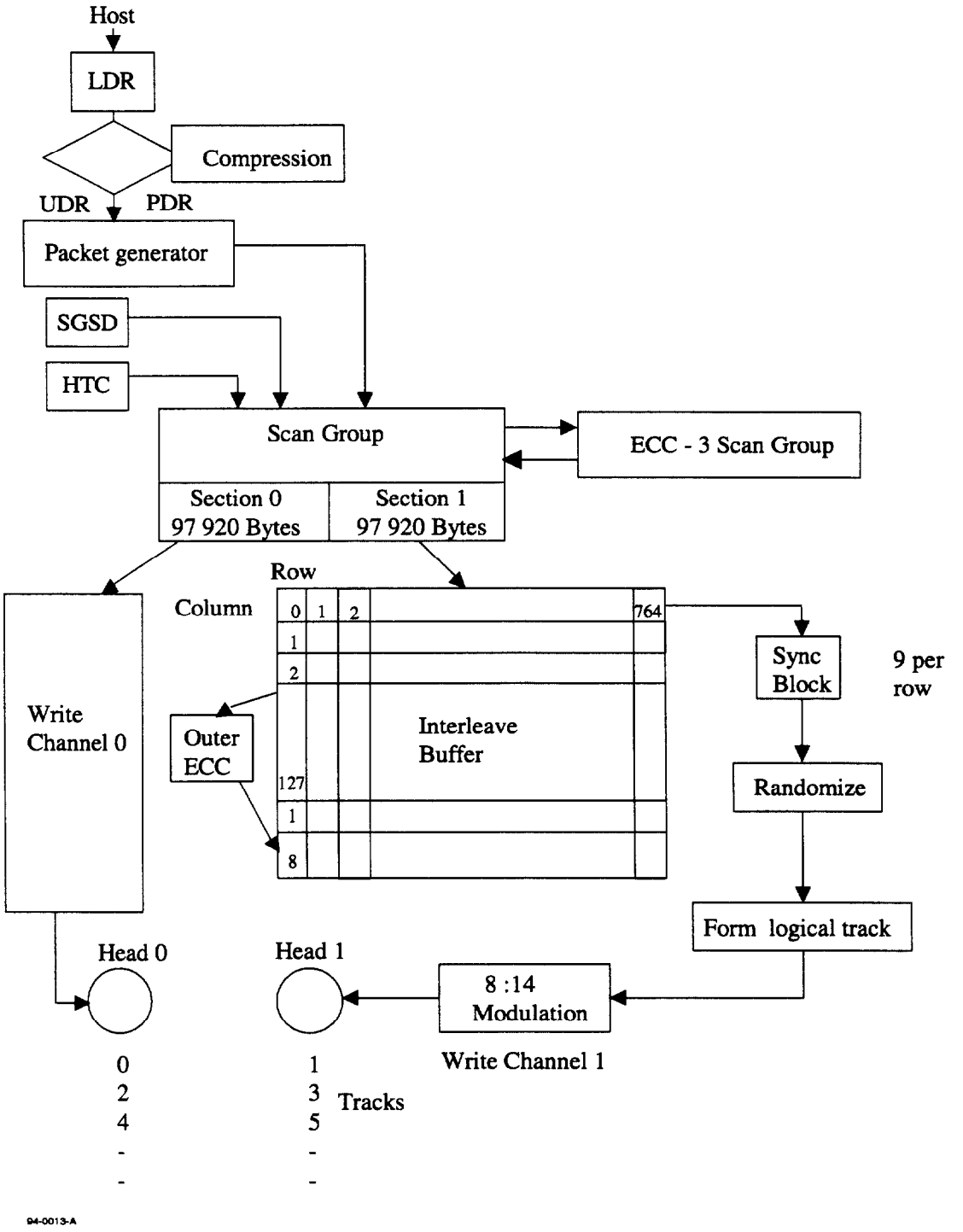


Figure 28 - A typical write data path

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11.2 Packet format (figure 29)

11.2.1 Records received from the host shall be formatted into Packets and placed in the Packet Buffer.

A Packet shall consist of :

Packet ID
UDR
Packet Trailer

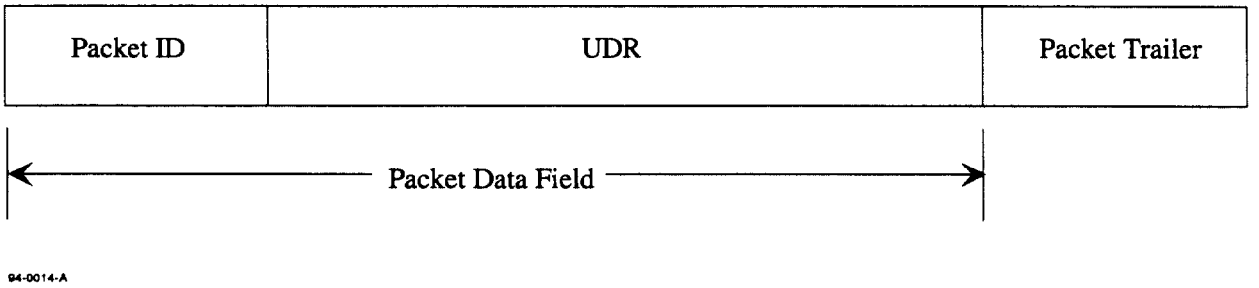


Figure 29 - Outline Packet format

11.2.2 Packet ID (figure 30)

The Packet ID shall consist of 32 bytes, numbered 1 to 32. Packet ID bytes shall not be processed.

Bytes 1 to 6 constitute the Packet Block ID

Byte 1

Bits 7 to 1 shall be set to 0100000

Bit 0 shall be set to

ZERO if the Packet is recorded in the first 95 sectors
ONE if the Packet is recorded in the last 95 sectors (see 16.2.1)

Byte 2

Bit 7 shall be set to

ZERO if the Packet is recorded in the first 95 sectors
ONE if the Packet is recorded in the last 95 sectors

Bit 6 to 0 shall expresss, in binary notation, a count of the number of the sector in which the Packet is recorded.

The count shall increment from 1 to 95 for the first half of the tape and decrement from 95 to 1 for the second half of the tape.

Bytes 3 to 6 shall express, in binary notation, the Logical Block Number.

It shall be set to 0 for the first UDR written after the SEP area (see 11.3.6.6). It shall be increased by 1 for each UDR or Tape Mark.

Bytes 7 to 10 shall express, in binary notation, a value equal to the total number of bytes in the Packet Data Field, (figure 29) minus 1.

Byte 11 shall express in binary notation, a value equal to the total number of bytes in the Packet Trailer.

The sum of Bytes 7 to 10 and Byte 11 shall be equal to the total number of bytes in the Packet, minus 1.

Byte 12

Bit 7 shall be set to ZERO.

Bit 6 shall be set to

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ZERO if the Packet has not been processed.
ONE if the Packet has been processed.

Bits 5 to 0 shall be set to all ZEROs.

Byte 13 When bit 6 of Byte 12 is set to ZERO, Byte 13 shall be set to all ZEROs.

When bit 6 of Byte 12 is set to ONE, Byte 13 shall contain, in binary notation, the registered identifier of the algorithm used to process the LDR data.

Bytes 14 to 30 shall be set to all ZEROs.

Bytes 31 and 32 shall contain CRC Byte 1 and CRC Byte 2, respectively, computed sequentially over the previous 30 bytes, as described in annex A.

The data from the Packet ID bytes shall be inverted before processing in the CRC generator. The bits in the CRC character shall be inverted before appending to the first 30 bytes of the Packet ID.

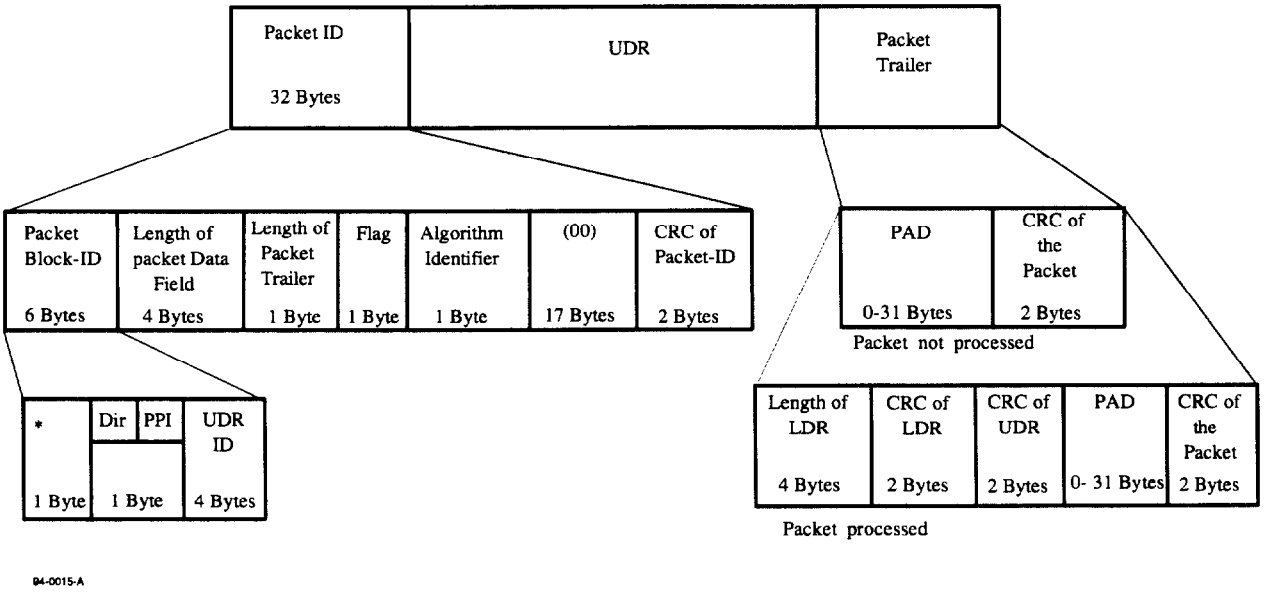


Figure 30 - Complete Packet format

11.2.3 UDR (figure 30)

The UDR shall contain either all processed data, or all unprocessed data, as indicated by Byte 12, bit 6 of the Packet ID.

11.2.4 Packet Trailer (figure 30)

There are two forms of Packet Trailer; one form is used in Packets containing processed data, and the other in Packets containing unprocessed data. Packet Trailer bytes shall not be processed.

11.2.4.1 Packet Trailer when data has been processed

The Packet Trailer shall be 10 to 41 bytes in length.

Bytes 1 to 4 shall express, in binary notation, a count of the number of bytes from the LDR in the Packet, (i.e., before processing).

Bytes 5 and 6 shall contain CRC Byte 1 and CRC Byte 2, respectively, computed sequentially over the bytes from the LDR in the Packet, (i.e. before processing), as described in annex A.

Bytes 7 and 8 shall contain CRC Byte 1 and CRC Byte 2, respectively, computed sequentially over the bytes from the UDR in the Packet (i.e., after processing), and the first six bytes of the Packet Trailer, as described in annex A.

Pad bytes A sufficient number of all ZEROs pad bytes, in the range 0 to 31 shall be added to the Packet Trailer such that the entire Packet consists of an integral multiple of 32 bytes.

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Packet Trailer CRC bytes

The penultimate and ultimate bytes of the Packet Trailer shall contain CRC Byte 1 and CRC Byte 2, respectively, computed sequentially over the bytes from the UDR (i.e., after processing), and the preceding bytes in the Packet Trailer, as described in annex A.

The input shall be inverted before processing in the CRC generator. The bits in the CRC character shall be inverted before appending to the rest of the bytes of the Packet Trailer.

11.2.4.2 Packet trailer when data has not been processed

The Packet Trailer shall be 2 to 33 bytes in length.

Pad bytes There shall be 0 to 31 all ZEROs pad bytes such that the entire Packet consists of an integral multiple of 32 bytes.

Packet Trailer CRC bytes

The penultimate and ultimate bytes of the Packet Trailer shall contain CRC Byte 1 and CRC Byte 2, respectively, computed sequentially over the bytes from the LDR in the Packet, and the preceding pad bytes in the Packet Trailer, as described in annex A.

The input shall be inverted before processing in the CRC generator. The bits in the CRC character shall be inverted before appending to the rest of the bytes of the Packet Trailer.

11.3 Scan Group

The Scan Group is the basic unit for formatting recordings on the tape. A Scan Group consists of six consecutive helical tracks on tape.

There are eight types of Scan Groups :

Data Scan Group
Pad Scan Group
End of Data Scan Group
Tape Mark Scan Group
ECC-3 Scan Group
Separator (SEP) Scan Group
Internal Leader Header (ILH) Scan Group
Density Identification (DID) Scan Group

A Scan Group shall consist of :

Scan Group Start Data
Helical Time Code
Variable Header
Fixed Header
Data Part
Trailer

The sequence of the above components shall differ between odd-numbered Scan Groups and even-numbered Scan Groups, as shown in figures 31 and 32; the numbers shown indicate the number of bytes in each field. The serial number of a Scan Group is defined in 11.3.3.1 Bytes 2 to 5.

SGSD	HTC	HTC	Variable Header		Fixed Header		Data Part	Trailer	
				CRC		CRC		Resd	CRC
768	768	768	20	2	100	2	193 408	2	2

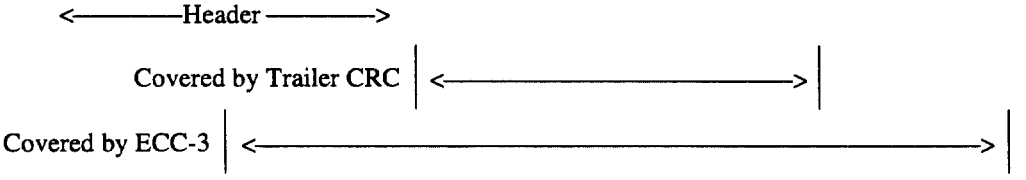


Figure 31 - Format of an odd-numbered Scan Group

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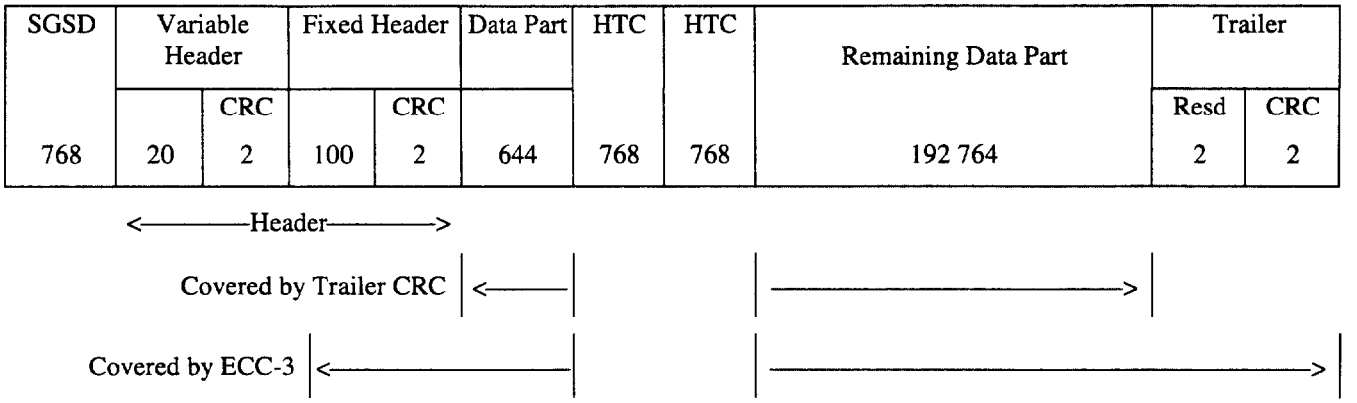


Figure 32 - Format of an even-numbered Scan Group

11.3.1 Scan Group Start Data (SGSD)

The SGSD shall consist of 768 bytes set to (3C) and shall define the start of a Scan Group.

11.3.2 Helical Time Code (HTC)

There is a unique Time Code for each Scan Group Pair. This Time Code shall comprise 90 bits, as shown in annex M. The HTC is formed from the Time Code as described in 11.3.2.6.

11.3.2.1 Synchronizing bits

Bit pairs [0,1] [10,11] [20,21] [30,31] [40,41] [50,51] [60,61] [70,71] and [80,81] shall be synchronizing bits and set as specified in annex M.

11.3.2.2 Count bits

The count of Scan Group Pairs shall be contained in eight sets of count bits.

Bits 2 to 5 shall express, in binary notation, a count of units of Scan Group Pairs, in the range 0 to 9

Bits 12 to 13 shall express, in binary notation, a count of tens of Scan Group Pairs, in the range 0 to 2

Note 5 - At the nominal linear speed of the tape of 83,88 mm/s, 30 Scan Group Pairs will be written, or read, in one second.

Bits 22 to 25 shall express, in binary notation, a count of units of seconds, in the range 0 to 9

Bits 32 to 34 shall express, in binary notation, a count of tens of seconds, in the range 0 to 5

Bits 42 to 45 shall express, in binary notation, a count of units of minutes, in the range 0 to 9

Bits 52 to 54 shall express, in binary notation, a count of tens of minutes, in the range 0 to 5

Bits 62 to 65 shall express, in binary notation, a count of units of hours, in the range 0 to 9

Bits 72 and 73 shall express, in binary notation, a count of tens of hours, in the range 0 to 3

The first Scan Group Pair written on the tape - the first Scan Group Pair of the DID - shall have ZEROs entered in all count bits. The count shall be incremented by 1 for each subsequent Scan Group Pair.

11.3.2.3 Supplementary Data

There shall be eight groups of Supplementary Data each consisting of four bits. EOD Scan Group Pairs shall have all eight groups set to 0011. For all other types of Scan Group these groups shall be set to 0000.

11.3.2.4 Even/odd bit

Bit 35 shall be set to ZERO for even-numbered Scan Groups;
to ONE for odd-numbered Scan Groups.

11.3.2.5 CRC

Bits 82 to 89 contain the CRC, computed over bits 0 to 81 as described in annex N.

11.3.2.6 Formation of the HTC

The 90 bits of the Time Code shall be represented in the HTC as follows (see figure 33).

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A ONE bit shall be represented by 8 (AC) bytes, except that

i. when the ONE bit follows a ZERO bit, the first two bytes shall be (86)(A2),

ii. when the ONE bit is followed by a ZERO bit, the last two bytes shall be (A2)(86).

A ZERO bit shall be represented by 8 (3C) bytes, except that

i. when the ZERO bit follows a ONE bit, the first two bytes shall be (62)(46),

ii. when the ZERO bit is followed by a ONE bit, the last two bytes shall be (46)(62).

At the end of the string of 720 bytes so generated, 48 bytes of 3C shall be added to create a 768 byte HTC.

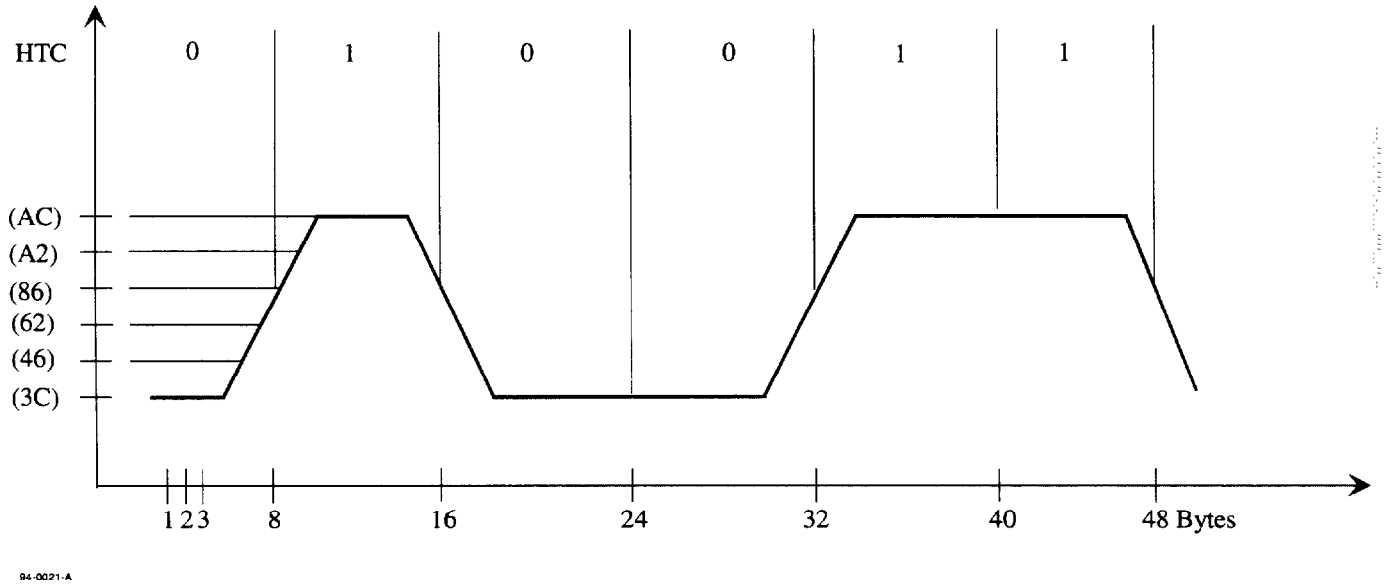


Figure 33 - Encoding of HTC bits

11.3.2.7 Positions of the HTC in a Scan Group

There shall be two HTCs in a Scan Group; their positions in odd-numbered and in even-numbered Scan Groups shall be as shown in figures 31 and 32.

11.3.3 Header

The header shall consist of 124 bytes, which shall be subdivided into a Variable Header field of 22 bytes and a Fixed Header field of 102 bytes, each of which includes a separate 2-byte CRC.

11.3.3.1 Variable Header field

The Variable Header contains bytes which will change if the Scan Group is rewritten, and bytes which are different in an ECC-3 Scan Group from those in a Data or ILH Scan Group. The field is not protected by an ECC-3 Scan Group.

Byte 0 Scan Group type

When set to (00) it shall indicate a Data Scan Group
(02) Pad Scan Group
(03) End of Data Scan Group
(04) Tape Mark Scan Group
(08) ECC-3 Scan Group
(20) Separator Scan Group (SEP)
(40) Internal Leader Header Scan Group (ILH)
(80) Density Identification Scan Group (DID)

Byte 1 Rewrite count

This byte shall express, in binary notation, a count of the number of times that the Scan Group has been rewritten. The first time that the Scan Group is written, this count shall be

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set to 0, it shall be increased by 1 for each copy of the Scan Group. The Scan Group copy with the highest count shall be used as the valid Scan Group.

Bytes 2 to 5 Physical Scan Group count

These bytes shall contain, in binary notation, the serial number of the Scan Group, starting with 0 for the first Scan Group which shall be a DID Scan Group and increased by 1 for every Scan Group written, regardless of its type.

Byte 6 Super Group sequence (see 11.3.6.5)

The function of this byte shall be determined by the value to which Byte 0 is set.

(00) Byte 6 shall express the sequence number of the Scan Group within the ECC Super Group, starting with 0 and incrementing by 1 for each successive Scan Group.

(40) Byte 6 shall express the sequence number of the ILH Scan Group within the ECC Super Group. The number shall be 0 for the first ILH Scan Group and 1 for the second ILH Scan Group.

(03) or (04) Byte 6 shall be set to (00)

(08) Byte 6 shall express, in binary notation, the number of Data or ILH Scan Groups covered by this Scan Group.

(02),(20) or (80) Byte 6 shall be set to (FF)

Bytes 7 to 10 These bytes shall express, in binary notation, a count of the number of Scan Groups since the last Tape Mark Scan Group, starting with 1 for the first Scan Group following the last Tape Mark Scan Group and increased by 1 for each Scan Group.

If there is no previous Tape Mark Scan Group, the count shall be set to 0.

Bytes 11 to 13 Super Group Count

Byte 0 set to (00), (08) or 40)

These bytes shall express, in binary notation, a count of the number of Super Groups up to this point. The ILH Super Group is the first on the tape and shall have the number 0. The count shall increment by 1 for each subsequent Super Group.

Byte 0 set to (03) or (04)

The count shall be 1 plus the value of the Super Group count in the previous Super Group.

Byte 0 set to (02), (20) or (80)

These bytes shall be set to all ONEs.

Bytes 14 to 19 Reserved for future use; shall be ignored in interchange.

Bytes 20 and 21 CRC over the Variable Header

These bytes shall contain CRC Byte 1 and CRC Byte 2, respectively. They shall be computed sequentially over the previous 20 bytes, as described in annex B, and each bit of the output shall be inverted before appending to Bytes 0 to 19.

11.3.3.2 Fixed Header field

When Byte 0 is set to (08) Bytes 22 to 123 shall be generated by the exclusive OR operation (see 11.3.6.5). For all other settings of Byte 0 defined in 11.3.3.1 the following requirements shall apply.

The contents of the field shall not change when the Scan Group is rewritten. They are protected by the ECC-3 Scan Group.

Byte 22 Mode of recording

Bits 7 to 5 Reserved for future use, to be ignored in interchange

Bit 4 when set to ZERO shall indicate that Write-without-retry is disabled
ONE shall indicate that Write-without-retry is enabled

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Bits 3 to 1 Reserved for future use, to be ignored in interchange

Bit 0 when set to ZERO shall indicate that File-safe is disabled
ONE shall indicate that File-safe is enabled

Bytes 23 to 25 File Identification (File ID)

These bytes shall express, in binary notation, a count of the number of Tape Mark Scan Groups written up to this point. The first Tape Mark Scan Group written shall have a File ID of 1. Scan Groups written before the first Tape Mark Scan Group shall have a File ID of 0.

Scan Groups written between the first and second Tape Marks shall have a File ID of 1.

Bytes 26 to 29 Logical Scan Group number

These bytes shall express, in binary notation, a count of the combined number of Data Scan Groups and Tape Mark Scan Groups written up to this point.

The first ILH Scan Group shall have the Logical Scan Group number 0. The first Data or Tape Mark Scan Group written after the SEP area (see 11.3.6.6) shall have the number 2.

The number increments by 1 for each Data, ILH or Tape Mark Scan Group written.

If a Data or Tape Mark Scan Group is rewritten, its logical Scan Group number does not change.

All EOD Scan Groups (11.3.6.3) shall have 1 plus the Logical Scan Group number of the last Data, Tape Mark or ILH Scan Group (whichever was written last).

For all other Types of Scan Group the bytes shall be set to all ONEs.

Byte 30 Continuation information

If Byte 0 is set to (00) - for a Data Scan Group - this byte shall define whether a UDR continues from the previous Scan Group and whether it continues into the next Scan Group.

For all other types of Scan Group this byte shall be set to all ZEROs.

Bits 7 to 5 Reserved for future use; to be ignored in interchange.

Bit 4 When set to ZERO shall indicate that the last Packet contained in this Scan Group does not continue into the next Scan Group.

When set to ONE shall indicate that the last Packet contained in this Scan Group continues into the next Scan Group.

Bits 3 to 1 Reserved for future use; to be ignored in interchange.

Bit 0 When set to ZERO shall indicate that the Packet byte contained in Byte 0 of the Data Part of the Scan Group is not continued from the previous Scan Group.

When set to ONE shall indicate that the Packet byte contained in Byte 0 of the Data Part of the Scan Group is continued from the previous Scan Group.

Bytes 31 to 33 Number of pad bytes

If Byte 0 is set to (00), these bytes shall contain a count, in binary notation, of the number of pad bytes following the last Packet of host data.

If Byte 0 is set to (40), these bytes shall be set to ZEROs. For other settings of Byte 0, these bytes shall be set to all ONEs.

Bytes 34 to 36 Pointer to the first Packet beginning in the Scan Group.

If a Packet started in the previous Scan Group, continues into this Scan Group and is followed by a further Packet, these bytes shall indicate, in binary notation, the offset of this Packet Header from the beginning of the Data Part.

When set to all ZEROs shall indicate that the first Packet in the Scan Group starts at the beginning of the Data Part.

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When set to all ONEs shall indicate that no Packet starts in this Scan Group.

Bytes 37 to 41 First Logical Block number in the Scan Group

These bytes shall contain, in binary notation, a Logical Block Number assigned sequentially to each Packet and Tape Mark Scan Group. The logical block number of the first Packet or Tape Mark Scan Group shall be 0, starting at BOT, and shall be increased by 1 for each succeeding Packet or Tape Mark Scan Group. Their setting depends on that of Byte 00.

Byte 0 set to (00)

These bytes shall be set to the logical block number of the Packet containing the first byte that is included in the Scan Group. This Packet may start at the beginning of the Data Part or be continued from a previous Scan Group.

Byte 0 set to (04)

These bytes shall be set to the logical block number of the Tape Mark Scan Group (see 11.3.6.4).

Byte 0 set to (02),(03),(20),(40) or (80)

These bytes shall be set to all ONEs.

Bytes 42 to 46 Last Logical Block number in the Scan Group

Byte 0 set to (00)

These bytes shall be set to the logical block number of the Packet containing the last byte that is included in the Scan Group.

Byte 0 set to (04)

These bytes shall be set to the logical block number of the Tape Mark.

Byte 0 set to (02),(03),(20),(40) or (80)

These bytes shall be set to all ONEs.

Bytes 47 to 50 Uncompressed byte count

These bytes shall express, in binary notation, a count of the number of bytes of uncompressed (LDR) data in the Scan Group. The bytes of partial records shall only be counted in the Scan Group in which they end.

Byte 51 Write Start identifier

When the tape is written from BOT the Write Start identifier shall be (01).

When writing commences from any point other than BOT the Write Start identifier shall increment by 1 relative to the Write Start identifier in the Fixed Header field of the Scan Group immediately preceding the commencement of the new writing. If the number exceeds (FF) it shall start again at 0.

The Write Start identifier for the ILH shall always be (01).

Bytes 52 to 55 Start of EOD

Byte 0 set to (03) - End of Data

These bytes shall contain, in binary notation, the Physical Scan Group count of the first EOD Scan Group.

Byte 56 to 121 Reserved for future use; to be ignored in interchange

Bytes 122 and 123 CRC over the Fixed Header
These bytes shall contain CRC Byte 1 and CRC Byte 2, respectively, computed sequentially over the previous 100 bytes, as described in annex B.

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11.3.4 Data Part

193 408 bytes shall be allocated to the Data Part. The contents of these bytes shall be as described in 11.3.6.

11.3.5 Trailer

The Trailer shall consist of 4 bytes.

Bytes 0 and 1 Reserved for future use; to be ignored in interchange

Bytes 2 and 3 These bytes shall contain CRC Byte 1 and CRC Byte 2, respectively, computed sequentially over the Data Part, as described in annex B.

11.3.6 Types of Scan Group

11.3.6.1 Data Scan Group

The Data Part of a Data Scan Group shall be formed sequentially from the contents of the Packet buffer. As the size of a Packet is dependent upon the size of the host data record, and upon whether such data is compressed or not, Packets may not match the Data Part of a Scan Group. Thus a Data Scan Group may contain one or more Packets, or only part of a Packet, and the following rules shall apply :

- A Packet may begin or end anywhere within a Data Scan Group, with the exception that, as a Packet ID shall not be split between two Data Scan Groups, a new Packet shall not commence within the last 32 bytes of a Data Scan Group.
- A Packet may span the boundary(s) between two or more Data Scan Groups.
- The number of Packet IDs in a Data Scan Group does not necessarily equal the number of Packet Trailers; they may differ by 1.
- If the Packets do not fill the entire Data Part, the Data Part shall be completed by pad bytes, the setting of which is not defined; the count of pad bytes is given in Bytes 31-33 of the header.

11.3.6.2 Pad Scan Group

All bytes in the Data Part shall be set to (02).

11.3.6.3 End of Data Scan Group

All bytes in the Data Part shall be set to (03).

It shall be identified by the Time Code Track (see 15.1)

10 End of Data Scan Groups constitute an End of Data (EOD) ; EOD shall mark the end of valid data on the tape. EOD shall always be preceded by a Pad Scan Group.

11.3.6.4 Tape Mark Scan Group

All bytes in the Data Part shall be set to (04).

A Tape Mark consists of a Tape Mark Scan Group. A Tape Mark Scan Group shall always be preceded by a Pad Scan Group.

11.3.6.5 ECC-3 Scan Group

This Scan Group shall provide a third level of data protection for the *n* preceding Data Scan Groups, where *n* shall be in the range 1 to 24. The ECC-3 Scan Group and the associated Data Scan Groups shall be collectively referred to as a Super Group.

Pad Scan Groups may occur at any point between Data Scan Groups; their presence shall not be included in the count of Data Scan Groups.

An ECC-3 Scan Group shall be formed by performing an exclusive OR operation on all parts of the Data Scan Groups of the Super Group, except for the Variable Header, which shall contain the information defined in 11.3.3.1. The operation shall be carried out on a byte-by-byte basis such that, for example, the 23rd byte of the ECC-3 is the exclusive OR of the 23rd bytes of all the Data Scan Groups of the Super Group.

The contents of any Pad Scan Groups shall not be included in this operation.

If a Logical Data Scan Group has been rewritten, only one instance of the Scan Group shall be used in the generation of the ECC-3 Scan Group.

11.3.6.6 Separator Scan Group

Separator Scan Groups constitute a buffer area on the tape between ILH and BOT, termed SEP. Initially there shall be 125 Separator Scan Groups in the SEP. Separator Scan Groups may be overwritten when the ILH is rewritten (see 11.3.6.7.1).

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All bytes in the Data Part shall be set to (20).

11.3.6.7 Internal Leader Header (ILH) Scan Group

A valid ILH shall not be mandatory for interchange; if present it shall fulfil the following requirements.

11.3.6.7.1 Description of the ILH

The ILH shall comprise two ILH Scan Groups followed by an ECC-3 Scan Group. It shall be initialized when the cartridge is first mounted and thereafter shall be updated to contain a history of the usage and performance of the cartridge.

It shall be read each time that the cartridge is mounted and updated each time that the cartridge is unloaded, except that the ILH of a cartridge on which the write-inhibit notch is open cannot be updated.

If, when the ILH is rewritten, one of the Scan Groups fails, it shall be rewritten in the SEP area, together with any succeeding Scan Groups of the ILH, as shown in 16.2.3.

The remainder of the SEP shall not be rewritten. The total number of Scan Groups in the SEP and ILH areas shall always be 128; rewriting of the ILH shall not extend beyond the SEP area, if the ILH cannot be rewritten before the end of the SEP area, no further rewriting of the ILH can be allowed.

11.3.6.7.2 Cartridge usage information

The first 2 048 bytes of the data part of the first ILH Scan Group shall be used for cartridge usage information.

Byte 0	Format of the information stored in the ILH
	This byte shall be set to (01) for the ILH format described in this International Standard.
Byte 1	Tape Type
Bits 7 to 2	shall be set to 000010
Bits 1 and 0	shall be set to 00 for cartridge Type A 01 for cartridge Type B 10 for cartridge Type C
Byte 2	Reserved, to be ignored in data interchange
Byte 3	Mode of recording
Bits 7 to 5	Reserved, to be ignored in interchange
Bit 4	when set to ZERO shall indicate that Write-without-retry is disabled ONE shall indicate that Write-without-retry is enabled
Bits 3 to 1	Reserved for future use, to be ignored in interchange
Bit 0	when set to ZERO shall indicate that File-safe is disabled ONE shall indicate that File-safe is enabled
Bytes 4 to 83	shall specify the volume header label as defined in Standard ECMA-13.
Bytes 4 to 9	shall contain the Volume Identifier
Byte 10	shall be an alpha character from ECMA-13, appendix A, specifying, for the installation, the accessibility permitted to data on the cartridge.
	SPACE shall indicate that no restrictions exist.
Byte 11	shall specify the label standard version and shall be set to 00000100 when Bytes 4 to 10 are set as defined in ECMA-13.

If a valid volume header label is not available from the host, Bytes 4 to 11 shall be set to all ONEs.

Bytes 12 to 83	shall be set to all ONEs
Bytes 84 to 87	Location of last valid Data Scan Group preceding EOD
	These bytes shall contain a copy of bytes 2 to 5 of the header of the last valid Data Scan Group.
Bytes 88 to 91	Number of times mounted

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These bytes shall express, in binary notation, a count of the number of times that the cartridge has been mounted on a drive. The first mount shall have a count of 1.

Bytes 92 to 191 Identification of the last five drives

These bytes shall be set to the serial numbers of the last five tape drives on to which the cartridge was mounted. The entries shall be numbered 0 to 4; the number of a new entry shall be

(number of mounts at that time -1) mod 5

Bytes shall be allocated to the entries as follows

Bytes	92 to 111	Entry	0
	112 to 131		1
	132 to 151		2
	152 to 171		3
	172 to 191		4

Bytes 192 to 503 Reserved; to be ignored in data interchange.

Bytes 504 to 509 Date and time of first write pass

These bytes shall contain a record of the date and time of the first occasion on which the cartridge was mounted and written. Each byte shall contain two binary-coded (BCD) digits in the following format

YYMMDDHHNNSS

where	YY is years with a range of	00 to 99
	MM is months	00 to 12
	DD is days	00 to 31
	HH is hours	00 to 23
	NN is minutes	00 to 59
	SS is seconds	00 to 59

This record shall not be changed.

Bytes 510 to 539 Date and time of the last five mounts

These bytes shall contain a record of the dates and times for the last five occasions on which the cartridge was mounted. The entries shall be numbered 0 to 4; the number of a new entry shall be

(number of mounts at that time -1) mod 5

Six bytes shall be allocated to each entry as follows, and the format shall be the same as for bytes 504 to 509.

Bytes	510 to 515	Entry	0
	516 to 521		1
	522 to 527		2
	528 to 533		3
	534 to 539		4

Bytes 540 to 667 Tape manufacturer and tape batch

These bytes are used to identify the manufacturer and the product batch number for the cartridge. They are reserved for use by the tape manufacturer and shall be ignored in interchange.

Bytes 668 to 671 Number of Search Segment entries

These bytes shall express, in binary notation, a count of the number of valid entries in the search information part of the ILH (see 11.3.6.7.3). The search information shall not be valid beyond this count.

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Byte 672 Detection of a bad ILH

Bits 7 to 1 shall be set to ZERO.

Bit 0 When set to ZERO shall indicate that the ILH has no errors.
When set to ONE shall indicate that a bad Search Segment entry has been found.

The bit shall not be reset until new data has been written, starting at the beginning of the Data Area.

Bytes 673 to 675 Reserved for future use; to be ignored in interchange

Bytes 676 to 1699 Drive vendor

These bytes are used to identify the drive vendor. They are reserved for use by the drive vendor and shall be ignored in interchange

Bytes 1700 to 2047 Reserved for future use; to be ignored in interchange.

11.3.6.7.3 ILH search information

The tape shall be divided into Search Segments, each containing 32 Physical Scan Groups. The ILH search information shall be used to locate to a particular Physical or Logical Scan Group on the tape.

The remaining bytes in the first ILH Scan Group shall be used to store Segment Search entries of 32 bytes each. If the first ILH Scan Group has been filled with Search Segment entries the entries shall continue into the second ILH Scan Group until it has been filled. Thereafter no further Search Segment entries shall be made. The first Search Segment starts at the beginning of the Data Area.

Each Search Segment entry shall have the following content.

Bytes 0 to 3 Physical Scan Group count

These bytes shall contain the Physical Scan Group count of the first Data Scan Group of a Super Group following the Search Segment boundary. If the Logical Scan Group has had to be rewritten, the Physical count of the first attempt shall be used.

If no Super Group starts within the Search Segment these bytes shall be set to all ONEs.

When a Scan Group has had to be rewritten, the physical location of the valid version will be later than the count contained in these bytes. If the physical location is earlier, or more than 128 Scan Groups later, than the count contained in these bytes, the entry is invalid and the ILH shall be marked invalid (see 11.6.7.2 byte 672).

Bytes 4 to 6 File ID number

These bytes shall have the same content as bytes 23 to 25 of the Scan Group header.

Bytes 7 to 11 Logical block number of the host data Packet

These bytes shall have the same content as bytes 40 to 44 of the Scan Group header

Bytes 12 to 31 Reserved for future use; to be ignored in interchange.

When the appropriate Scan Group of a Search Segment is written, a Search Segment entry shall be prepared so that the ILH can be updated when the cartridge is unloaded.

11.3.6.8 Density Identification (DID) Scan Group

All bytes in the Data Part shall be set to (80).

The DID starts at BOT (see figure 45) and shall consist of 256 DID Scan Groups.

The DID Scan Group shall be correctable using the Inner ECC and the Outer ECC, and the Header CRCs and the Trailer CRC shall be valid in at least 100 DID Scan Groups.

11.3.7 Protection of Scan Groups

Protection of Scan Groups is available in the form of Outer ECC, Inner ECC, ECC-3, Header CRCs and the Trailer CRC. The extent to which they shall be utilized is given in table 2.

N/A indicates that the ECC-3 Scan Group is not used in conjunction with this type of Scan Group.

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If Write-without-retry is disabled, the requirements of columns 5 to 8 shall be met.

If Write-without-retry is enabled, the checks in columns 5 to 8 may not be valid, except that for ILH they shall always be met (but see 11.3.6.7.1).

Table 2 - Requirements for Scan Groups by Type

Scan Group Type	Type Designator	Data Field	Logical Scan Group number incremented	Correctable using Inner ECC Outer ECC	Header CRCs to be valid	Trailer CRC to be valid	ECC-3 to be valid
Data	(00)	From host	Yes	Yes	Yes	Yes	Yes
Pad	(02)	(02)	No	No	No	No	N/A
End of data	(03)	(03)	No	Yes	Yes	Yes	N/A
Tape Mark	(04)	(04)	Yes	Yes	Yes	Yes	N/A
ECC-3	(08)	From controller	No	Yes	Yes	Yes	N/A
SEP	(20)	(20)	No	No	No	No	N/A
ILH	(40)	From controller	Yes	Yes	Yes	Yes	Yes
DID	(80)	(80)	No	In at least 100 Scan Groups			N/A

11.4 Write data channel (see figure 28)

11.4.1 Scan Group sections

The 195 840 bytes, numbered 0 to 195 839, of a Scan Group are divided into two sections, referred to as Section 0 and Section 1. Even bytes, 0 to 766 are directed to Section 0 and odd bytes, numbered 1 to 767, are directed to Section 1, thereafter bytes are allocated to Section 0 and Section 1 as shown in figure 34.

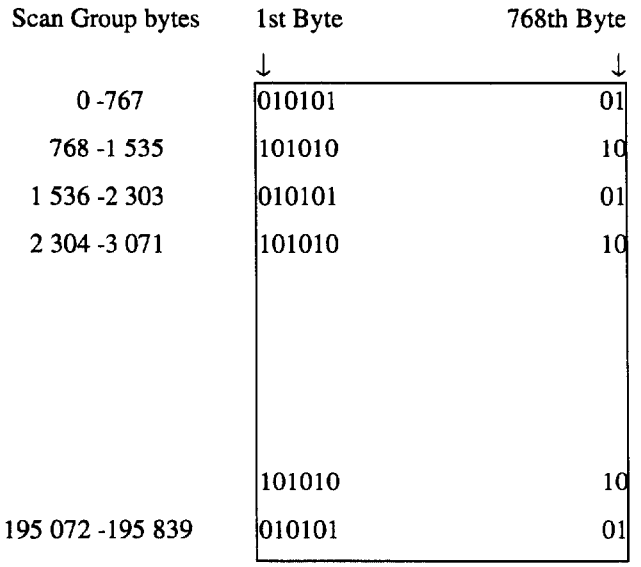


Figure 34 - Allocation of Scan Group bytes to Scan Group Sections

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11.4.2 Interleave Buffer

Each of the two buffers shall be as shown in figures 35 and 36. There shall be 765 columns, numbered 0 to 764, and 136 rows, numbered 0 to 135. The first 128 rows shall contain data and the last 8 rows shall contain Outer ECC bytes (see 11.4.2.2.2).

Sub-arrays

The buffer shall be divided into nine sub-arrays, each consisting of 85 adjacent columns.

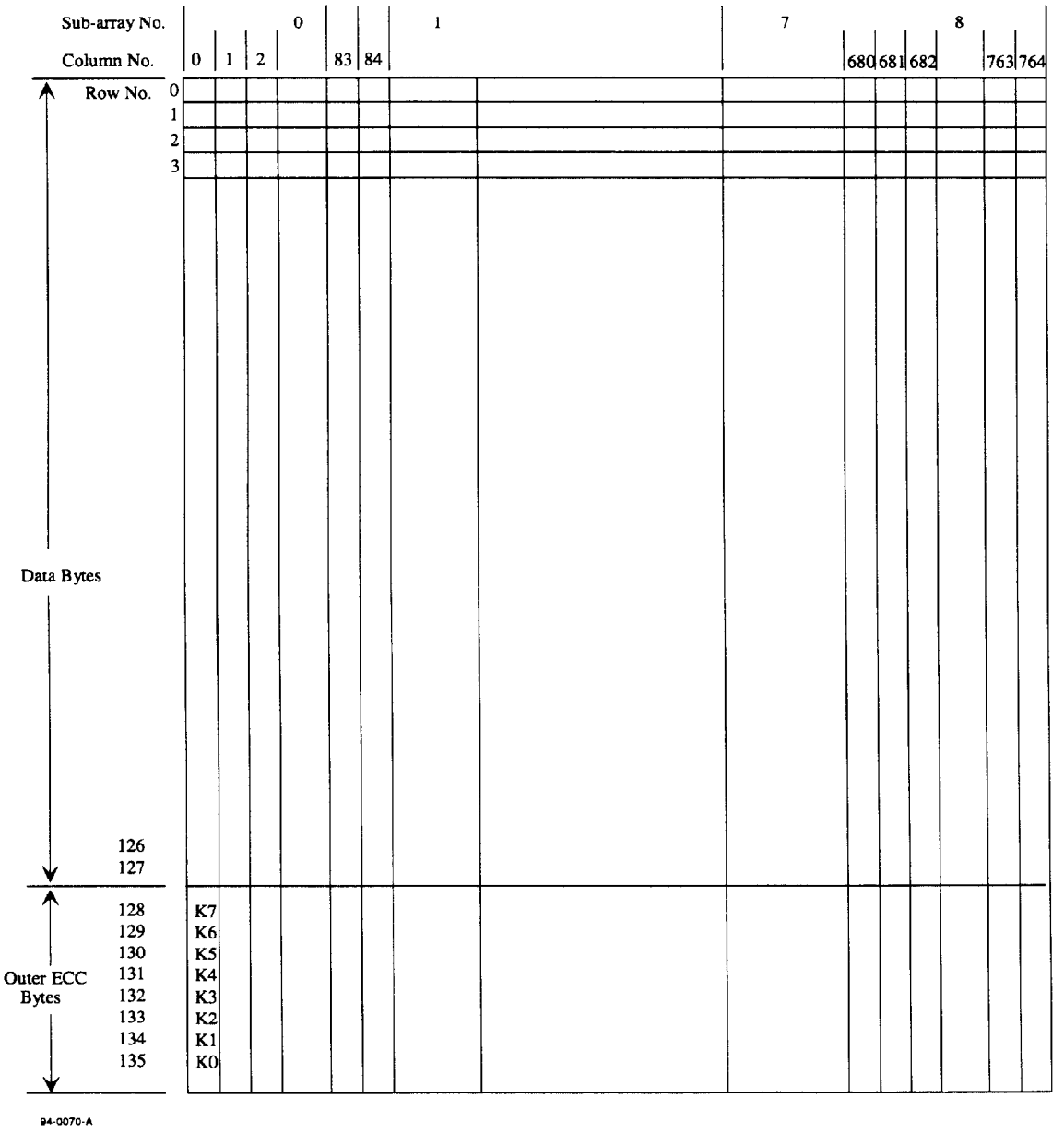


Figure 35 - Loading the Interleave buffer

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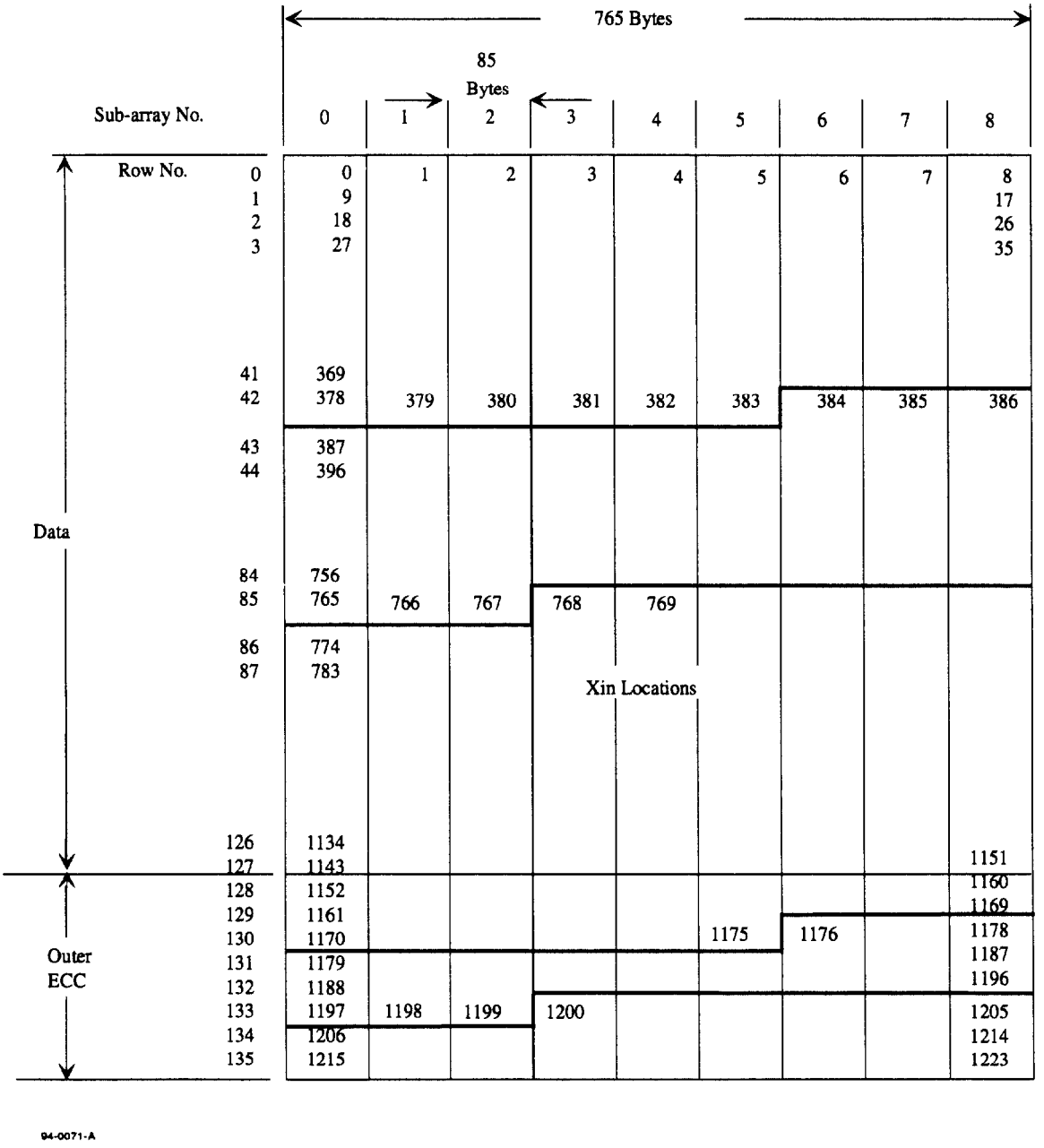


Figure 36 - Unloading the Interleave Buffer

Xin Locations

Xin locations shall each consist of a horizontal group of 85 bytes; there shall be nine Xin locations in a row. Xin locations shall be allocated numbers in the range 0 to 1 223, as shown in the figure.

11.4.2.1 Loading the Interleave Buffer (figure 35)

The first 128 bytes of the first column, column 0 in figure 35, shall be filled by the first 128 bytes of the Section of the Scan Group buffer. An 8-byte Outer ECC (see 11.4.2.2) shall be formed from these 128 bytes and placed in rows 128 to 135 of column 0.

Further groups of 128 bytes from the Scan Group section shall not be placed in adjacent columns; the sequence of filling columns shall be

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(n, n + 255, n + 510)

where n increments sequentially from 0 to 254

Thus columns shall be filled in the sequence 0, 255, 510, 1, 256, 511 to 764.

11.4.2.2 Outer ECC

The Outer ECC shall consist of 8 bytes derived from the 128 bytes in rows 0 to 127 of a column of the Interleave Buffer. It shall be formed using the Reed-Solomon code denoted (136,128). The derivation shall be as described in annex D.

The eight bytes K_7 to K_0 shall be appended to the 128 bytes of data and placed in rows 128 to 135, as shown in figure 35.

11.4.2.3 Unloading the Interleave Buffer (figure 36)

The contents of the Buffer are sufficient, after further processing, to fill three helical tracks on the tape; one third of the Buffer is read out for each pass of a write head. The Buffer in Write Channel 0 shall write Track 0 in each Track Pair. The Buffer in Write Channel 1 shall write Track 1 in each Track Pair.

One Scan Group shall provide the data for six tracks.

The first track to be written (Track 0, Track Pair 0) shall be formed from Xin 1152 to 1175 (Outer ECC rows) followed by Xin 0 to 383 (Data rows).

Track 0, Track Pair 1 shall be formed from Xin 1176 to 1199 and Xin 384 to 767.

Track 0, Track Pair 2 shall be formed from Xin 1200 to 1223 and Xin 768 to 1151.

For more effective use of the ECCs, the Xin number for the start of Data in Tracks 1 shall be displaced from these Xin values by 576.

Further, the Xin numbers for the starting points of further tracks in the Track Pairs shall be displaced over a cycle of four Scan Groups. The address of the first Xin is derived from the following formulae, and is shown in figure 37.

For data

Xin = [384(Track Pair No) + 96(Scan Group No) + 576(Track No)] modulo 1152

For Outer ECC

Xin = 1152 + 24(Track Pair No)

where : Scan Group No. lies in the range 0 to 3
Track Pair No. lies in the range 0 to 2
Track No. is 0 or 1

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			Xin - Order of unloading	
Scan Group	**Track pair**	**Track**	**ECC**	**Data**
0	0	0	1152 - 1175	0 - 383
		1		576 - 959
	1	0	1176 - 1199	384 - 767
		1		960 - 191
	2	0	1200 - 1223	768 - 1151
		1		192 - 575
1	0	0	1152 - 1175	96 - 479
		1		672 - 1055
	1	0	1176 - 1199	480 - 863
		1		1056 - 287
	2	0	1200 - 1223	864 - 95
		1		288 - 671
2	0	0	1152 - 1175	192 - 757
		1		768 - 1151
	1	0	1176 - 1199	576 - 959
		1		0 - 383
	2	0	1200 - 1223	960 - 191
		1		384 - 767
3	0	0	1152 - 1175	288 - 671
		1		864 - 85
	1	0	1176 - 1199	672 - 1055
		1		96 - 479
	2	0	1200 - 1223	1056 - 287
		1		480 - 863

Figure 37 - Interleave buffer, sequence of unloading

11.4.3 Sync Blocks

Data from the Interleave Buffer shall be formatted into Sync Blocks. A Sync Block shall consist of

Sync pattern
Sync Block ID
Data Part
Inner ECC

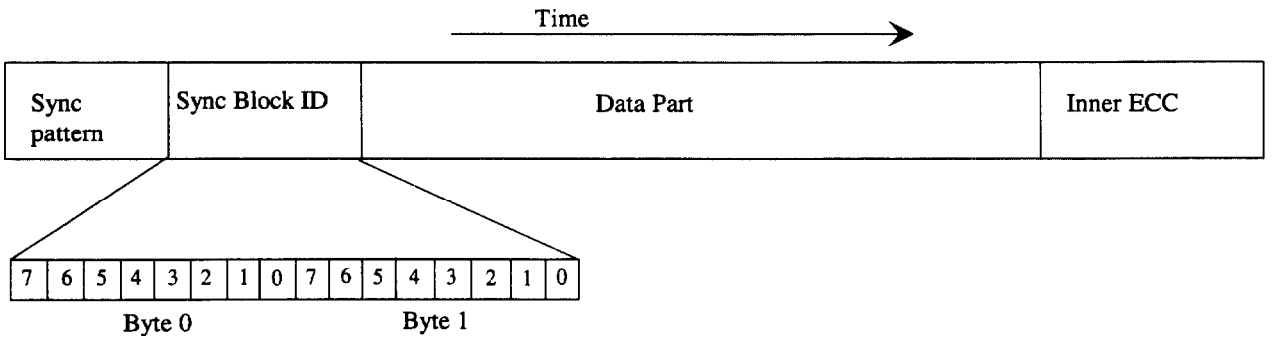


Figure 38 - Sync block

11.4.3.1 Sync Pattern

The Sync Pattern shall be (97)(F1)

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11.4.3.2 Sync Block ID

The Sync block ID shall consist of two bytes.

Byte 0	shall contain the eight least significant bits of the Sync Block number in the helical track. The Sync Block number shall be 0 for the first Sync Block in the track and increment by 1 for each subsequent Sync Block, up to 407.
Byte 1	
Bits 7 and 6	shall be set to ZERO.
Bits 5 and 4	shall express the number of the Scan Group in the range 0 to 3.
Bit 3	shall be set to ZERO.
Bits 2 and 1	shall express the number of the Track Pair in the range 0 to 2.
Bit 0	shall contain the most significant bit of the Sync Block number.

11.4.3.3 Data Part

The Data Part shall consist of the 85 bytes of a sub-array unloaded from the Interleave Buffer as described in 11.4.2.3. The Data Part of the first 24 Sync Blocks shall be taken from rows 128 to 135. The Data Part of the remaining 384 Sync Blocks shall be taken from rows 0 to 127.

11.4.3.4 Inner ECC

The Inner ECC shall consist of 8 bytes derived from the 87 bytes of the ID and the Data Part. It shall be formed using the Reed-Solomon code denoted RS (95,87). The derivation shall be as described in annex D.

11.4.3.5 Randomizing

The 95 bytes comprising the ID, the Data Part and the Inner ECC shall be randomized by performing the exclusive OR operation between this serial data stream and the serial data stream generated by the polynomial

$$x^8 + x^4 + x^3 + x^2 + 1$$

The first term shall be the most significant and the first to enter the computation. The shift register shall be set to (80) at the start of the Sync Block ID.

11.4.4 Layout of a logical helical track

A logical helical track shall consist of

Track Preamble
24 Outer ECC Sync Blocks
384 Data Sync Blocks
Track Postamble

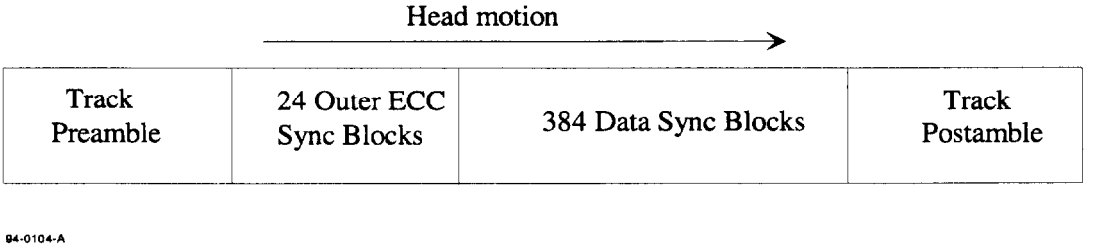


Figure 39 - Layout of a logical helical track

11.4.4.1 Track Preamble

The Track Preamble shall consist of 1 998 bytes.

Bytes 0 to 1 989	shall be set to (2C).
Bytes 1 990 and 1 991	shall be set to (97)(F1).
Byte 1 992	shall be set to (FF).

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Byte 1 993

Bits 7 and 6	shall be set to ZERO
Bits 5 and 4	shall be set to 00, 01, 10 or 11, corresponding to the Scan Group number
Bit 3	shall be set to ZERO
Bits 2 and 1	shall be set to 00, 01 or 10, corresponding to the Track Pair number
Bit 0	shall be set to ONE.
Bytes 1 994 to 1 997	shall be set to ZERO.
Bytes 1 992 to 1 997	shall be randomized as described in 11.4.3.5.

11.4.4.2 Outer ECC Sync Blocks

The 24 Outer ECC Sync Blocks shall be taken from Xin 1152 to 1223 of the Interleave Buffer in the sequence described in 11.4.2.3 and shown in figure 37.

11.4.4.3 Data Sync Blocks

The 384 Data Sync Blocks shall be taken from Xin 0 to Xin 1151 of the Interleave Buffer in the sequence described in 11.4.2.3 and shown in figure 37.

11.4.4.4 Track Postamble

The Track Postamble shall consist of 1944 bytes.

Bytes 0 and 1	shall be set to (97)(F1).
Byte 2	shall be set to (98).

Byte 3

Bits 7 and 6	shall be set to ZERO
Bits 5 and 4	shall be set to 00, 01, 10 or 11, corresponding to the Scan Group number
Bit 3	shall be set to ZERO
Bits 2 and 1	shall be set to 00, 01 or 10, corresponding to the Track Pair number
Bit 0	shall be set to ONE.
Bytes 4 to 1943	shall be set to (2C).
Bytes 2 and 3	shall be randomized as described in 11.4.3.5.

11.4.5 Byte translation (annex C)

Each 8-bit byte of the track format described in 11.2 to 11.4.4 shall be represented on the tape by a 14-bit pattern. The bits of a pattern are called Channel Bits. The CDS shown in table C.1 and table C.2 presents the DSV for each 14-bit pattern shown. The selection of a pattern to represent a given 8-bit byte is constrained by the following

- the magnetic recording system chosen requires that the deviation from zero of the DC level of the recorded signal be kept between chosen limits
- to enable the synchronization of detected signals to be maintained it is necessary to restrict the number of consecutive identical bits to seven

The choice of the most effective 14-bit pattern to represent a given 8-bit byte shall be determined by the selection sequence described below.

The following further definitions apply

EDSV is the value of DSV at the boundary of a 14-bit pattern.
BDSV is the value of DSV at any other point in the pattern.

a) From the Tables C1 and C2 select all the 14-bit patterns satisfying the conditions

   i) the number of identical bits at the junction with the preceding 14-bit pattern is in the range 2 to 7

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and

ii) the absolute value of the EDSV at the end of a 14-bit pattern, is equal to, or less than, 2.

b) if two or more patterns satisfy a), choose a pattern giving the minimum absolute value of EDSV

c) if two or more patterns satisfy b),

calculate the BDSV for each bit of each pattern and select the pattern in which the minimum absolute value of the BDSV is the smallest.

d) if two or more patterns satisfy c),

select a pattern in which the maximum absolute value of the BDSV is equal to, or less than, 6

e) if two or more patterns satisfy d),

select a pattern for which the number of identical bits at the junction with the preceding pattern is equal to, or less than, 6

f) if no pattern satisfying d) satisfies e),

or

two or more patterns satisfy e),

select a pattern in which the number of consecutive identical bits is equal to, or less than, 6

g) if no pattern satisfying d) satisfies e) and f),

or

if no pattern satisfying e) satisfies f)

or

if two or more patterns satisfy f)

the following steps shall be taken, using the patterns selected in d), e) or f), respectively

i) for a pattern with an EDSV of -2, select from table C.3 a pattern of higher priority; priority 1 is the highest. For a pattern with an EDSV of +2, use table C.4

ii) if two or more patterns treated as in g) i) have the same priority, select them all temporarily.

if EDSV is zero, select a code in which the last six bits are not all ONEs or all ZEROs.

h) if no pattern satisfying d) satisfies e), f) and g)

or

if no pattern satisfying e) satisfies f) and g)

or

if no pattern satisfying f) satisfies g)

or

if two or more patterns satisfy g)

select a pattern in which the BDSV has the smallest maximum absolute value

i) if two or more patterns satisfy h), select a pattern in which the minimum absolute value of the BDSV occurs earliest in the pattern

j) if two or more patterns satisfy i), select a pattern in which there is a bit reversal earliest after the junction with the preceding pattern

12 Track geometry

12.1 General

Two types of track shall be recorded on the tape, helically recorded tracks and longitudinally recorded tracks.

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Helically recorded tracks contain user data.

The Servo Control Track and the Time Code Track are longitudinally recorded.

The configuration of the tracks is shown in figure 40.

12.2 Helically recorded tracks (figure 40)

The helical track pattern is formed by the relationship between the speed and direction of tape motion and the axis and speed of rotation of a pair of heads, one of which has a positive azimuth angle and the other a negative azimuth angle. If the track pitch is greater than the width of the recorded track, the condition of the tape in the remaining part of the track pitch shall be a.c. erased to 2 % or less of SRA1.

The direction of recording is away from the Tape Reference Edge.

12.2.1 Track width

The width of each track shall be 20,0 µm ± 1,0 µm.

12.2.2 Adjacent track pitch

The distance between the centrelines of any two adjacent tracks, measured perpendicular to the track centrelines, shall be

$T = 20\ \mu m \pm 2\ \mu m$

If the track pitch is greater than the width of the recorded track, the condition of the tape in the remaining part of the track pitch shall be a.c. erased to 2 % or less of SRA1.

12.2.3 Track angle

The angle of each track relative to the Tape Reference Edge shall be

$\theta = 4{,}9192° \pm 0{,}0103°$

12.2.4 Straightness of a track

The centrelines of any four consecutive tracks shall be contained within the pattern of the four tolerance zones shown in figure 41.

Each zone is defined by two parallel lines which are inclined at the angle θ relative to the Tape Reference Edge.

The centrelines of adjacent zones shall be spaced 20 µm ± 2 µm apart. The width of zone 2 shall be 4 µm; the width of zones 1, 3 and 4 shall be 6 µm.

All errors of track angle, track straightness and track pitch shall be contained within these zones.

A method of measurement is given in annex E.

12.2.5 Track length

The length of each track shall be $l_{112} = 117{,}667\ mm \pm 0{,}050\ mm$.

12.2.6 Azimuth angles (see figure 42)

The azimuth of the first track of each track pair shall be oriented in the positive (counter-clockwise) direction relative to a line perpendicular to the track centreline by the angle

$A_0 = 20{,}019° \pm 0{,}150°$

The azimuth of the second track of each track pair shall be oriented in the negative (clockwise) direction by the angle

$A_1 = 19{,}981° \pm 0{,}150°$

12.2.7 Location of positive azimuth tracks (figure 40)

The distance from the lower edge of the first flux transition on a positive azimuth track to the Tape Reference Edge shall be

$l_{113} = 1{,}567\ mm \pm 0{,}010\ mm$

12.2.8 Location of Data Area Reference Point

The Data Area Reference line shall be a line parallel to the Tape Reference Edge and spaced

$l_{114} = 2{,}030\ mm \pm 0{,}050\ mm$ from it.

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The Data Area Reference point for a positive azimuth track is at the intersection of the Data Area Reference line and the centreline of the track.

12.3 Time Code Track (figure 40)

The Time Code Track contains information used to locate a Scan Group Pair.

12.3.1 Track location

The lower edge of the track shall be the Tape Reference Edge. The upper edge of the track shall be defined by

l_{115} = 0,450 mm ± 0,050 mm

12.3.2 Azimuth

The angle that a flux transition makes with a line perpendicular to the Tape Reference Edge shall not be greater than ± 0,25°.

12.4 Servo Control Track (figure 40)

The signals on the Servo Control Track maintain the correct relationship between the rotational speed of the scanner and the linear speed of the tape.

12.4.1 Track location

The location of the track is defined by the specified distances from the Tape Reference Edge of its lower and upper edges, which are

l_{116} = 0,900 mm ± 0,050 mm

l_{117} = 1,300 mm ± 0,050 mm

12.4.2 Azimuth

The angle that a flux transition makes with a line perpendicular to the Tape Reference Edge shall not be greater than ± 0,25°.

12.5 Reserved Longitudinal Track

The third longitudinal track is not specified for use in this International Standard and shall be reserved for future development.

Track location

The location of the track is defined by the specified distances from the Tape Reference Edge of its lower and upper edges, which are

l_{118} = 11,950 mm ± 0,050 mm

l_{119} = 12,550 mm ± 0,050 mm

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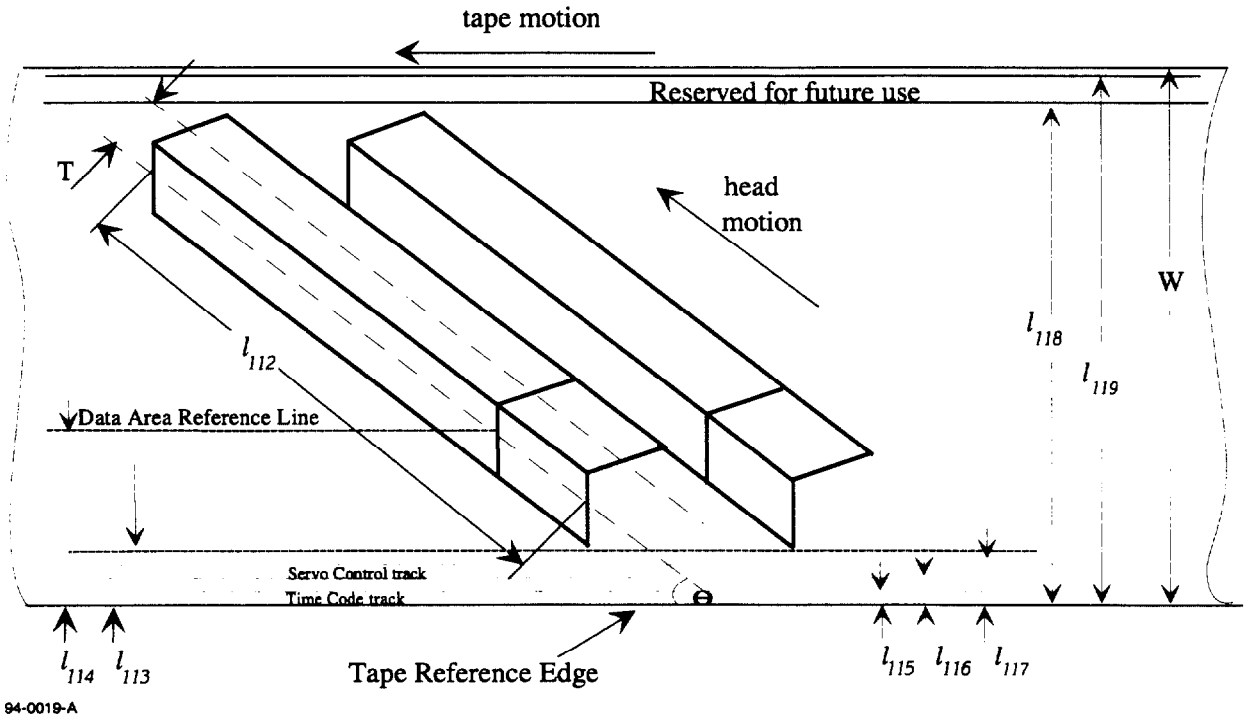


Figure 40 - Locations and dimensions of recorded tracks

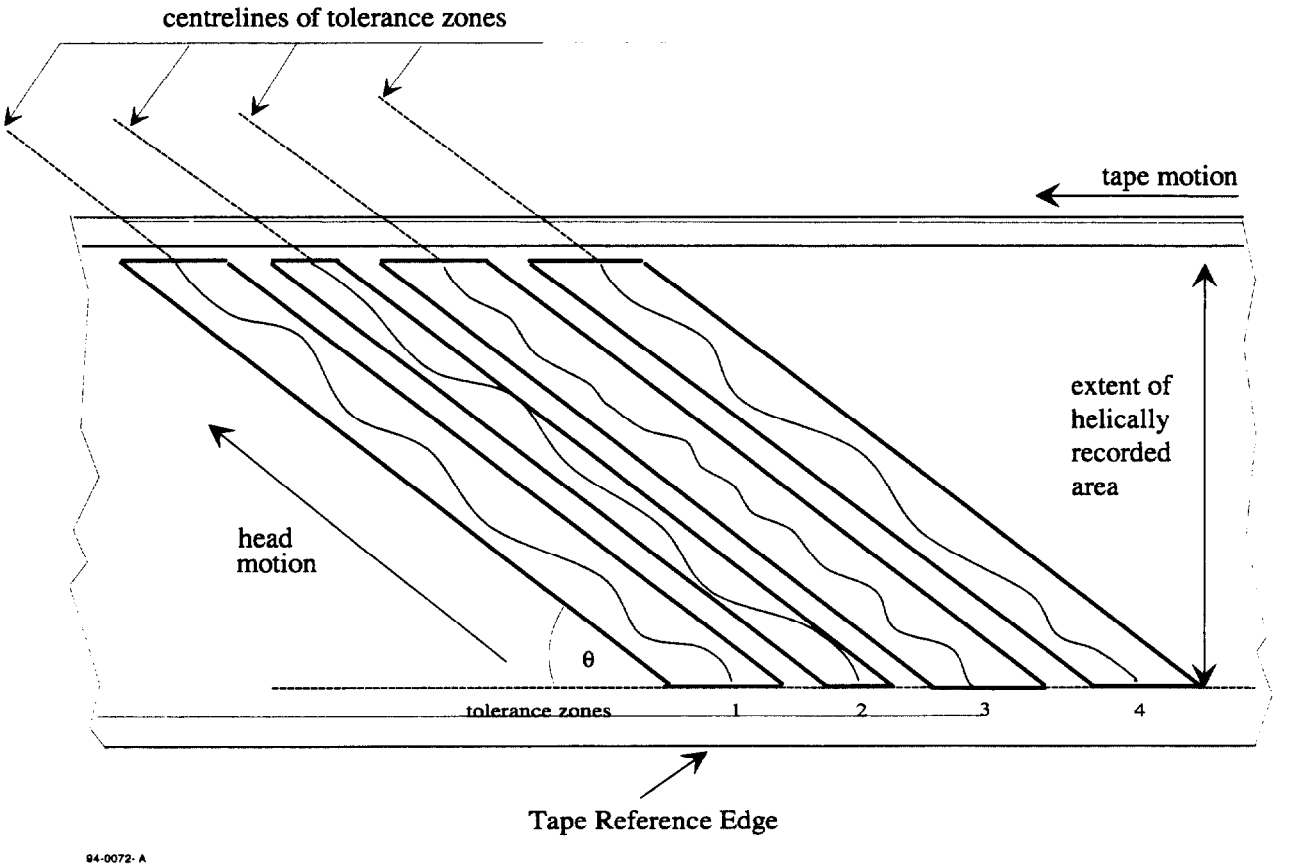


Figure 41 - Location and dimensions of tolerance zones of helical tracks

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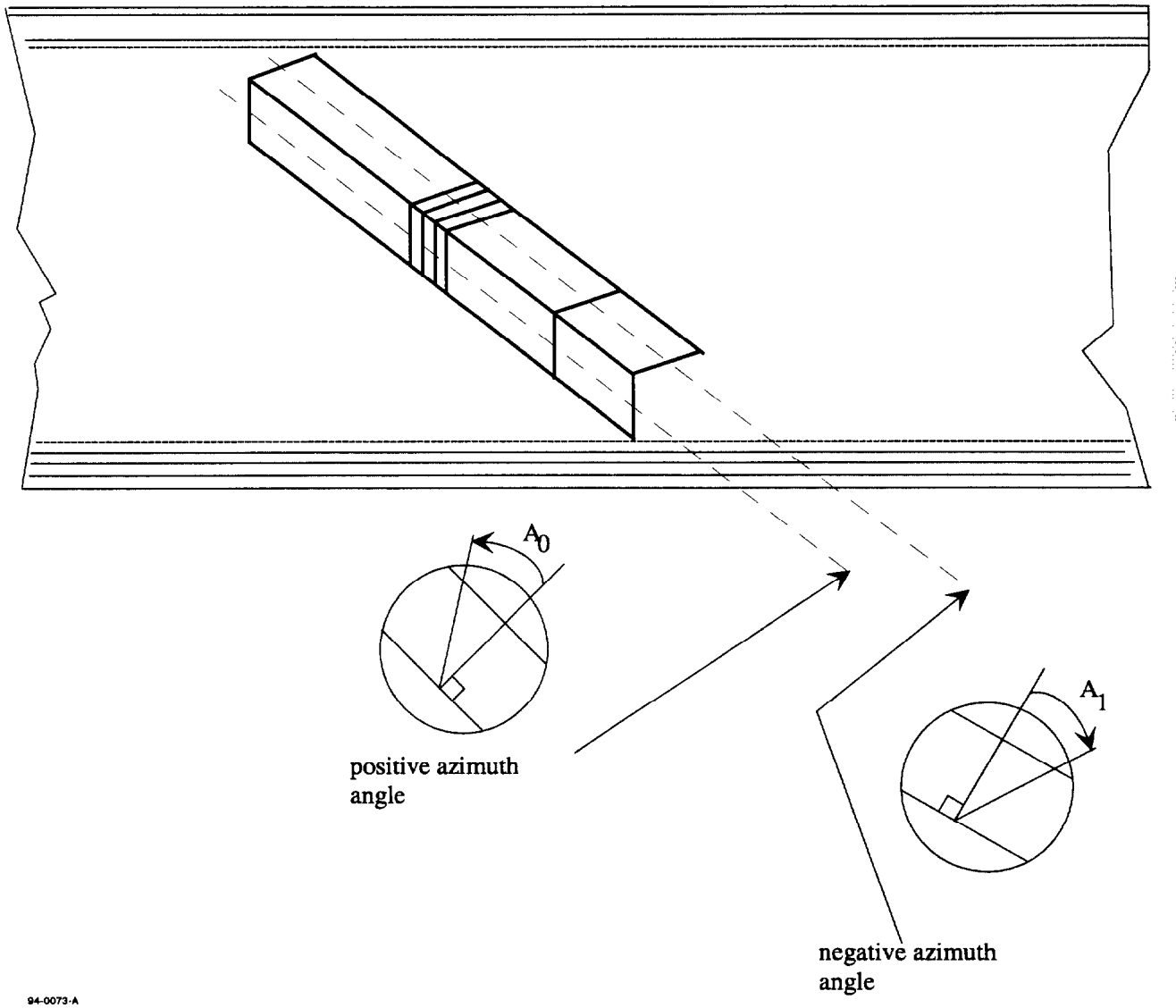


Figure 42 - Azimuths of helical tracks

13 Method of recording helical tracks

13.1 Tape condition before recording

Each track shall be a.c. erased to 2 % or less of SRA1.

13.2 Method of recording

A flux transition shall occur on the bit cell boundary between bit cells containing dissimilar bits.

13.3 Physical Recording Densities

The byte translation process specified in 11.4.5 requires:

- the minimum spacing between flux transitions to be two bit cells
- the maximum spacing between flux transitions to be seven bit cells.

The maximum physical recording density, which occurs in a pattern of alternating pairs of ONEs and pairs of ZEROs, shall be 2 597 ftpmm.

The minimum physical recording density, which occurs in a pattern of alternating sequences of seven ONEs and seven ZEROs, is 742 ftpmm.

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13.4 Nominal Bit Cell Length

The nominal bit cell length resulting from 13.3 is 0,192 5 µm.

13.5 Long-term Average Bit Cell Length

The long-term average bit cell length shall be measured over a minimum of 305 000 consecutive cells in a track. It shall be within 0,20 % of the nominal bit cell length.

13.6 Short-term Average Bit Cell Length (STA)

The STA, referred to a particular bit cell, shall be the average taken over the previous 16 bit cells. It shall be within 0,35 % of the nominal bit cell length.

13.7 Rate of Change of the STA

The rate of change of the STA, taken over any two consecutive 16-bit cell lengths, shall not exceed 0,05 %.

STA_n	STA_{n+1}
16 bits	16 bits

$$100 \times \frac{|STA_n - STA_{n+1}|}{STA_n} \leq 0{,}05$$

Figure 43 - Rate of change of STA

13.8 Bit shift

The maximum displacement of any zero crossing, exclusive of missing pulses, shall not deviate by more than 20 % from the expected nominal position as defined by the average bit cell length. See annex F for the test procedure.

13.9 Read signal amplitude

The average read signal amplitude of an interchanged cartridge, averaged over 3 000 flux transitions at 2 597 ftpmm, and excluding missing pulses, shall be between 80 % and 130 % of SRA1. Averaging may be segmented into blocks.

Traceability to SRA1 is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

14 Servo Control Track

14.1 Format

The Servo Control Track shall be recorded with a repetitive pattern of 12 flux transitions with the sequence shown in figure 44.

The nominal value of D shall be 93,29 µm.

The length of a 4D - 6D or a 6D - 4D Pulse Pair shall be 932,90 µm ± 0,47 µm.

The distance l_{120} between the final flux transitions of adjacent Pulse Pairs shall be 2 798,70 µm ± 1,40 µm.

The 12 helical tracks in which a Scan Group Pair is recorded shall extend over l_{120}.

14.2 Relative locations of Pulse Pairs and Scan Group Pairs

The distance between the final flux transition of a Pulse Pair and the Data Area Reference Point of the first helical track of the Scan Group Pair to which it refers, measured between lines perpendicular to the Tape Reference Edge, shall be

P = 176 000 µm ± 50 µm

14.3 Polarity of magnetisation

The polarity of magnetisation in the Servo Control Track shall be as shown in Detail A of figure 44.

14.4 Read signal amplitude

The average signal amplitude, averaged over 200 flux transitions and exclusive of missing pulses, shall be between 80 % and 130 % of SRA2.

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14.5 Quality of the Servo Control Track

A missing pulse zone begins with a missing pulse and ends when 10 consecutive flux transitions, which are not missing pulses, have been detected. The length of a missing pulse zone shall not exceed 42 mm.

15 Time Code Track

15.1 Format

The Time Code Track shall contain a unique Time Code for each Scan Group Pair. Each Time Code shall comprise 80 bits, as shown in annex M.

15.1.1 Count bits

The count of Scan Group Pairs shall be contained in eight groups of count bits.

Bits 0 to 3 shall express, in binary notation, a count of units of Scan Group Pairs, in the range 0 to 9

Bits 8 and 9 shall express, in binary notation, a count of tens of Scan Group Pairs, in the range 0 to 2

Note 6 - At the nominal linear speed of the tape of 83,88 mm/s, 30 Scan Group Pairs will be written, or read, in one second.

Bits 16 to 19 shall express, in binary notation, a count of units of seconds, in the range 0 to 9

Bits 24 to 26 shall express, in binary notation, a count of tens of seconds, in the range 0 to 5

Bits 32 to 35 shall express, in binary notation, a count of units of minutes, in the range 0 to 9

Bits 40 to 42 shall express, in binary notation, a count of tens of minutes, in the range 0 to 5

Bits 48 to 51 shall express, in binary notation, a count of units of hours, in the range 0 to 9

Bits 56 and 57 shall express, in binary notation, a count of tens of hours, in the range 0 to 3

The first Scan Group Pair written on the tape - the first Scan Group of the DID - shall have ZEROs entered in all count bits. The count shall be incremented by 1 for each subsequent Scan Group Pair.

15.1.2 Supplementary Data

There shall be eight groups of Supplementary Data, each consisting of 4 bits. EOD Scan Group Pairs shall have all eight groups in the five Time Codes associated with the five EOD Scan Group Pairs set to 0011. For all other types of Scan Group these groups shall be set to 0000.

15.1.3 Phase bit

Bit 27 shall be set such that there is an even number of ZEROs in the 80-bit Time Code.

15.1.4 Synchronizing pattern

Bits 64 to 79 shall be set to the synchronizing pattern

0011111111111101

15.2 Extent of a Time Code

The 80 bits of a Time Code shall extend along the tape for a distance equal to that between the final flux transitions of adjacent Pulse Pairs in the Servo Control Track (see figure 44).

15.3 Relative locations of the Time Code and Scan Group Pairs

The distance between bit 0 of the Time Code and the Data Area Reference Point of the first helical track of the Scan Group Pair to which it refers shall be P.

15.4 Form of recording

The form of recording on the tape shall be as follows

- a ZERO is represented by a flux transition at the beginning of a bit cell
- a ONE is represented by a flux transition at the beginning of a bit cell followed by a flux transition at the centre of the bit cell

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15.4.1 Nominal bit density

The nominal bit density shall be 28,59 ftpmm.

15.4.2 Nominal bit cell length

The nominal bit cell length resulting from 15.4.1 is 34,927 µm.

15.4.3 Bit shift

The maximum displacement of any ONEs zero crossing, exclusive of missing pulses, from the expected position as defined by the nominal bit cell length shall not exceed 25 %.

15.5 Read signal amplitude

The average read signal amplitude, taken over 800 flux transitions and exclusive of missing pulses, shall be between 80 % and 130 % of SRA3.

15.6 Quality of the Time Code Track

In any group of 8 Time Codes at least 6 shall not be corrupted by missing pulses or bit shift.

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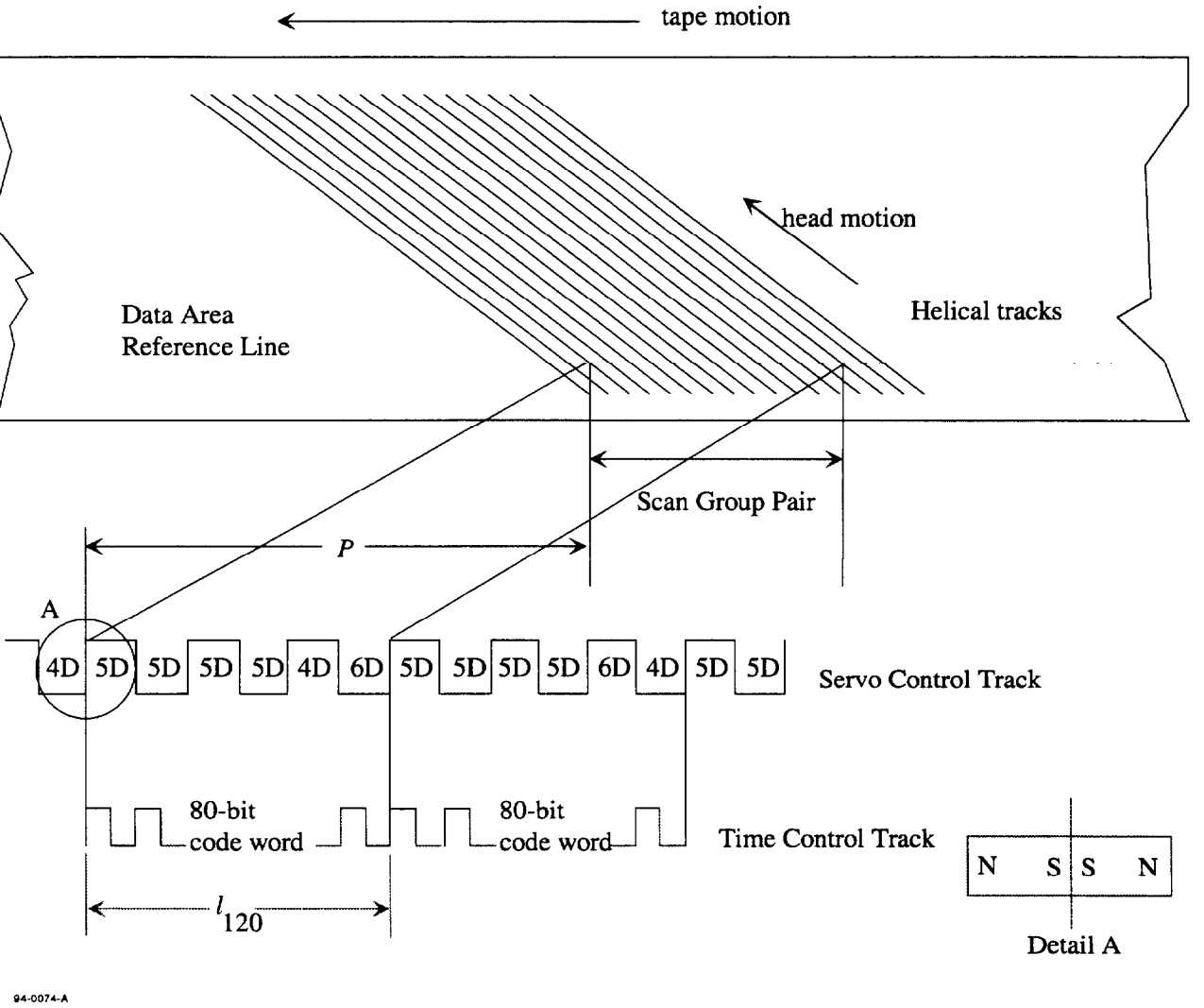


Figure 44 - Details of Servo Control and Time Code Tracks

16 Tape format

16.1 Layout of the magnetic tape

The layout of the magnetic tape shall be as shown in figure 45.

The distance from the leader block to the trailing edge of the BOT slot shall be

$$l_{121} = 457 \text{ mm} \begin{matrix} +\ 543\text{mm} \\ -\ 305\text{ mm} \end{matrix}$$

The distance l_{122} from the trailing edge of the BOT slot to the Data Area Reference Point of the first helical track of the DID shall be between 963 mm and 1 064 mm.

The DID shall be as described in 11.3.6.8.

The ILH shall be as described in 11.3.6.7.

The SEP shall be as described in 11.3.6.6.

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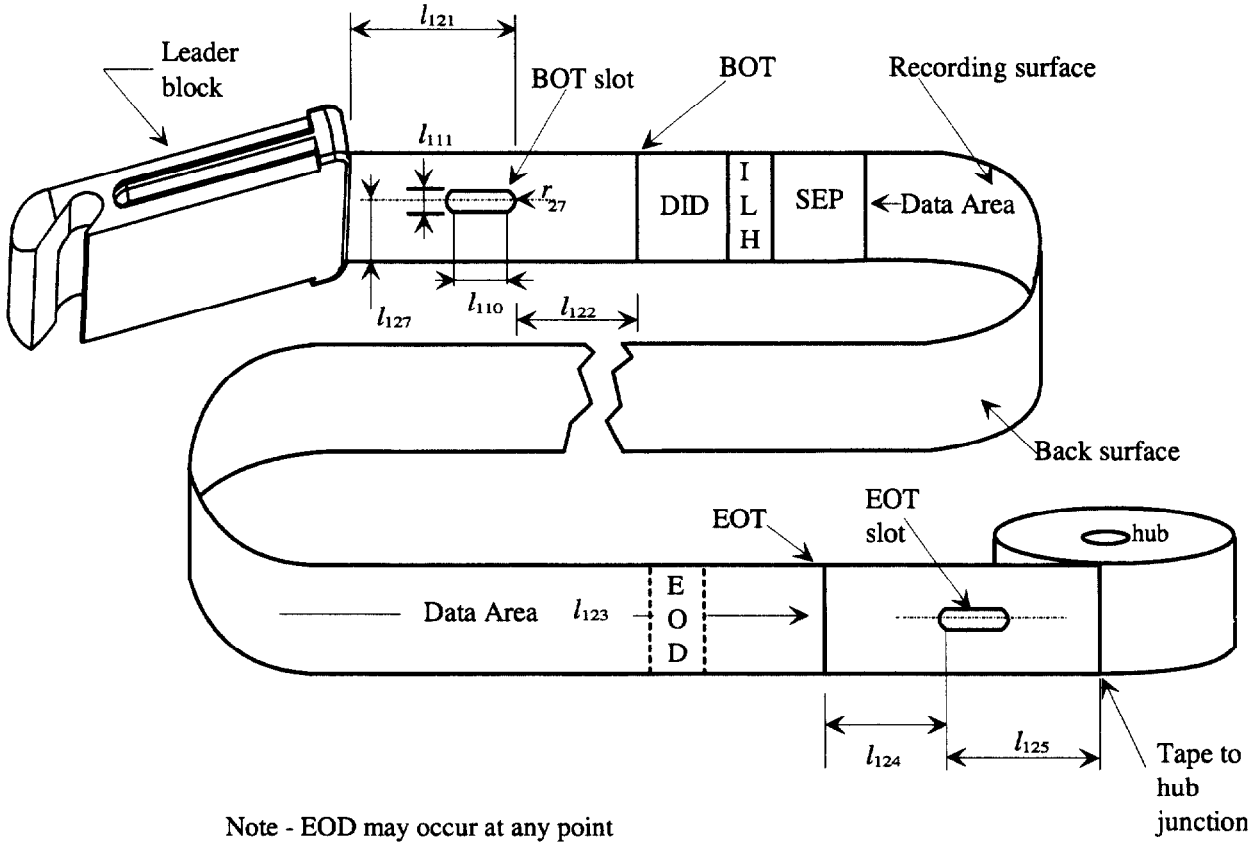


Figure 45 - Tape layout

16.2 Data Area

16.2.1 The Data Area, between SEP and EOT, shall be divided into 190 equal Tape Sectors. The sector numbers shall first increment from 1 to 95 and shall then decrement from 95 to 1.

The length of the Data Area, l_{123}, shall be dependent upon the overall length of the tape.

The capacity of a Tape Sector shall be

For Type A	310 Scan Groups
For Type B	736 Scan Groups
For Type C	1 446 Scan Groups

In each case the last Tape Sector may contain more, or less, than the specified number of Scan Groups, dependent upon the exact length of the tape.

16.2.2 Sequence of Scan Groups on the tape

The requirements of 11.3.6.5 permit the following typical sequences of Scan Groups.

16.2.2.1 Super Groups of maximum size

The maximum density of data on the tape is achieved when 24 Data Scan Groups are followed by an ECC-3 Scan Group, as shown in figure 46, where

The Physical Scan Group Count increments by 1 for both Data Scan Groups and ECC-3 Scan Groups.

The Logical Scan Group Number increments only for Data Scan Groups.

No Scan Group has needed to be rewritten.

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	Data 0	Data 1	----	Data 22	Data 23	ECC	Data 0	Data 1	----	Data 22	Data 23	ECC	Data 0	Data 1
Super Group sequence number	0	1	----	22	23	24	0	1	----	22	23	24	0	1
Physical Scan Group Count	n	n+1	----	n+22	n+23	n+24	n+25	n+26	----	n+47	n+48	n+49	n+50	n+51
Logical Scan Group number	m	m+1	----	m+22	m+23		m+24	m+25	----	m+46	m+47		m+48	m+49
Rewrite count	0	0	----	0	0	0	0	0	----	0	0	0	0	0

94-0039-A

Figure 46 - Maximum Super Groups

16.2.2.2 Short sequence

It is permissible for a Super Group to contain less than 24 Data Scan Groups, as shown in figure 47.

	Data 0	Data 1	Data 2	Data 3	ECC	Data 0	Data 1	Data 2	Data 3	Data 4	Data 5	ECC	
Super Group sequence number →	0	1	2	3	4	0	1	2	3	4	5	6	

94-0040-A

Figure 47 - Short Super Group

16.2.2.3 Use of Pad Scan Groups

It is permissible to include Pad Scan Groups at any point in the Data Area of the Tape, as shown in figure 48. 11.3.6.3 and 11.3.6.4 require that a Pad Scan Group shall always be written before a Tape Mark Scan Group and before the first EOD Scan Group.

	Data 0	Data 1	Pad	ECC	Data 0	Data 1	Data 2	Data 3	Data 4	ECC	Pad	Data 0	
Super Group sequence number →	0	1	(FF)	2	0	1	2	3	4	5	(FF)	0	

94-0041-A

Figure 48 - Sequence with Pad Scan Groups

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16.2.3 Write skips

A Scan Group may be repeated by writing it farther along the tape. The repeated Scan Group may be written after zero, one, two, three or four further Scan Groups have been written. Each such sequence of the original Scan Group and the zero, one, two, three or four Scan Groups may be repeated to allow skipping over bad areas on the tape. The maximum number of instances of a sequence shall be 30, i.e. the original sequence and up to 29 repetitions.

To maintain the sequence of the Logical Scan Group Count, intermediate Scan Groups, i.e. those Scan Groups written between the original Scan Group and its repetition, shall also be rewritten and the rewrite counts shall be incremented by 1. Figure 49 shows the sequence when the Data Scan Group 2 has been rewritten twice.

When there are multiple instances of a Scan Group, that with the highest rewrite count, or that furthest down the tape, which can be read, shall be used.

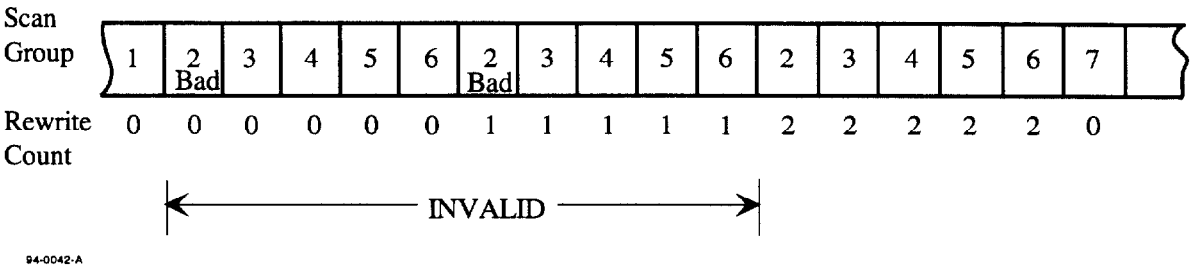


Figure 49 - Write skips

16.2.4 Appended Data

When data has been appended to a previously-written tape, all the requirements of Section 4 of this International Standard shall be met.

16.3 EOD

The EOD shall be as described in 11.3.6.3. The distance from the Data Area Reference Point of the last helical track of the EOD to the leading edge of the EOT slot shall be

l_{124} = 163 mm min.

The point on the tape delineated by this minimum value is EOT.

The distance from the leading edge of the EOT slot to the hub end of the tape shall be

4 300 mm < l_{125} < 5 000 mm

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Annex A
(normative)

Representation of the CRC used in 11.2 - Packet Format

A.1 Description

Each CRC shall consist of 16 bits and be represented by two bytes, CRC 1 and CRC 2.

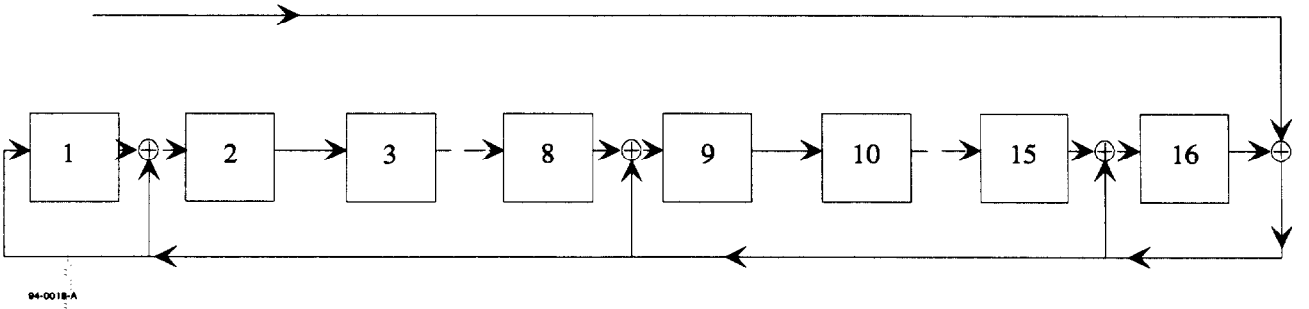
A.2 Computation

The CRC shall be computed from the generator polynomial

$$x^{16} + x^{15} + x^8 + x + 1$$

as shown in the following shift register representation:

Incoming serial data



where ⊕ indicates modulo 2 addition.

Prior to the computation all positions of the shift register shall be set to ZERO.

Incoming data bits within a byte shall be processed starting with bit 0, the least significant bit, and ending with bit 7, the most significant bit.

A.3 Allocation of bits to CRC 1 and CRC 2

On completion of the computation the bits in the shift register shall be allocated to the bit positions in the two CRC bytes as follows:

	CRC Byte 1	CRC Byte 2
Bits in shift register	8 to 15	0 to 7

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Annex B
(normative)

Representation of the CRC used in 11.3 - Scan Group

B.1 Description

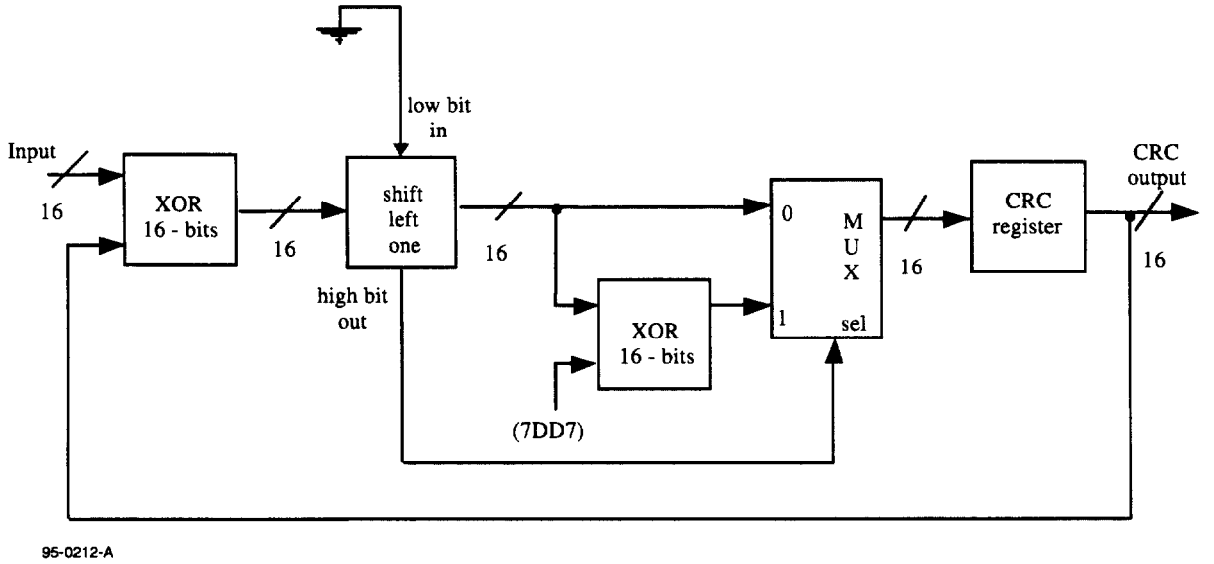
Each CRC shall consist of 16 bits and be represented by two bytes, CRC 1 (most significant) and CRC 2 (least significant).

B.2 Computation

The CRC shall be computed from the generator polynomial.

$$x^{16} + x^{14} + x^{13} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^6 + x^4 + x^2 + x + 1$$

as shown in the following representation for parallel computation and serial output.



Prior to the computation all positions of the registers shall be set to ZERO.

B.3 Allocation of bits to CRC 1 and CRC 2

On completion of the computation the bits in the output register shall be allocated to the bit positions in the two CRC bytes as follows

	CRC Byte 1	CRC Byte 2
Bits in the CRC register	15 to 8	7 to 0

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Annex C
(normative)

Representation of 8-bit bytes by 14-bit patterns

Table C.1 - (CDS ≥ 0)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(00)	01111110000001	0		(00)	10000001111110	0
	(01)	01111100110000	0		(01)	10000011001111	0
	(02)	01111100011000	0		(02)	10000011100111	0
	(03)	01111100001100	0		(03)	10000011110011	0
	(04)	01111100000110	0		(04)	10000011111001	0
	(05)	01111100000011	0		(05)	10000011111100	0
	(06)	01111001110000	0		(06)	10000110001111	0
	(07)	01111001100001	0		(07)	10000110011110	0
	(08)	01111000111000	0		(08)	10000111000111	0
	(09)	01111000110001	0		(09)	10000111001110	0
	(0A)	01111000011100	0		(0A)	10000111100011	0
	(0B)	01111000011001	0		(0B)	10000111100110	0
	(0C)	01111000001110	0		(0C)	10000111110001	0
	(0D)	01111000000111	0		(0D)	10000111111000	0
	(0E)	01110011110000	0		(0E)	10001100001111	0
	(0F)	01110011100001	0		(0F)	10001100011110	0
	(10)	01110011001100	0		(10)	10001100110011	0
	(11)	01110011000110	0		(11)	10001100111001	0
	(12)	01110011000011	0		(12)	10001100111100	0
	(13)	01110001111000	0		(3)	10001110000111	0
	(14)	01110001110001	0		(14)	10001110001110	0
	(15)	01110001100110	0		(15)	10001110011001	0
	(16)	01110001100011	0		(16)	10001110011100	0
	(17)	01110000111100	0		(17)	10001111000011	0
	(18)	01110000111001	0		(18)	10001111000110	0
	(19)	01110000110011	0		(19)	10001111001100	0
	(1A)	01110000011110	0		(1A)	10001111100001	0
	(lB)	01110000001111	0		(lB)	10001111110000	0
	(1C)	01100111110000	0		(1C)	10011000001111	0
	(1D)	01100111100001	0		(1D)	10011000011110	0
	(1E)	01100111001100	0		(1E)	10011000110011	0
	(1F)	01100111000110	0		(1F)	10011000111001	0
	(20)	01100111000011	0		(20)	10011000111100	0
	(21)	01100110011100	0		(21)	10011001100011	0
1 A	(22)	01100110011001	0	1 B	(22)	10011001100110	0
	(23)	01100110001110	0		(23)	10011001110001	0
	(24)	01100110000111	0		(24)	10011001111000	0
	(25)	01100011111000	0		(25)	10011100000111	0
	(26)	01100011110001	0		(26)	10011100001110	0
	(27)	01100011100110	0		(27)	10011100011001	0
	(28)	01100011100011	0		(28)	10011100011100	0
	(29)	01100011001110	0		(29)	10011100110001	0
	(2A)	01100011000111	0		(2A)	10011100111000	0
	(2B)	01100001111100	0		(2B)	10011110000011	0
	(2C)	01100001111001	0		(2C)	10011110000110	0
	(2D)	01100001110011	0		(2D)	10011110001100	0
	(2E)	01100001100111	0		(2E)	10011110011000	0
	(2F)	01100000111110	0		(2F)	10011111000001	0

In columns one and five,
the letter A indicates patterns commencing with a ZERO
the letter B indicates patterns commencing with a ONE
the numeral indicates the number of leading ZEROs, or ONEs, respectively.

(continued)

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Table C.1 (continued)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(30)	01100000011111	0		(30)	10011111100000	0
	(31)	01111111001100	4		(31)	10000011111110	2
	(32)	01111111000110	4		(32)	10000110011111	2
	(33)	01111111000011	4		(33)	10000111001111	2
	(34)	01111110011100	4		(34)	10000111100111	2
	(35)	01111110011001	4		(35)	10000111110011	2
	(36)	01111110001110	4		(36)	10000111111001	2
	(37)	01111110000111	4		(37)	10000111111100	2
	(38)	01111100111100	4		(38)	10001100011111	2
	(39)	01111100111001	4		(39)	10001100111110	2
	(3A)	01111100110011	4		(3A)	10001110001111	2
	(3B)	01111100011110	4		(3B)	10001110011110	2
	(3C)	01111100001111	4		(3C)	10001111000111	2
	(3D)	01111001111100	4		(3D)	10001111001110	2
	(3E)	01111001111001	4		(3E)	10001111100011	2
	(3F)	01111001110011	4		(3F)	10001111100110	2
	(40)	01111001100111	4		(40)	10001111110001	2
	(41)	01111000111110	4		(41)	10001111111000	2
	(42)	01111000011111	4		(42)	10011000011111	2
	(43)	01110011111100	4		(43)	10011000111110	2
	(44)	01110011111001	4		(44)	10011001100111	2
1 A	(45)	01110011110011	4		(45)	10011001110011	2
	(46)	01110011100111	4		(46)	10011001111001	2
	(47)	01110011001111	4		(47)	10011001111100	2
	(48)	01110001111110	4		(48)	10011100001111	2
	(49)	01110000111111	4		(49)	10011100011110	2
	(4A)	01100111111100	4		(4A)	10011100110011	2
	(4B)	01100111111001	4		(4B)	10011100111001	2
	(4C)	01100111110011	4		(4C)	10011100111100	2
	(4D)	01100111100111	4		(4D)	10011110000111	2
	(4E)	01100111001111	4		(4E)	10011110001110	2
	(4F)	01100110011111	4	1 B	(4F)	10011110011001	2
	(50)	01100011111110	4		(50)	10011110011100	2
	(51)	01111111000001	2		(51)	10011111000011	2
	(52)	01111110011000	2		(52)	10011111000110	2
	(53)	01111110001100	2		(53)	10011111001100	2
	(54)	01111110000110	2		(54)	10011111100001	2
	(55)	01111110000011	2		(55)	10011111110000	2
	(56)	01111100111000	2		(56)	10001111001111	4
	(57)	01111100110001	2		(57)	10001111100111	4
	(58)	01111100011100	2		(58)	10001111110011	4
	(59)	01111100011001	2		(59)	10011001111110	4
	(5A)	01111100001110	2		(5A)	10011100111110	4
	(5B)	01111100000111	2		(5B)	10011110001111	4
	(5C)	01111001111000	2		(5C)	10011110011110	4
	(5D)	01111001110001	2		(5D)	10011111000111	4
	(5E)	01111001100110	2		(5E)	10011111001110	4
	(5F)	01111001100011	2		(5F)	10011111100011	4

(continued)

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Table C.1 (continued)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(60)	01111000111100	2		(60)	10011111100110	4
	(61)	01111000111001	2		(61)	11000111100111	4
1 A	(62)	01111000110011	2		(62)	11000111110011	4
	(63)	01111000011110	2		(63)	11000000111111	2
	(64)	01111000001111	2		(64)	11000001111110	2
	(65)	01110011111000	2		(65)	11000011001111	2
	(66)	01110011110001	2		(66)	11000011100111	2
	(67)	01110011100110	2		(67)	11000011110011	2
	(68)	01110011100011	2		(68)	11000011111001	2
	(69)	01110011001110	2		(69)	11000011111100	2
	(6A)	01110011000111	2		(6A)	11000110001111	2
	(6B)	01110001111100	2		(6B)	11000110011110	2
	(6C)	01110001111001	2		(6C)	11000111000111	2
	(6D)	01110001110011	2	2 B	(6D)	11000111001110	2
	(6E)	01110001100111	2		(6E)	11000111100011	2
	(6F)	01110000111110	2		(6F)	11000111100110	2
	(70)	01110000011111	2		(70)	11000111110001	2
	(71)	01100111111000	2		(71)	11000111111000	2
	(72)	01100111110001	2		(72)	11001100001111	2
	(73)	01100111100110	2		(73)	11001100011110	2
	(74)	01100111100011	2		(74)	11001100110011	2
	(75)	01100111001110	2		(75)	11001100111001	2
	(76)	01100111000111	2		(76)	11001100111100	2
	(77)	01100110011110	2		(77)	11001110000111	2
	(78)	01100110001111	2		(78)	11001110001110	2
	(79)	01100011111100	2		(79)	11001110011001	2
	(7A)	01100011111001	2		(7A)	11001110011100	2
	(7B)	01100011110011	2		(7B)	11001111000011	2
	(7C)	01100011100111	2		(7C)	11001111000110	2
	(7D)	01100011001111	2		(7D)	11001111001100	2
	(7E)	01100001111110	2		(7E)	11001111100001	2
	(7F)	01100000111111	2		(7F)	11001111110000	2
	(80)	00111111100000	0		(80)	11000000011111	0
	(81)	00111111000001	0		(81)	11000000111110	0
	(82)	00111110011000	0		(82)	11000001100111	0
	(83)	00111110001100	0		(83)	11000001110011	0
	(84)	00111110000110	0		(84)	11000001111001	0
	(85)	00111110000011	0		(85)	11000001111100	0
2 A	(86)	00111100111000	0		(86)	11000011000111	0
	(87)	00111100110001	0		(87)	11000011001110	0
	(88)	00111100011100	0		(88)	11000011100011	0
	(89)	00111100011001	0		(89)	11000011100110	0
	(8A)	00111100001110	0		(8A)	11000011110001	0
	(8B)	00111100000111	0		(8B)	11000011111000	0
	(8C)	00111001111000	0		(8C)	11000110000111	0
	(8D)	00111001110001	0		(8D)	11000110001110	0
	(8E)	00111001100110	0		(8E)	11000110011001	0
	(8F)	00111001100011	0		(8F)	11000110011100	0

(continued)

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Table C.1 (continued)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(90)	00111000111100	0		(90)	11000111000011	0
	(91)	00111000111001	0		(91)	11000111000110	0
	(92)	00111000110011	0		(92)	11000111001100	0
	(93)	00111000011110	0		(93)	11000111100001	0
	(94)	00111000001111	0		(94)	11000111110000	0
	(95)	00110011111000	0		(95)	11001100000111	0
	(96)	00110011110001	0		(96)	11001100001110	0
	(97)	00110011100110	0		(97)	11001100011001	0
	(98)	00110011100011	0		(98)	11001100011100	0
	(99)	00110011001110	0		(99)	11001100110001	0
	(9A)	00110011000111	0	2 B	(9A)	11001100111000	0
	(9B)	00110001111100	0		(9B)	11001110000011	0
	(9C)	00110001111001	0		(9C)	11001110000110	0
	(9D)	00110001110011	0		(9D)	11001110001100	0
	(9E)	00110001100111	0		(9E)	11001110011000	0
	(9F)	00110000111110	0		(9F)	11001111000001	0
	(A0)	00110000011111	0		(A0)	11001111100000	0
	(A1)	00111111100001	2		(Al)	11001100111110	4
2 A	(A2)	00111111001100	2		(A2)	11001110011110	4
	(A3)	00111111000110	2		(A3)	11001111000111	4
	(A4)	00111111000011	2		(A4)	11001111001110	4
	(A5)	00111110011100	2		(A5)	11001111100011	4
	(A6)	00111110011001	2		(A6)	11001111100110	4
	(A7)	00111110001110	2		(A7)	11100001111110	4
	(A8)	00111110000111	2		(A8)	11100011100111	4
	(A9)	00111100111100	2		(A9)	11100011110011	4
	(AA)	00111100111001	2		(AA)	11100011111100	4
	(AB)	00111100110011	2		(AB)	11100110011110	4
	(AC)	00111100011110	2		(AC)	11100111000111	4
	(AD)	00111100001111	2		(AD)	11100111001110	4
	(AE)	00111001111100	2		(AE)	11100111100011	4
	(AF)	00111001111001	2		(AF)	11100111100110	4
	(B0)	00111001110011	2		(B0)	11100111111000	4
	(B1)	00111001100111	2		(B1)	11100000011111	2
	(B2)	00111000111110	2	3 B	(B2)	11100000111110	2
	(B3)	00111000011111	2		(B3)	11100001100111	2
	(B4)	00110011111100	2		(B4)	11100001110011	2
	(B5)	00110011111001	2		(B5)	11100001111001	2
	(B6)	00110011110011	2		(B6)	11100001111100	2
	(B7)	00110011100111	2		(B7)	11100011000111	2
	(B8)	00110011001111	2		(B8)	11100011001110	2
	(B9)	00110001111110	2		(B9)	11100011100011	2
	(BA)	00110000111111	2		(BA)	11100011100110	2
	(BB)	00111111100110	4		(BB)	11100011110001	2
	(BC)	00111111100011	4		(BC)	11100011111000	2
	(BD)	00111111001110	4		(BD)	11100110000111	2
	(BE)	00111111000111	4		(BE)	11100110001110	2
	(BF)	00111110011110	4		(BF)	11100110011001	2

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Table C.1 (continued)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(C0)	00111110001111	4		(C0)	11100110011100	2
	(C1)	00111100111110	4		(C1))	11100111000011	2
	(C2)	00111100011111	4		(C2)	11100111000110	2
	(C3)	001110011111110	4		(C3)	11100111001100	2
	(C4)	00111000111111	4		(C4)	11100111100001	2
2 A	(C5)	00110011111110	4		(C5)	11100111110000	2
	(C6)	00011111110000	0		(C6)	11100000001111	0
	(C7)	00011111100001	0		(C7)	11100000011110	0
	(C8)	00011111001100	0		(C8)	11100000110011	0
	(C9)	00011111000110	0		(C9)	11100000111001	0
	(CA)	00011111000011	0	3 B	(CA)	11100000111100	0
	(CB)	00011110011100	0		(CB)	11100001100011	0
	(CC)	00011110011001	0		(CC)	11100001100110	0
	(CD)	00011110001110	0		(CD)	11100001110001	0
	(CE)	00011110000111	0		(CE)	11100001111000	0
	(CF)	00011100111100	0		(CF)	11100011000011	0
	(D0)	00011100111001	0		(D0)	11100011000110	0
	(D1)	00011100110011	0		(D1)	11100011001100	0
	(D2)	00011100011110	0		(D2)	11100011100001	0
	(D3)	00011100001111	0		(D3)	11100011110000	0
	(D4)	00011001111100	0		(D4)	11100110000011	0
	(D5)	00011001111001	0		(D5)	11100110000110	0
	(D6)	00011001110011	0		(D6)	11100110001100	0
3 A	(D7)	00011001100111	0		(D7)	11100110011000	0
	(D8)	00011000111110	0		(D8)	11100111000001	0
	(D9)	00011000011111	0		(D9)	11100111100000	0
	(DA)	00011111110001	2		(DA)	11110001111100	4
	(DB)	00011111100110	2		(DB)	11110011111000	4
	(DC)	00011111100011	2		(DC)	11110000001111	2
	(DD)	00011111001110	2		(DD)	11110000011110	2
	(DE)	00011111000111	2		(DE)	11110000110011	2
	(DF)	00011110011110	2		(DF)	11110000111001	2
	(E0)	00011110001111	2		(E0)	11110000111100	2
	(E1)	00011100111110	2		(E1)	11110001100011	2
	(E2)	00011100011111	2	4 B	(E2)	11110001100110	2
	(E3)	00011001111110	2		(E3)	11110001110001	2
	(E4)	00011000111111	2		(E4)	11110001111000	2
	(E5)	00011111110011	4		(E5)	11110011000011	2
	(E6)	00011111100111	4		(E6)	11110011000110	2
	(E7)	00011111001111	4		(E7)	11110011001100	2
	(E8)	00011110011111	4		(E8)	11110011100001	2
	(E9)	00011100111111	4		(E9)	11110011110000	2
	(EA)	00001111111000	0		(EA)	11110000000111	0
	(EB)	00001111110001	0		(EB)	11110000001110	0
	(EC)	00001111100110	0		(EC)	11110000011001	0
4 A	(ED)	00001111100011	0		(ED)	11110000011100	0
	(EE)	00001111001110	0		(EE)	11110000110001	0
	(EF)	00001111000111	0		(EF)	11110000111000	0

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Table C.1 (concluded)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(F0)	00001110011110	0		(F0)	11110001100001	0
	(F1)	00001110001111	0	4 B	(F1)	11110001110000	0
	(F2)	00001100111110	0		(F2)	11110011000001	0
	(F3)	00001100011111	0		(F3)	11110011100000	0
4 A	(F4)	00001111111001	2		(F4)	11111000000111	2
	(F5)	00001111110011	2		(F5)	11111000001110	2
	(F6)	00001111100111	2		(F6)	11111000011001	2
	(F7)	00001111001111	2		(F7)	11111000011100	2
	(F8)	00001110011111	2		(F8)	11111000110001	2
	(F9)	00001100111111	2	5 B	(F9)	11111000111000	2
	(FA)	00000111111100	0		(FA)	11111001100001	2
	(FB)	00000111111001	0		(FB)	11111001110000	2
	(FC)	00000111110011	0		(FC)	11111000001100	0
5 A	(FD)	00000111100111	0		(FD)	11111000011000	0
	(FE)	00000111001111	0		(FE)	11111000110000	0
	(FF)	00000110011111	0		(FF)	11111001100000	0

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Table C.2 - (CDS ≤ 0)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(00)	01111110000001	0		(00)	10000001111110	0
	(01)	01111100110000	0		(01)	10000011001111	0
	(02)	01111100011000	0		(02)	10000011100111	0
	(03)	01111100001100	0		(03)	10000011110011	0
	(04)	01111100000110	0		(04)	10000011111001	0
	(05)	01111100000011	0		(05)	10000011111100	0
	(06)	01111001110000	0		(06)	10000110001111	0
	(07)	01111001100001	0		(07)	10000110011110	0
	(08)	01111000111000	0		(08)	10000111000111	0
	(09)	01111000110001	0		(09)	10000111001110	0
	(0A)	01111000011100	0		(0A)	10000111100011	0
	(0B)	01111000011001	0		(0B)	10000111100110	0
	(0C)	01111000001110	0		(0C)	10000111110001	0
	(0D)	01111000000111	0		(0D)	10000111111000	0
	(0E)	01110011110000	0		(0E)	10001100001111	0
	(0F)	01110011100001	0		(0F)	10001100011110	0
	(10)	01110011001100	0		(10)	10001100110011	0
	(11)	01110011000110	0		(11)	10001100111001	0
	(12)	01110011000011	0		(12)	10001100111100	0
	(13)	01110001111000	0		(13)	10001110000111	0
	(14)	01110001110001	0		(14)	10001110001110	0
	(15)	01110001100110	0		(15)	10001110011001	0
	(16)	01110001100011	0		(16)	10001110011100	0
	(17)	01110000111100	0		(17)	10001111000011	0
	(18)	01110000111001	0		(18)	10001111000110	0
	(19)	01110000110011	0		(19)	10001111001100	0
	(1A)	01110000011110	0		(1A)	10001111100001	0
	(1B)	01110000001111	0		(1B)	10001111110000	0
	(1C)	01100111110000	0		(1C)	10011000001111	0
1 C	(1D)	01100111100001	0		(1D)	10011000011110	0
	(1E)	01100111001100	0		(1E)	10011000110011	0
	(1F)	01100111000110	0		(1F)	10011000111001	0
	(20)	01100111000011	0		(20)	10011000111100	0
	(21)	01100110011100	0		(21)	10011001100011	0
	(22)	01100110011001	0	1 D	(22)	10011001100110	0
	(23)	01100110001110	0		(23)	10011001110001	0
	(24)	01100110000111	0		(24)	10011001111000	0
	(25)	01100011111000	0		(25)	10011100000111	0
	(26)	01100011110001	0		(26)	10011100001110	0
	(27)	01100011100110	0		(27)	10011100011001	0
	(28)	01100011100011	0		(28)	10011100011100	0
	(29)	01100011001110	0		(29)	10011100110001	0
	(2A)	01100011000111	0		(2A)	10011100111000	0
	(2B)	01100001111100	0		(2B)	10011110000011	0
	(2C)	01100001111001	0		(2C)	10011110000110	0
	(2D)	01100001110011	0		(2D)	10011110001100	0
	(2E)	01100001100111	0		(2E)	10011110011000	0
	(2F)	01100000111110	0		(2F)	10011111000001	0

In columns one and five,
the letter C indicates patterns commencing with a ZERO
the letter D indicates patterns commencing with a ONE
the numeral indicates the number of leading ZEROs, or ONEs, respectively.

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Table C.2 (continued)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(30)	01100000011111	0		(30)	10011111100000	0
	(31)	01111100000001	-2		(31)	10000000110011	-4
	(32)	01111001100000	-2		(32)	10000000111001	-4
	(33)	01111000110000	-2		(33)	10000000111100	-4
	(34)	01111000011000	-2		(34)	10000001100011	-4
	(35)	01111000001100	-2		(35)	10000001100110	-4
	(36)	01111000000110	-2		(36)	10000001110001	-4
	(37)	01111000000011	-2		(37)	10000001111000	-4
	(38)	01110011100000	-2		(38)	10000011000011	-4
	(39)	01110011000001	-2		(39)	10000011000110	-4
	(3A)	01110001110000	-2		(3A)	10000011001100	-4
	(3B)	01110001100001	-2		(3B)	10000011100001	-4
	(3C)	01110000111000	-2		(3C)	10000011110000	-4
	(3D)	01110000110001	-2		(3D)	10000110000011	-4
	(3E)	01110000011100	-2		(3E)	10000110000110	-4
	(3F)	01110000011001	-2		(3F)	10000110001100	-4
	(40)	01110000001110	-2		(40)	10000110011000	-4
	(41)	01110000000111	-2		(41)	10000111000001	-4
	(42)	01100111100000	-2		(42)	10000111100000	-4
	(43)	01100111000001	-2		(43)	10001100000011	-4
	(44)	01100110011000	-2		(44)	10001100000110	-4
	(45)	01100110001100	-2	1 D	(45)	10001100001100	-4
	(46)	01100110000110	-2		(46)	10001100011000	-4
	(47)	01100110000011	-2		(47)	10001100110000	-4
	(48)	01100011110000	-2		(48)	10001110000001	-4
	(49)	01100011100001	-2		(49)	10001111000000	-4
	(4A)	01100011001100	-2		(4A)	10011000000011	-4
	(4B)	01100011000110	-2		(4B)	10011000000110	-4
	(4C)	01100011000011	-2		(4C)	10011000001100	-4
	(4D)	01100001111000	-2		(4D)	10011000011000	-4
	(4E)	01100001110001	-2		(4E)	10011000110000	-4
1 C	(4F)	01100001100110	-2		(4F)	10011001100000	-4
	(50)	01100001100011	-2		(50)	10011100000001	-4
	(51)	01100000111100	-2		(51)	10000000111110	-2
	(52)	01100000111001	-2		(52)	10000001100111	-2
	(53)	01100000110011	-2		(53)	10000001110011	-2
	(54)	01100000011110	-2		(54)	10000001111001	-2
	(55)	01100000001111	-2		(55)	10000001111100	-2
	(56)	01110000110000	-4		(56)	10000011000111	-2
	(57)	01110000011000	-4		(57)	10000011001110	-2
	(58)	01110000001100	-4		(58)	10000011100011	-2
	(59)	01100110000001	-4		(59)	10000011100110	-2
	(5A)	01100011000001	-4		(5A)	10000011110001	-2
	(5B)	01100001110000	-4		(5B)	10000011111000	-2
	(5C)	01100001100001	-4		(5C)	10000110000111	-2
	(5D)	01100000111000	-4		(5D)	10000110001110	-2
	(5E)	01100000110001	-4		(5E)	10000110011001	-2
	(5F)	01100000011100	-4		(5F)	10000110011100	-2

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Table C.2 (continued)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(60)	01100000011001	-4		(60)	10000111000011	-2
	(61)	00111000011000	-4		(61)	10000111000110	-2
	(62)	00111000001100	-4	1 D	(62)	10000111001100	-2
	(63)	00111111000000	-2		(63)	10000111100001	-2
	(64)	00111110000001	-2		(64)	10000111110000	-2
	(65)	00111100110000	-2		(65)	10001100000111	-2
	(66)	00111100011000	-2		(66)	10001100001110	-2
	(67)	00111100001100	-2		(67)	10001100011001	-2
	(68)	00111100000110	-2		(68)	10001100011100	-2
	(69)	00111100000011	-2		(69)	10001100110001	-2
	(6A)	00111001110000	-2		(6A)	10001100111000	-2
	(6B)	00111001100001	-2		(6B)	10001110000011	-2
	(6C)	00111000111000	-2		(6C)	10001110000110	-2
	(6D)	00111000110001	-2		(6D)	10001110001100	-2
	(6E)	00111000011100	-2		(6E)	10001110011000	-2
2 C	(6F)	00111000011001	-2		(6F)	10001111000001	-2
	(70)	00111000001110	-2		(70)	10001111100000	-2
	(71)	00111000000111	-2		(71)	10011000000111	-2
	(72)	00110011110000	-2		(72)	10011000001110	-2
	(73)	00110011100001	-2		(73)	10011000011001	-2
	(74)	00110011001100	-2		(74)	10011000011100	-2
	(75)	00110011000110	-2		(75)	10011000110001	-2
	(76)	00110011000011	-2		(76)	10011000111000	-2
	(77)	00110001111000	-2		(77)	10011001100001	-2
	(78)	00110001110001	-2		(78)	10011001110000	-2
	(79)	00110001100110	-2		(79)	10011100000011	-2
	(7A)	00110001100011	-2		(7A)	10011100000110	-2
	(7B)	00110000111100	-2		(7B)	10011100001100	-2
	(7C)	00110000111001	-2		(7C)	10011100011000	-2
	(7D)	00110000110011	-2		(7D)	10011100110000	-2
	(7E)	00110000011110	-2		(7E)	10011110000001	-2
	(7F)	00110000001111	-2		(7F)	10011111000000	-2
	(80)	00111111100000	0		(80)	11000000011111	0
	(81)	00111111000001	0		(81)	11000000111110	0
	(82)	00111110011000	0		(82)	11000001100111	0
	(83)	00111110001100	0		(83)	11000001110011	0
	(84)	00111110000110	0		(84)	11000001111001	0
	(85)	00111110000011	0		(85)	11000001111100	0
	(86)	00111100111000	0	2 D	(86)	11000011000111	0
	(87)	00111100110001	0		(87)	11000011001110	0
	(88)	00111100011100	0		(88)	11000011100011	0
	(89)	00111100011001	0		(89)	11000011100110	0
	(8A)	00111100001110	0		(8A)	11000011110001	0
	(8B)	00111100000111	0		(8B)	11000011111000	0
	(8C)	00111001111000	0		(8C)	11000110000111	0
	(8D)	00111001110001	0		(8D)	11000110001110	0
	(8E)	00111001100110	0		(8E)	11000110011001	0
	(8F)	00111001100011	0		(8F)	11000110011100	0

(continued)

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Table C.2 (continued)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(90)	00111000111100	0		(90)	11000111000011	0
	(91)	00111000111001	0		(91)	11000111000110	0
	(92)	00111000110011	0		(92)	11000111001100	0
	(93)	00111000011110	0		(93)	11000111100001	0
	(94)	00111000001111	0		(94)	11000111110000	0
	(95)	00110011111000	0		(95)	11001100000111	0
	(96)	00110011110001	0		(96)	11001100001110	0
	(97)	00110011100110	0		(97)	11001100011001	0
	(98)	00110011100011	0		(98)	11001100011100	0
	(99)	00110011001110	0		(99)	11001100110001	0
2 C	(9A)	00110011000111	0		(9A)	11001100111000	0
	(9B)	00110001111100	0		(9B)	11001110000011	0
	(9C)	00110001111001	0		(9C)	11001110000110	0
	(9D)	00110001110011	0		(9D)	11001110001100	0
	(9E)	00110001100111	0		(9E)	11001110011000	0
	(9F)	00110000111110	0		(9F)	11001111000001	0
	(A0)	00110000011111	0		(A0)	11001111100000	0
	(A1)	00110011000001	-4		(Al)	11000000011110	-2
	(A2)	00110001100001	-4	2 D	(A2)	11000000110011	-2
	(A3)	00110000111000	-4		(A3)	11000000111001	-2
	(A4)	00110000110001	-4		(A4)	11000000111100	-2
	(A5)	00110000011100	-4		(A5)	11000001100011	-2
	(A6)	00110000011001	-4		(A6)	11000001100110	-2
	(A7)	00011110000001	-4		(A7)	11000001110001	-2
	(A8)	00011100011000	-4		(A8)	11000001111000	-2
	(A9)	00011100001100	-4		(A9)	11000011000011	-2
	(AA)	00011100000011	-4		(AA)	11000011000110	-2
	(AB)	00011001100001	-4		(AB)	11000011001100	-2
	(AC)	00011000111000	-4		(AC)	11000011100001	-2
	(AD)	00011000110001	-4		(AD)	11000011110000	-2
	(AE)	00011000011100	-4		(AE)	11000110000011	-2
3 C	(AF)	00011000011001	-4		(AF)	11000110000110	-2
	(B0)	00011000000111	-4		(B0)	11000110001100	-2
	(B1)	00011111100000	-2		(B1)	11000110011000	-2
	(B2)	00011111000001	-2		(B2)	11000111000001	-2
	(B3)	00011110011000	-2		(B3)	11000111100000	-2
	(B4)	00011110001100	-2		(B4)	11001100000011	-2
	(B5)	00011110000110	-2		(B5)	11001100000110	-2
	(B6)	00011110000011	-2		(B6)	11001100001100	-2
	(B7)	00011100111000	-2		(B7)	11001100011000	-2
	(B8)	00011100110001	-2		(B8)	11001100110000	-2
	(B9)	00011100011100	-2		(B9)	11001110000001	-2
	(BA)	00011100011001	-2		(BA)	11001111000000	-2
	(BB)	00011100001110	-2		(BB)	11000000011001	-4
	(BC)	00011100000111	-2		(BC)	11000000011100	-4
	(BD)	00011001111000	-2		(BD)	11000000110001	-4
	(BE)	00011001110001	-2		(BE)	11000000111000	-4
	(BF)	00011001100110	-2		(BF)	11000001100001	-4

(continued)

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Table C.2 (continued)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
	(C0)	00011001100011	-2		(C0)	11000001110000	-4
	(C1)	00011000111100	-2		(C1)	11000011000001	-4
	(C2)	00011000111001	-2		(C2)	11000011100000	-4
	(C3)	00011000110011	-2		(C3)	11000110000001	-4
	(C4)	00011000011110	-2	2 D	(C4)	11000111000000	-4
	(C5)	00011000001111	-2		(C5)	11001100000001	-4
	(C6)	00011111110000	0		(C6)	11100000001111	0
	(C7)	00011111100001	0		(C7)	11100000011110	0
	(C8)	00011111001100	0		(C8)	11100000110011	0
	(C9)	00011111000110	0		(C9)	11100000111001	0
3 C	(CA)	00011111000011	0		(CA)	11100000111100	0
	(CB)	00011110011100	0		(CB)	11100001100011	0
	(CC)	00011110011001	0		(CC)	11100001100110	0
	(CD)	00011110001110	0		(CD)	11100001110001	0
	(CE)	00011110000111	0		(CE)	11100001111000	0
	(CF)	00011100111100	0		(CF)	11100011000011	0
	(D0)	00011100111001	0		(D0)	11100011000110	0
	(D1)	00011100110011	0		(D1)	11100011001100	0
	(D2)	00011100011110	0		(D2)	11100011100001	0
	(D3)	00011100001111	0		(D3)	11100011110000	0
	(D4)	00011001111100	0		(D4)	11100110000011	0
	(D5)	00011001111001	0		(D5)	11100110000110	0
	(D6)	00011001110011	0		(D6)	11100110001100	0
	(D7)	00011001100111	0	3 D	(D7)	11100110011000	0
	(D8)	00011000111110	0		(D8)	11100111000001	0
	(D9)	00011000011111	0		(D9)	11100111100000	0
	(DA)	00001110000011	-4		(DA)	11100000001110	-2
	(DB)	00001100000111	-4		(DB)	11100000011001	-2
	DC)	00001111110000	-2		(DC)	11100000011100	-2
	(DD)	00001111100001	-2		(DD)	11100000110001	-2
	(DE)	00001111001100	-2		(DE)	11100000111000	-2
	(DF)	00001111000110	-2		(DF)	11100001100001	-2
	(E0)	00001111000011	-2		(E0)	11100001110000	-2
	(El)	00001110011100	-2		(El)	11100011000001	-2
4 C	(E2)	00001110011001	-2		(E2)	11100011100000	-2
	(E3)	00001110001110	-2		(E3)	11100110000001	-2
	(E4)	00001110000111	-2		(E4)	11100111000000	-2
	(E5)	00001100111100	-2		(E5)	11100000001100	-4
	(E6)	00001100111001	-2		(E6)	11100000011000	-4
	(E7)	00001100110011	-2		(E7)	11100000110000	-4
	(E8)	00001100011110	-2		(E8)	11100001100000	-4
	(E9)	00001100001111	-2		(E9)	11100011000000	-4
	(EA)	00001111111000	0		(EA)	11110000000111	0
	(EB)	00001111110001	0		(EB)	11110000001110	0
	(EC)	00001111100110	0	4 D	(EC)	11110000011001	0
	(ED)	00001111100011	0		(ED)	11110000011100	0
	(EE)	00001111001110	0		(EE)	11110000110001	0
	(EF)	00001111000111	0		(EF)	11110000111000	0

(continued)

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Table C.2 (concluded)

Class	8-bit data	Patterns beginning with 0	CDS	Class	8-bit data	Patterns beginning with 1	CDS
4 C	(F0)	00001110011110	0	4 D	(F0)	11110001100001	0
	(F1)	00001110001111	0		(F1)	11110001110000	0
	(F2)	00001100111110	0		(F2)	11110011000001	0
	(F3)	00001100011111	0		(F3)	11110011100000	0
5 C	(F4)	00000111111000	-2		(F4)	11110000000110	-2
	(F5)	00000111110001	-2		(F5)	11110000001100	-2
	(F6)	00000111100110	-2		(F6)	11110000011000	-2
	(F7)	00000111100011	-2		(F7)	11110000110000	-2
	(F8)	00000111001110	-2		(F8)	11110001100000	-2
	(F9)	00000111000111	-2		(F9)	11110011000000	-2
	(FA)	00000110011110	-2	5 D	(FA)	11111000000011	0
	(FB)	00000110001111	-2		(FB)	11111000000110	0
	(FC)	00000111110011	0		(FC)	11111000001100	0
	(FD)	00000111100111	0		(FD)	11111000011000	0
	(FE)	00000111001111	0		(FE)	11111000110000	0
	(FF)	00000110011111	0		(FF)	11111001100000	0

Table C.3 - EDSV = -2

Pattern	Priority
xxxxxxxxxxx001	4
xxxxxxxxxx0011	1
xxxxxxxxx00111	2
xxxxxxxx001111	3
xxxxxxx0011111	8
xxxxxxxxxxx110	10
xxxxxxxxxx1100	5
xxxxxxxxx11000	6
xxxxxxxx110000	7
xxxxxxx1100000	9
xxxxxx11000000	11
NOTE: x is a don't care bit.	

Table C.4 - EDSV = +2

Pattern	Priority
xxxxxxxxxxx110	4
xxxxxxxxxx1100	1
xxxxxxxxx11000	2
xxxxxxxx110000	3
xxxxxxx1100000	8
xxxxxxxxxxx001	10
xxxxxxxxxx0011	5
xxxxxxxxx00111	6
xxxxxxxx001111	7
xxxxxxx0011111	9
xxxxxx00111111	11
NOTE: x is a don't care bit.	

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Annex D
(normative)

Generation of Outer ECC and Inner ECC

D.1 Outer ECC

The Outer ECC is a Reed-Solomon code denoted RS(136,128).

The Galois Field shall be GF(2^8)

The Field Generator Polynomial shall be $\rho(x) = x^8 + x^4 + x^3 + x^2 + 1$

where x^n are place-keeping variables in GF(2^1), the binary field

The Code Generator Polynomial shall be

$G(x) = (x+1)(x+a)(x+a^2)(x+a^3)(x+a^4)(x+a^5)(x+a^6)(x+a^7)$

where a is given by (02)$_H$ in GF(2^8)

$D(x) = B_{127}x^{127} + B_{126}x^{126} + - - - + B_2x^2 + B_1x + B_0$

where B_m are the values of the bytes in the column of the Interleave Buffer

The check characters K_7 to K_0 shall be taken from the remainder of the following division.

$$\frac{x^8D(x)}{G(x)}$$

The polynomial of the full code is

$B_{127}x^{135} + B_{126}x^{134} + ... + B_1x^9 + B_0x^8 + K_7x^7 + K_6x^6 + K_5x^5 + K_4x^4 + K_3x^3 + K_2x^2 + K_1x^1 + K_0$

Order of use

The left-most term in all the above equations is the most significant and is the first written to tape.

D.2 Inner ECC

The Inner ECC is a Reed-Solomon code denoted RS(95,87).

The Galois Field shall be GF(2^8).

The Field Generator Polynomial shall be $\rho(x) = x^8 + x^4 + x^3 + x^2 + 1$

where x^n are place-keeping variables in GF(2^1), the binary field.

The Code Generator Polynomial shall be

$G(x) = (x+1)(x+a)(x+a^2)(x+a^3)(x+a^4)(x+a^5)(x+a^6)(x+a^7)$

where a is given by (02) in GF(2^8)

$D(x) = ID_0x^{86} + ID_1x^{85} + B_{84}x^{84} + - - - - B_2x^2 + B_1x + B_0$

where ID_0 and ID_1 are the values of the bytes in the Sync Block Identifier and B_n are the values of the bytes of the Data Part of the Sync Block.

The check characters K_7 to K_0 shall be taken from the remainder of the following division.

$$\frac{x^8D(x)}{G(x)}$$

The polynomial of the full code is

$ID_0x^{94} + ID_1x^{93} + B_{84}x^{92} + B_{83}x^{91}..... + B_1x^9 + B_0x^8 + K_7x^7 + K_6x^6 ..... + K_2x^2 + K_1x + K_0$

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Order of use

The left-most term in all the above equations is the most significant and is the first written to tape.

--`,,```,,,,````-`-`,,`,,`,`,,`---

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Annex E
(informative)

Measurement of the geometry of helical tracks

E.1 General

This test method is based on the fact that all helical tracks recorded by the same head at constant tape speed, and with constant angular rotation of the scanner, have the same longitudinal track pitch, the same track angle and the same track curvature.

Using ferrofluids, develop the recorded pattern of tracks and flux transitions over a section of tape of length 100 mm.

All measurements are made in the Test Environment and with no tension applied to the tape.

The longitudinal track pitch is then corrected for the tape tension defined for use in a drive.

The theoretical track position is calculated from the corrected longitudinal track pitch and the theoretical track angle.

The track location error is calculated as the difference between the theoretical track position and the measured track position.

E.2 Longitudinal track pitch

Measure the distance CTM over n Servo Control Track pitches.

Correct this value for the effect of tape tension specified for the tape drive.

$$CTM' = \left(1 + \frac{T}{AE}\right) CTM$$

where T is the tension = 0, 31 N

E is Young's Modulus = 8 000 N/mm^2

A is the cross-sectional area of the tape

The corrected longitudinal pitch of the helical tracks is

$$L = \frac{CTM'}{4n}$$

E.3 Measurement of track edges (see figure E.1)

The starting point for calculations and measurements is a Program Reference Point, which is a point where a line parallel to the Tape Reference Edge, and spaced Y_0 from it, intersects the bottom edge of a track.

Moving along the measurement path, which is perpendicular to the Tape Reference Edge ± 0°10' and passes through the Program Reference Point, measure for 80 successive tracks i the distance Y_i from the Tape Reference Edge.

The values for every fourth track are for Tolerance Zone 1; starting at the subsequent three tracks gives the values for Tolerance Zones 2 to 4.

Repeat these measurements for 200 measurement paths along the developed section of the tape.

E.4 Calculation of track location error

The track pitch perpendicular to the Tape Reference Edge is

$$\Delta Y = L \cdot \tan \theta$$

The theoretical position of track i at the measurement path is

$$Y_{it} = Y_o + i \cdot \Delta Y$$

The track location error at that measurement path is

$$TLE = Y_i - Y_{it}$$

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E.5 Calculation of track straightness (see figure E.2)

For the set of readings taken at each measurement path, plot the TLE against track number for each Tolerance Zone.

Construct the Tolerance Zones defined in 15.2.4 and centre them to give the best fit for Tolerance Zone 2.

All points should lie within the appropriate Zones.

Table E.1 - Nomenclature and calculation of track location error

Y_0	Data Area Reference Point	
CTM	Distance of n Servo Control Track pitches without tape tension	
CTM'	Distance of n Servo Control Track pitches with tape tension	$CTM' = \left(1 + \frac{T}{AE}\right) CTM$
L	Longitudinal track pitch	$L = \frac{CTM'}{4n}$
i	Track number, i = 0 for the track containing the reference point	
Y_i	Measured position of track i	
Y	Track pitch perpendicular to the Tape Reference Edge	$\Delta Y = L \cdot \tan\theta$
Y_{it}	Theoretical position of track i	$Y_{it} = Y_o + i \cdot \Delta Y$
I	Track pitch	$I = L \cdot \sin\theta$
TLE	Track location error	$TLE = Y_i - Y_{it}$
Z	Tolerance Zone	

For Tolerance Zone

Z1 : i = -4, 0, +4, +8 ...

Z2 : i = -5, -1, +3, +7 ...

Z3 : i = -6, -2, +2, +6

Z4 : i = -7, -3, +1, +5

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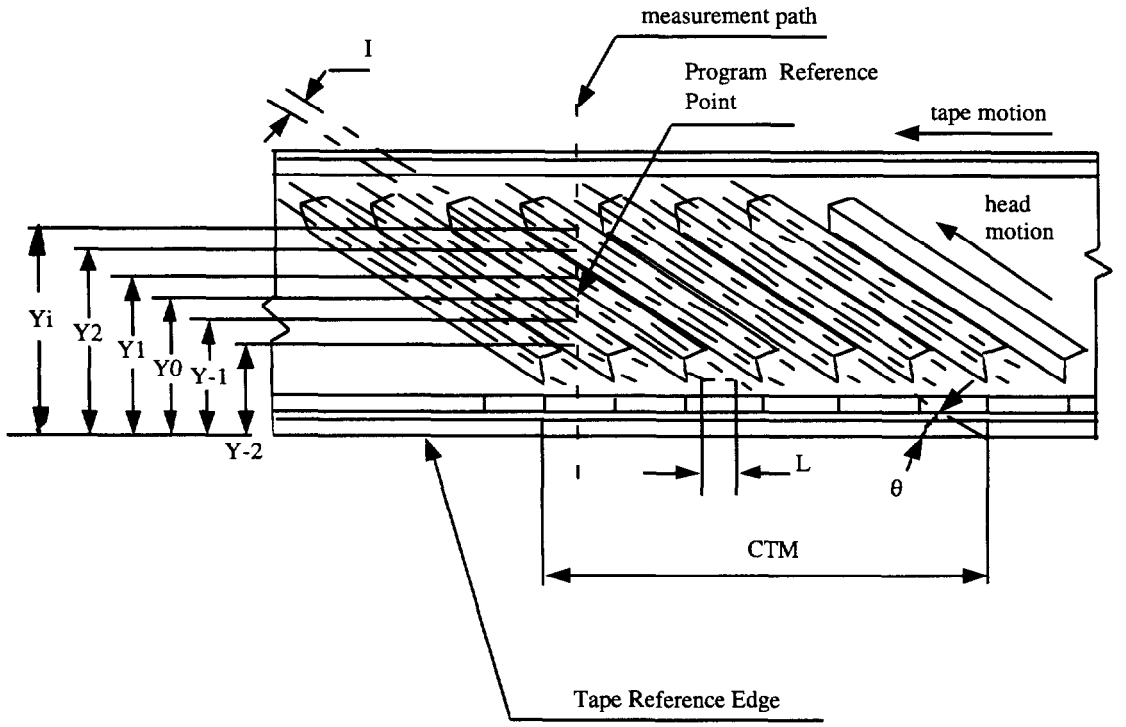


Figure E.l - Geometry of helical tracks

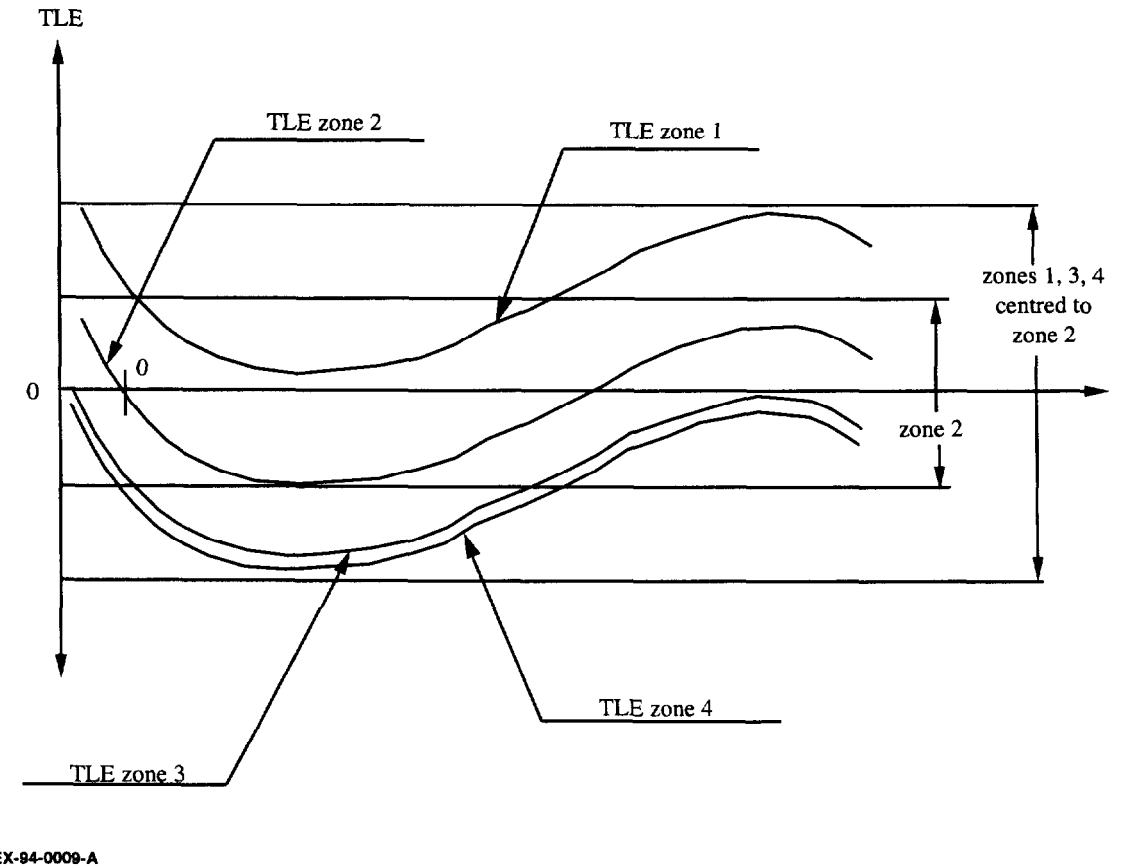


Figure E.2 - Plot of Track location error

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Annex F
(normative)

Measurement of Bit Shift

F.1 Requirements for recording

The generating system shall be that used by the originator of the interchanged cartridge.

The tape condition before recording shall be that specified in 13.1.

The tape shall be written in any mode compatible with systems operation.

F.2 Requirements for reading (see figure F.1)

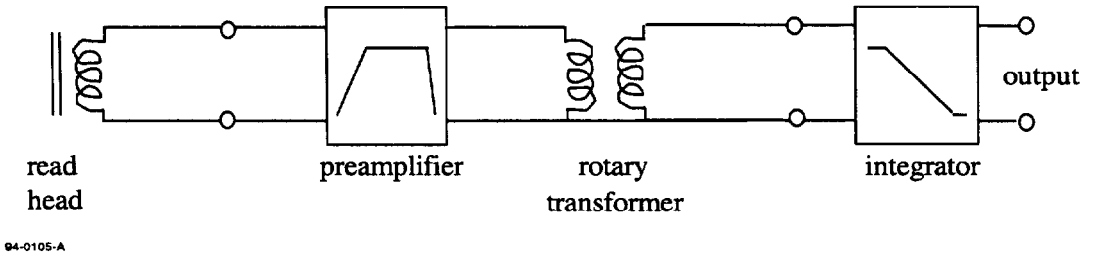


Figure F.1 - Read chain

The read chain shall comprise

read head
preamplifier
rotary transformer
integrator

F.2.1 General

Head-to-tape speed 21,400 m/s ± 0,043 m/s

f_1 is the frequency corresponding to a flux transition every seven bit cells.
Its value is 7,939 MHz.

f_2 is the frequency corresponding to a flux transition every two bit cells.
Its value is 27,788 MHz.

F.2.2 Read head

Gap width	25,0 µm to 35,0 µm
Gap length	0,22 µm ± 0,05 µm
Pole face length	3 mm for each pole tip
Gap azimuth	20,019° ± 0,015°
Track angle	4,919 2° ± 0,010 3°

F.2.3 Preamplifier and rotary transformer

Amplitude response

From f_1 to f_2 the response shall lie within a band of 2 dB.

At 0,015 x f_1 the response shall be -3 dB relative to the response at 2,58 Mhz.

Below 0,015 x f_1 the response shall fall at a rate of 6 dB per octave.

At 2 f_2 the response shall be -3 dB relative to the response at 2,58 Mhz.

Above 2 f_2 the response shall fall at a rate of 12 dB per octave.

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Damping coefficient

The damping coefficient of the input impedance of the preamplifier on the read head shall be ≥ 0,7.

Signal amplitude

There are no absolute requirements for the input voltage to the preamplifier except that the preamplifier, rotary transformer and integrator shall be so designed that the wideband signal-to-noise ratio of the read chain shall exceed 24 dB.

F.2.4 Integrator

The amplitude response of the integrator shall be within 1 dB of a line rising by 6 dB per octave from f_2 to 0,03 f_1.

F.3 Measurement of bit shift

F.3.1 Test pattern

Measurements shall be made over sections of helical tracks which display the sequence of flux transitions shown in figure F.2.

A data sequence of bytes of all ZEROs, after 8:14 modulation according to 11.4.5 and table C.1, will result in 14-bit patterns for (00) alternately from Class 1A and Class 1B.

The write current waveform is derived as defined in 13.2; it suffers no d.c. offset over two patterns.

The first Reference Zero Crossing ($RZC1_A$) in the waveform from the read chain occurs at a flux transition between intervals of 6 bit cells.

RZC2 occurs at the similar flux transition 28 bit cells later.

The first Test Zero Crossing ($TZC1_A$) occurs at the first flux transition following $RZC1_A$.

The second Test Zero Crossing ($TZC2_A$) occurs at the first flux transition following $TZC1_A$.

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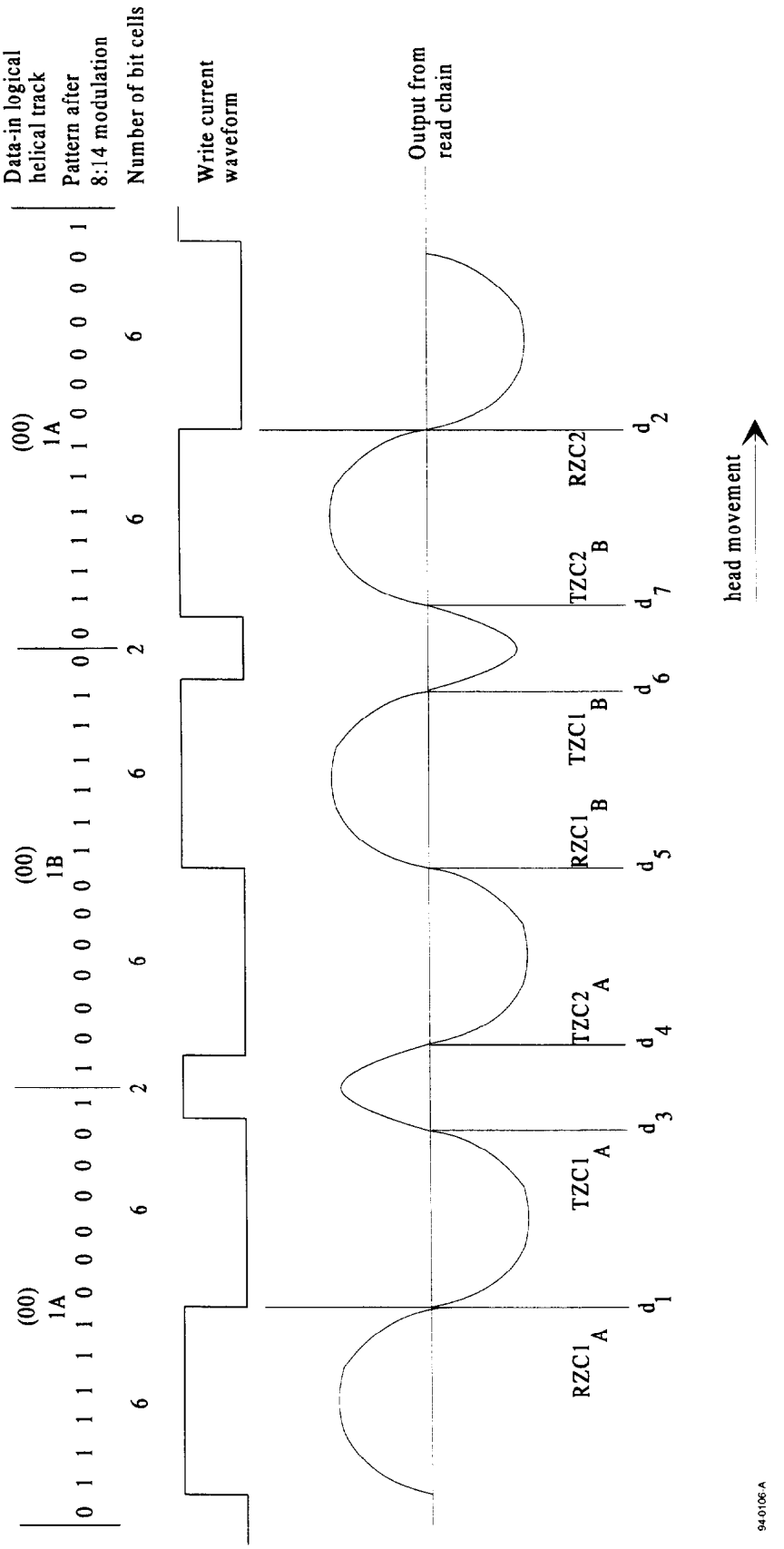


Figure F.2 - Test pattern

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F.3.2 Measurement of the average bit cell length

The average bit cell length shall be

$$L = \frac{d_2 - d_1}{28}$$

F.3.3 Calculation of bit shift

$$\text{Bit shift at } TZC1_A = \frac{6L - (d_3 - d_1)}{L} \times 100\%$$

$$\text{Bit shift at } TZC2_A = \frac{(d_4 - d_1) - 8L}{L} \times 100\%$$

To ensure that the asymmetrical effects of d.c. components are included, the measurements shall be repeated for the Class B waveform

$$\text{Bit shift at } TZC1_B = \frac{6L - (d_6 - d_5)}{L} \times 100\%$$

$$\text{Bit shift at } TZC2_B = \frac{(d_7 - d_5) - 8L}{L} \times 100\%$$

The requirements of 13.7 shall be met for all four measurements.

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Annex G
(normative)

Label - Media type

G.1 The media Type shall be identified in label area 3, as shown in figures G.1, G.2 and G.3. The dimensions shall be as given in table G.1.

G.2 Letter

The letter shall be A, B or C, as specified in 8.3.11. It shall conform to the requirements of figure G.5, where

T	= 0,79 mm ± 0,13 mm
H	= 5,61 mm ± 0,13 mm
W	= 3,15 mm ± 0,13 mm
r	= 1,54 mm ± 0,13 mm

The centrelines of the letter, at 1/2 H and 1/2 W, shall coincide with the horizontal and vertical centrelines for the letters shown in figures G.1, G.2 and G.3.

G.3 Bar Code

The bar code shall be the 3 of 9 bar code. The bar code shall be printed with the first bit of the code towards the bottom of the label and the last bit towards the top of the label.

The width of narrow spaces and bars shall be 0,74 mm ± 0,13 mm.

The width of wide spaces and bars shall be 1,47 mm ± 0,13 mm.

The maximum value of the width of a bar shall be measured to the outside of the edge roughness. The width of a space shall be the distance between such maxima.

The minimum value of the width of a bar shall be measured to the inside of the edge roughness.

G.4 Custom stop code

The bar code shall be followed by a 2 of 4 stop code. Four stop codes are defined, allocated to characters as shown in figure G.3.

G.5 Reflectivity

Measurements of the reflectivity of the white and black areas shall be made using the Macbeth PCM II Print Contrast Meter, or equivalent.

G.5.1 White areas

G.5.1.1 Reflectivity

The reflectivity of white areas, R_w, shall be

$55\ \% \leq R_w \leq 75\ \%$

It shall be measured in the centre of narrow spaces, avoiding isolated print defects and edge roughness.

G.5.1.2 Spots

A spot is defined as an area in the white area in which the reflectivity is less than 0,55. No spot shall have a diameter greater than 0,20 mm. There shall be no more than five spots per label. No two spots shall be within 0,51 mm of each other.

G.5.2 Black areas

G.5.2.1 Print contrast signal

The reflectivity of black areas, R_B, shall be measured anywhere within any black area, avoiding print defects and edge roughness. The print contrast signal, PCS, is defined as

$$PCS = \frac{R_w - R_B}{R_w}$$

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The minimum value shall be 0,85.

G.5.2.2 Voids

A void is defined as an area within the black in which the PCS is less than 0,85 mm. No void shall have a diameter greater than 0,20 mm. There shall be no more than one void per bar of an OCR character and no more than five voids in the entire label. No two voids shall be within 0,51 mm of each other.

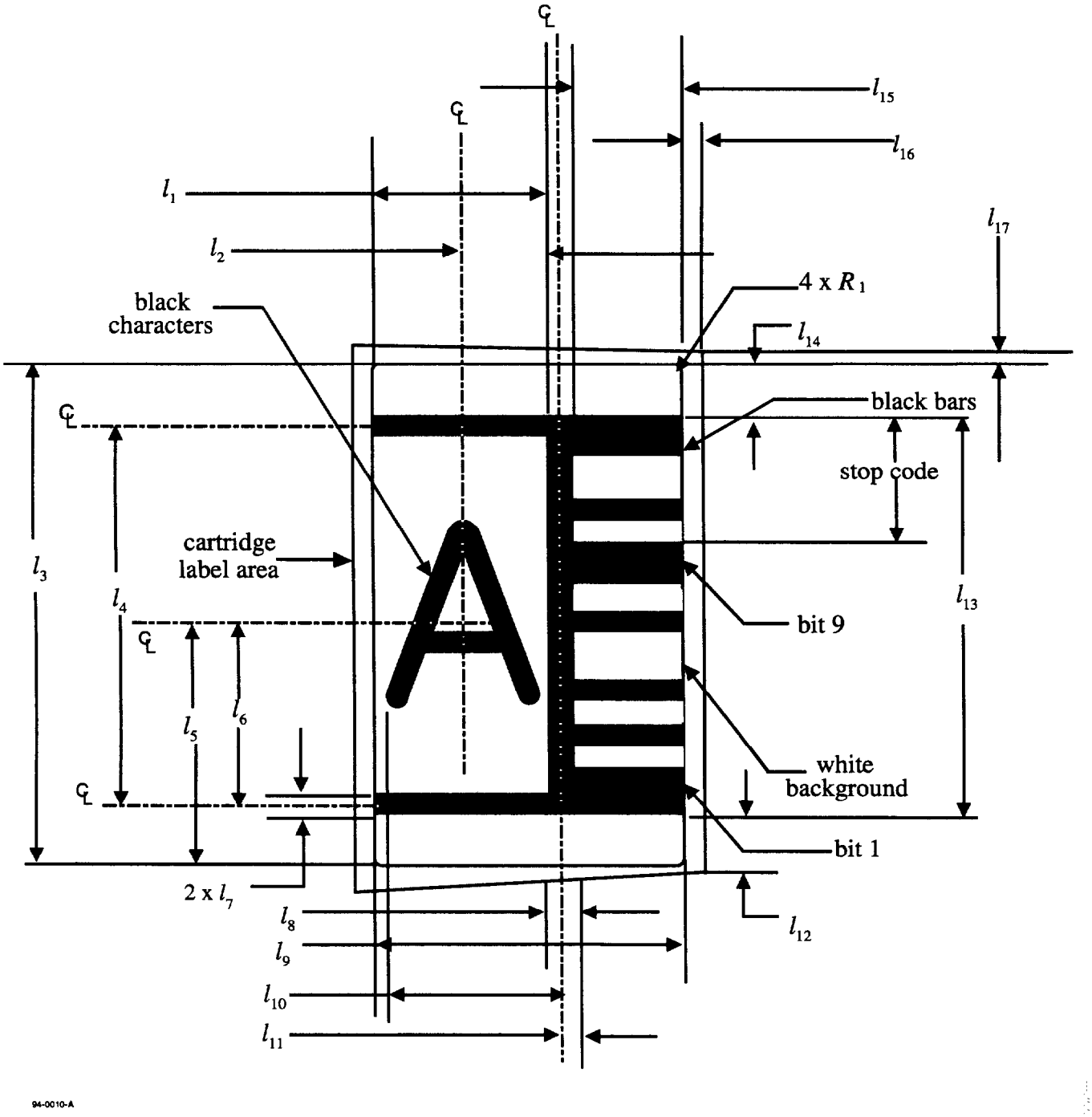


Figure G.1 - Bar code label for A

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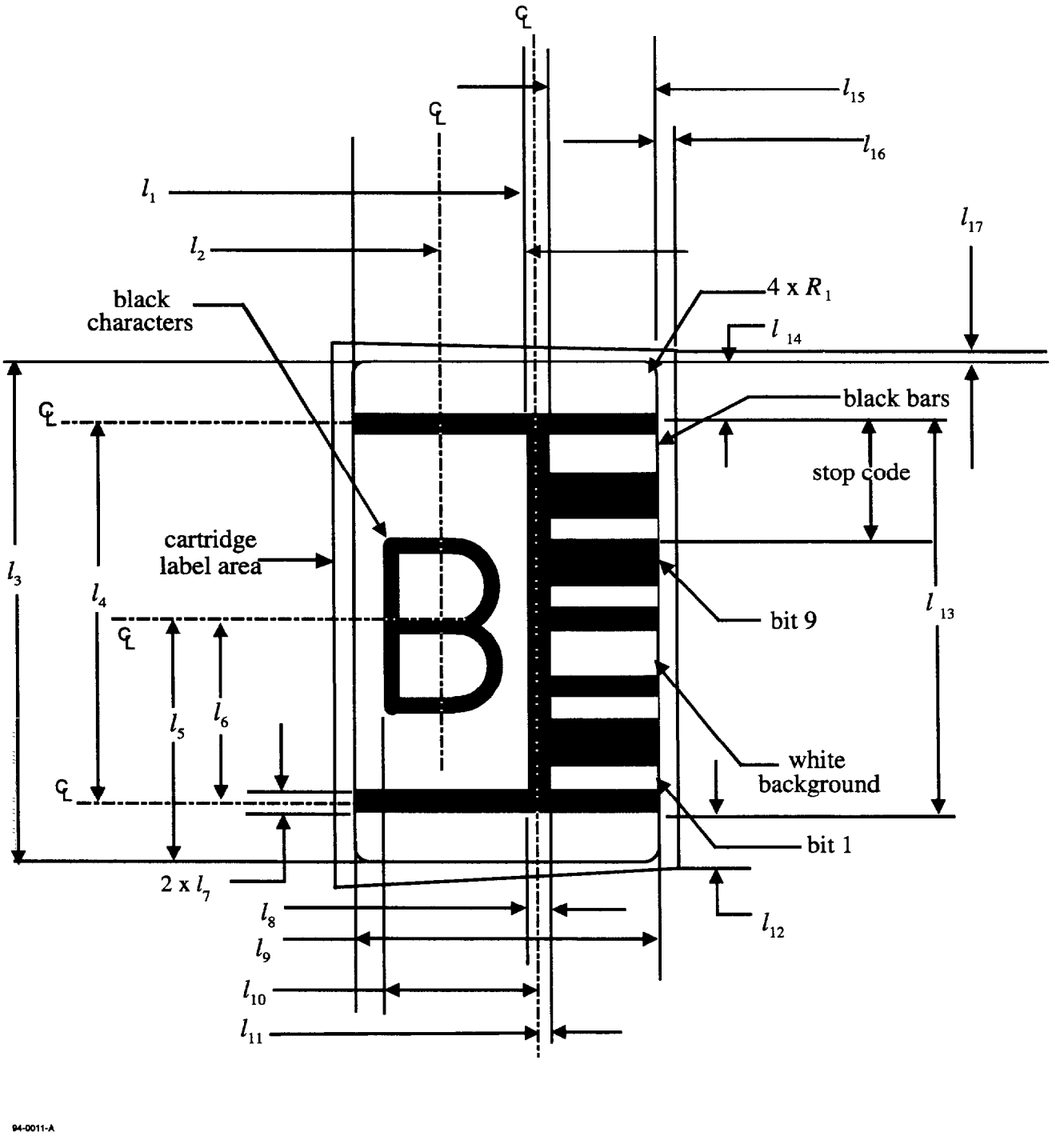


Figure G.2 - Bar code label for B

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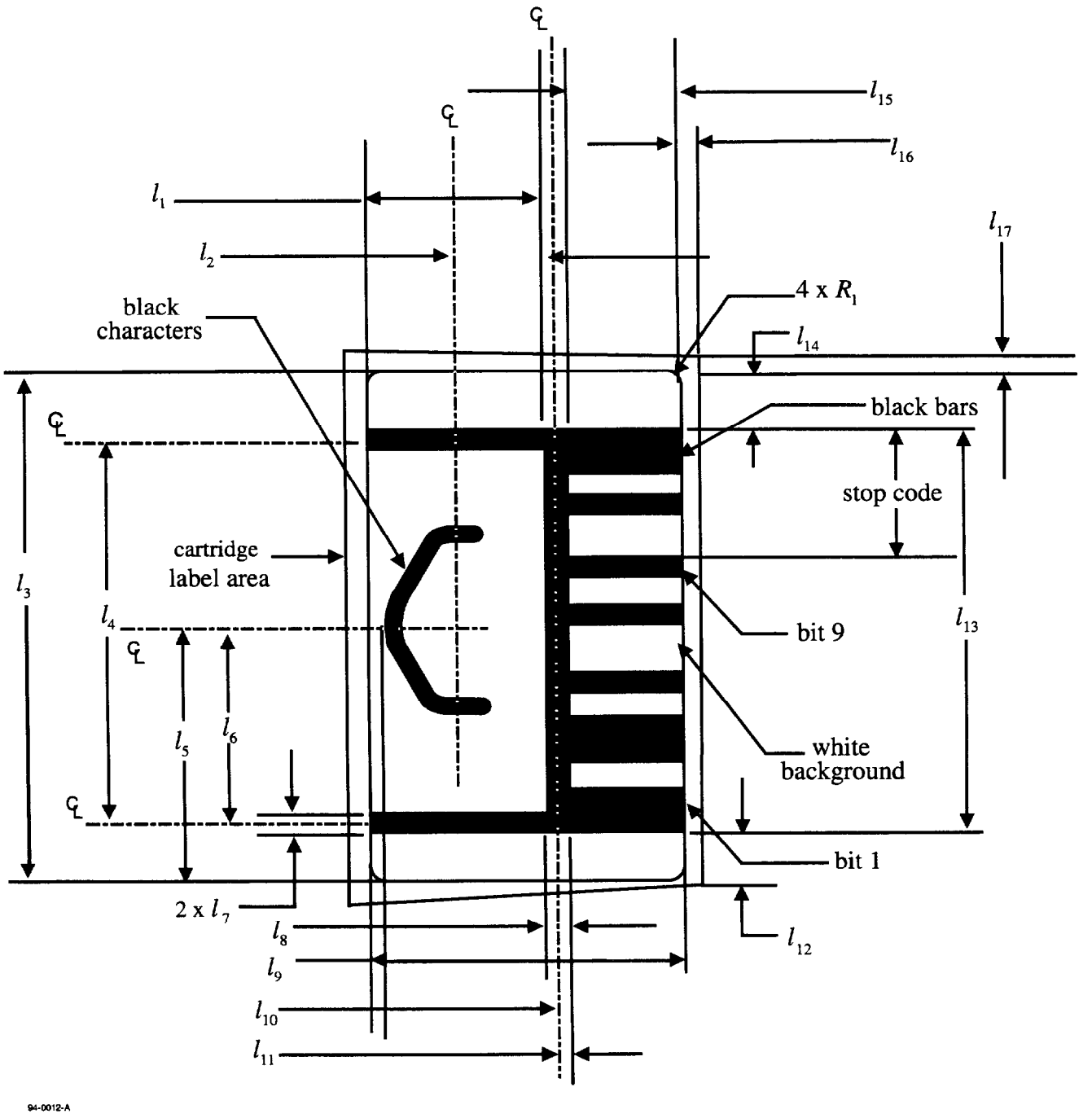


Figure G.3 - Bar code label for C

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Table G.1 - Dimensions and location of the Bar Code label

l_1	= 5,59 mm	± 0,51 mm
l_2	= 3,25 mm	± 0,13 mm
l_3	= 16,51 mm	± 0,25 mm
l_4	= 12,70 mm	± 0,13 mm
l_5	= 8,26 mm	± 0,13 mm
l_6	= 6,35 mm	± 0,13 mm
l_7	= 0,76 mm	± 0,13 mm
l_8	= 0,76 mm	± 0,13 mm
l_9	= 9,80 mm	+ 0,51 mm − 1,02 mm
l_{10}	= 5,21 mm	± 0,13 mm
l_{11}	= 0,38 mm	± 0,13 mm
l_{12}	= 1,65 mm	± 0,51 mm
l_{13}	= 13,26 mm	± 0,13 mm
l_{14}	= 1,14 mm	+ 0,51 mm - 0,00 mm
l_{15}	= 3,45 mm	± 0,51 mm
l_{16}	= 0,38 mm	+ 0,00 mm - 0,38 mm
l_{17}	= 0,38 mm	± 0,38 mm
R_1	= 1,52 mm	± 0,13 mm

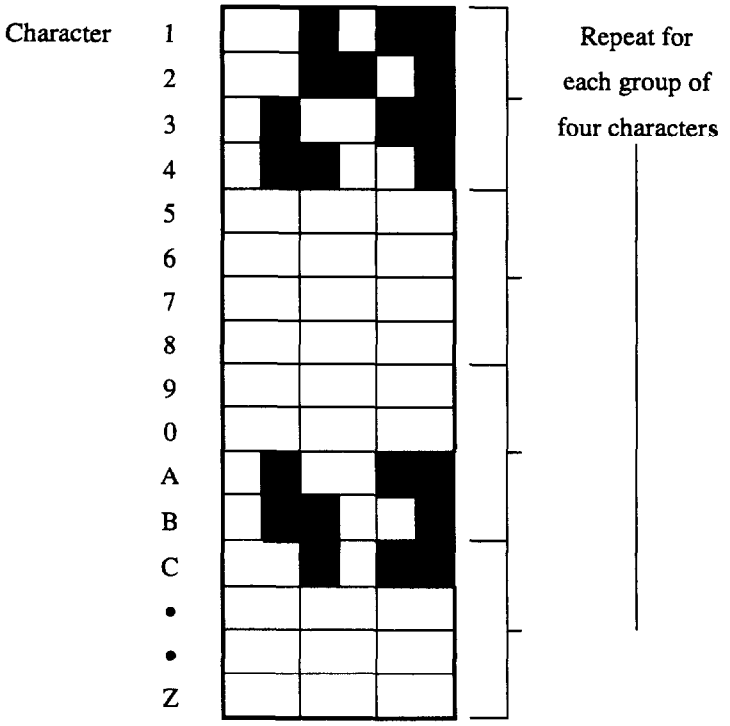


Figure G.4 - Stop code

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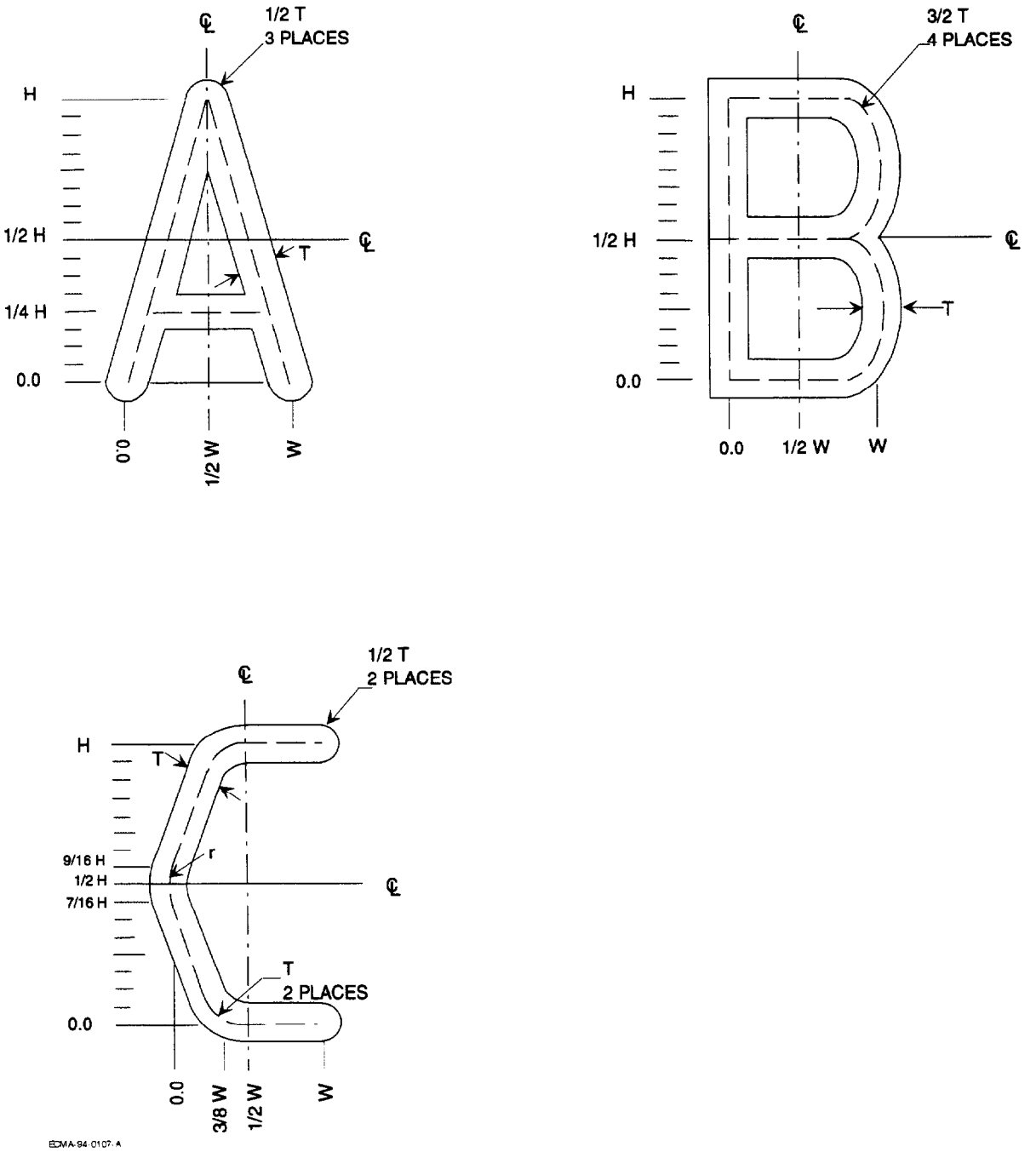


Figure G.5 - Data characters

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Annex H
(informative)

Reflection density of the case

H.1 Basis of the requirement

When used in an automated library it is essential that the vision system is able to correctly interpret the bar code label and to detect the target marker, which are white, from the case which must therefore appear sufficiently dark.

H.2 Definition

Reflection density is a measure of the ability of a material to absorb light and so reduce the amount of light that is reflected. A low reflection density indicates that the material absorbs little of the incident light and reflects most of it. A high reflection density indicates that the material absorbs much of the incident light, leaving little to be reflected.

The value is affected by

the colour of the material
the surface finish
the translucency of the material

H.3 Requirement

The case should be of such a material, colour and surface finish that the proportion of light reflected is low, particularly in the area surrounding label areas 3 and 4, and by the bar separating them (see 8.3.11)

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Annex J
(normative)

Measurement of light transmittance of tape

J.1 Introduction

The following description outlines the general principle of the measuring equipment and measuring method to be applied when measuring the light transmittance of tape.

For the purpose of this International Standard "light transmittance" is defined by convention as the relationship between the reading obtained from the measuring equipment with the test piece inserted and the reading obtained when no test piece is present. The transmittance value is expressed as the percentage ratio of the two readings.

J.2 Description of the measuring equipment

The equipment shall consist of

- the radiation source;
- the radiation receiver;
- the measuring mask;
- the optical path;
- the measuring circuitry.

J.2.1 Radiation source

An infra-red light-emitting diode (LED) with the following parameters shall be used:

Wavelength at peak emission : 700 nm to l 100 nm

Half-power bandwidth : ± 50 nm

J.2.2 Radiation receiver

A flat silicon photo diode shall be used. It shall be operated in the short circuit mode.

J.2.3 Measuring mask

The measuring mask shall have a thickness of 2 mm and a circular aperture of diameter d such that the area is 80 % to 100 % of the active area of the photo diode.

The surface of the mask shall be matt black.

The test piece shall be held firmly against the mask to cover the aperture and to ensure that no ambient light leaks past.

J.2.4 Optical path (figure J.I)

The optical path shall be perpendicular to the mask. The distance from the emitting surface of the LED to the mask shall be

$$L = \frac{d}{2 \tan\alpha} \text{ mm}$$

where d is in millimetres and α is the angle where the relative intensity of the LED is equal to, or greater than, 95 % of the intensity along the optical axis.

J.2.5 Finish

The whole assembly shall be enclosed in a matt black case.

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J.2.6 Measuring circuitry (figure J.2)

The components of the measuring circuitry are

E : regulated power supply with variable output voltage

R : current-limiting resistor

LED : light-emitting diode

Di : silicon photo diode

A : operational amplifier

R_{f0}, R_{f1} : feedback resistors

S : gain switch

V : voltmeter

The forward current of the LED, and consequently its radiation power, can be varied by means of the power supply E.

Di is operating in the short circuit mode,

The output voltage of the operational amplifier is given by

$V_0 = I_k \cdot R_f$ where I_k is the short-circuit current of Di.

The output voltage is therefore a linear function of the light intensity.

R_{f0} and R_{f1} shall be low temperature-drift resistors with an accuracy of 1 %. The following ratio applies

$$\frac{R_{f0}}{R_{f1}} = \frac{1}{20}$$

J.3 Measuring method

J.3.1 Set switch S to position 0

J.3.2 With no test piece mounted vary the supply voltage of E until voltmeter V reads full scale (100%).

J.3.3 Mount a leader or trailer tape on the mask. The reading of the voltmeter shall be in the range 60 % to 100 %.

J.3.4 Mount a test piece of magnetic tape on the mask. Set switch S to position 1. Full deflection of the voltmeter now represents a light transmittance of 5 %.

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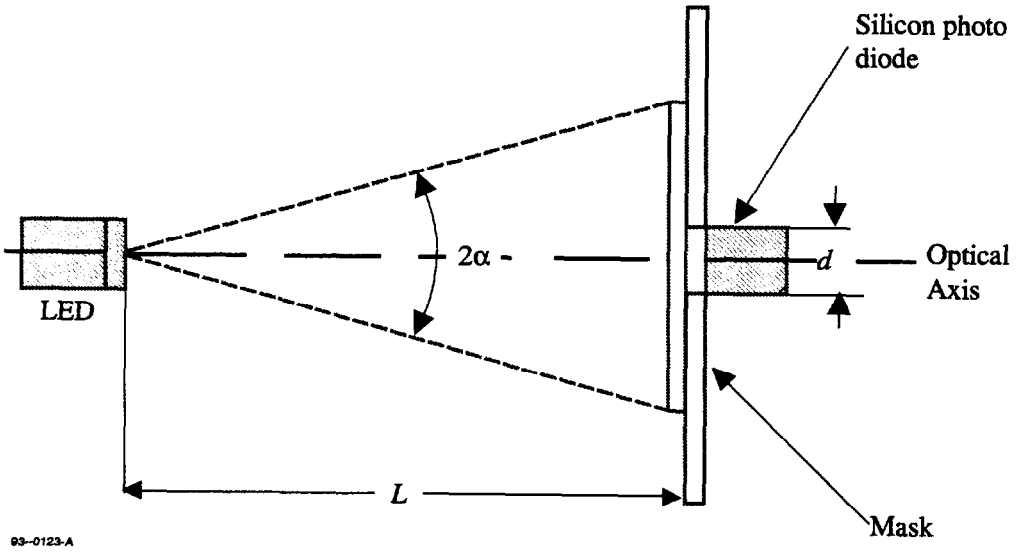


Figure J.1 - Optical arrangement

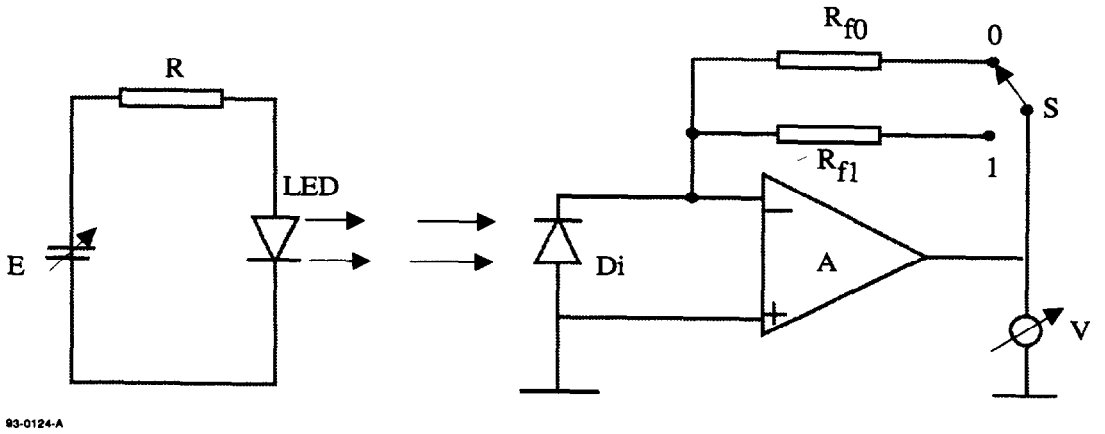


Figure J.2 - Measuring circuitry

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Annex K
(informative)

Recommendations for transportation

K.1 Environment

It is recommended that during transportation the cartridges are kept within the following conditions:

temperature	: 5°C to 40°C
relative humidity	: 5 % to 80 %
wet bulb temperature	: 26°C max.

There shall be no condensation in or on the cartridge.

K.2 Hazards

Transportation of recorded cartridges involves three basic potential hazards.

K.2.1 Impact loads and vibration

The following recommendations should minimize damage during transportation.

a) Avoid mechanical loads that would distort the cartridge shape.

b) Avoid dropping the cartridge more than 1 m.

c) Cartridges should be fitted into a rigid box containing adequate shock-absorbent material.

d) The final box must have a clean interior and a construction that provides sealing to prevent the ingress of dirt and water.

e) The orientation of the cartridges within the final box should be such that the axes of the tape reels are horizontal.

f) The final box should be clearly marked to indicate its correct orientation.

K.2.2 Extremes of temperature and humidity

a) Extreme changes in temperature and humidity should be avoided whenever possible.

b) Whenever a cartridge is received it should be conditioned in the operating environment for a period of at least 24 h.

K.2.3 Effects of stray magnetic fields

A nominal spacing of not less than 80 mm should exist between the cartridge and the outer surface of the shipping container. This should minimize the risk of corruption.

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Annex L
(informative)

Guidelines for handling tape cartridges

L.1 General

The following are general guidelines for handling:

- do not carry cartridges loosely in a container that would submit cartridges to unnecessary physical shock;
- do not expose the tape cartridge to moisture or direct sunlight;
- maintain clean operating, working and storage environments;
- do not place cartridges on or near devices that may produce a magnetic field.

L.2 Cleaning

The following are cleaning guidelines:

- do not allow cleaning solvents to contact tape;
- cartridge case may be cleaned with isopropyl alcohol.

L.3 Labels

The following are label guidelines:

- use labels provided by the tape supplier. Other labelling techniques may interfere with normal cartridge operation;
- do not use graphite pencils, water soluble felt pens or other debris-producing writing instrument on labels. Never erase a label, replace it.

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Annex M
(normative)

Helical and Longitudinal Time Codes

M.1 Content of the Time Codes

The contents of the bits in the Helical and Longitudinal Time Codes shall be as shown in table M.1.

Table M.1

Helical Time Code				Longitudinal Time Code		
Bit						
0	ONE	sync				
1	ZERO	sync				
						Bit
2			1		1	0
3			2	Units of Scan	2	1
4			4	Group Pairs	4	2
5			8		8	3
6						4
7				Supplementary		5
8				Data		6
9						7
10	ONE	sync				
11	ZERO	sync				
12			10	Tens of Scan	10	8
13			20	Group Pairs	20	9
14	ZERO				ZERO	10
15	ONE				ONE	11
16						12
17				Supplementary		13
18				Data		14
19						15
20	ONE	sync				
21	ZERO	sync				
22			1		1	16
23			2	Units of	2	17
24			4	seconds	4	18
25			8		8	19
26						20
27				Supplementary		21
28				Data		22
29						23
30	ONE	sync				
31	ZERO	sync				
32			10		10	24
33			20	Tens of	20	25
34			40	seconds	40	26
35	Even/odd			Phase correction bit		27
36						28
37				Supplementary		29
38				Data		30
39						31
40	ONE	sync				
41	ZERO	sync				
42			1		1	32
43			2	Units of	2	33
44			4	minutes	4	34
45			8		8	35

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Helical Time Code						Longitudinal Time Code
Bit 46						Bit
47			Supplementary			36
48			Data			37
49						38
						39
50	ONE	sync				
51	ZERO	sync				
52		10	Tens of	10		40
53		20	minutes	20		41
54		40		40		42
55	ZERO				ZERO	43
56						44
57			Supplementary			45
58			data			46
59						47
60	ONE	sync				
61	ZERO	sync				
62		1		1		48
63		2	Units of hours	2		49
64		4		4		50
65		8		8		51
66						52
67			Supplementary			53
68			Data			54
69						55
70	ONE	sync				
71	ZERO	sync				
72	ZERO				ZERO	56
73	ZERO				ZERO	57
74	ZERO				ZERO	58
75	ZERO				ZERO	59
76						60
77			Supplementary			61
78			Data			62
79						63
80	ONE	sync				
81	ZERO	sync				
82					ZERO	64
83					ZERO	65
84					ONE	66
85	CRC as defined				ONE	67
86	in annex N				ONE	68
87					ONE	69
88					ONE	70
89			Sync		ONE	71
			Pattern		ONE	72
					ONE	73
					ONE	74
					ONE	75
					ONE	76
					ONE	77
					ZERO	78
					ONE	79

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Annex N
(normative)

Representation of the CRC used in 11.3.2 - HTC

N.1 Description

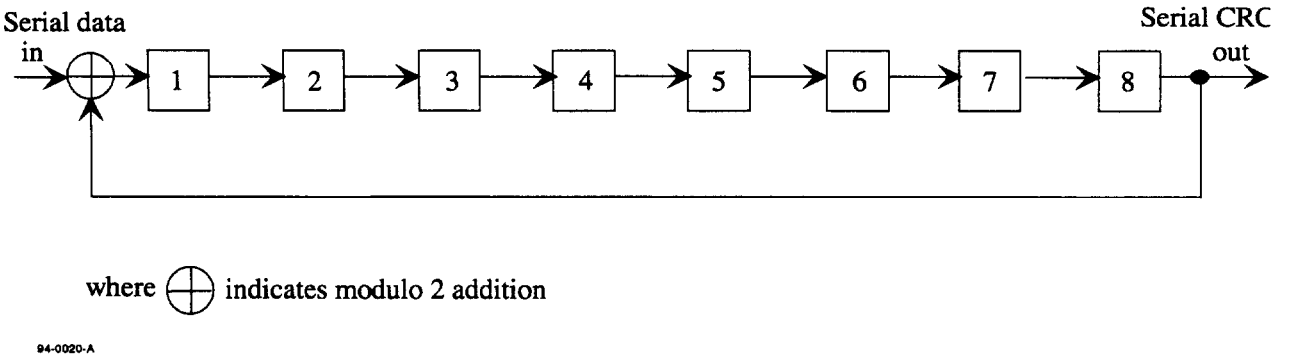
Each CRC shall consist of eight bits.

N.2 Computation

The CRC shall be computed from the generator polynomial

$x^8 + 1$

as shown in the following shift register representation:



where ⊕ indicates modulo 2 addition

94-0020-A

Prior to the computation all positions of the shift register shall be set to ZERO.

Bits shall be processed starting with bit 0 and ending with bit 81.

When bit 81 has entered the shift register, the eight bits of the CRC shall be clocked out of the shift register.

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Annex P
(informative)

Bibliography

ISO 5-3:1995 *Photography - Density measurements - Part 3: Spectral conditions.*

ANSI MH10.8M:1993 *Materials handling - Unit Loads and Transport Packages - Bar Code Symbols.*

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