DEVELOPMENT STANDARD

QIC-120-DC
Revision F
20 Jun 91

SERIAL RECORDED MAGNETIC TAPE CARTRIDGE FOR INFORMATION INTERCHANGE

Streaming Mode
0.250 inch (6.35 mm) Tape
15 Tracks
Data Density: 10,000 bpi (394 bpmm)
Group Code Recording

Formatted Capacity: 125 Mbytes
(with DC600A or Equivalent Cartridge)

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(See important notices on following page)

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1. SCOPE AND INTRODUCTION

1.1 Scope

This Standard is intended to provide a format and recording standard for a streaming 0.250 inch (6.3 mm) wide, fifteen track, magnetic tape in a cartridge to be used for information interchange between information processing systems, communication systems, and associated equipment utilizing a standard code for information interchange, as agreed upon by the interchange parties. This standard refers solely to recording on the 0.250 inch (6.30 mm) magnetic tape cartridge and complements the proposed American National Standard Unrecorded Magnetic Tape Cartridge for Information Interchange, 0.250 inch (6.30 mm), 10 000 ftpi (394 ftpm), X3B5/85-138, where the following sections are dealt with in detail: general requirements, definition, tape and cartridge, physical and magnetic requirements, speed requirements, and write enable feature. Compliance with the unrecorded standard is a requirement for information interchange. A labeling standard for tape cartridges used in the streaming mode is being investigated. The availability of such a labeling standard will provide for full data interchange between data processing systems.

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1.2 Introduction

1.2.1 This standard defines the requirements and supporting test methods necessary to ensure interchange at acceptable performance levels. It is distinct from a specification in that it delineates a minimum of restrictions consistent with compatibility in interchange transactions.

1.2.2 The performance levels contained in this standard represent the minimum acceptable levels of performance for interchange purposes. They therefore represent the performance levels which the interchanged items should meet or surpass during their useful life and thus define end-of-life criteria for interchange purposes. The performance levels in this standard are not intended to be employed as substitutes for purchase specifications.

1.2.3 Wherever feasible, quantitative performance level which must be met or exceeded in order to comply with this standard are given. In all cases, including those in which quantitative limits for requirements falling within the scope of this standard are to stated but are left to agreement between interchange parties, standard test methods and measurement procedures shall be used to determine such quantities.

1.2.4 U.S. engineering units are the original dimensions in this standard. Conversions of toleranced dimensions from customary U.S. engineering units (similar to British Imperial Units) to SI units have been done in this standard according to ANSI/IEEE STD 268-1982 and ISO 370-1975 Method A. Method A should be used for economy unless a requirement for absolute assurance of a fit justifies use of Method B. In the national standards of ISO member nations, additional rounding may be done to produce "preferred" values. These values should lie within or close to the original tolerance ranges.

1.2.5 Except as indicated in 1.2.3 above, interchange parties complying with the applicable standards should be able to achieve compatibility without need for additional exchange of technical information.

2. DEFINITIONS

For the purpose of this standard, the following definitions apply:

2.1 **Azimuth.** The angular deviation, in minutes of arc, of the mean flux transition line from the line normal to the cartridge reference plane.

2.2 **Bit.** A single digit in the binary number system.

2.3 **Bit Cell.** A distance along the track between adjacent flux transitions at 12 500 ftpi (493 ftpmm).

2.4 **Block.** A group of 512 consecutive bytes transferred as a unit.

2.5 **Beginning of Tape (BOT) Marker.** The BOT Marker is a set of two holes punched in the tape. There are three sets of holes provided, the innermost of which is used for the purpose of identifying the storage position for the cartridge. The additional sets of holes are used to ensure reliability of detection (see Figure 2).

NOTE: In the storage position, all of the permissible recording area is wound on the supply hub and is protected by at least one layer of tape. Cartridges to be interchanged shall be rewound to the storage position prior to interchange.

2.6 **Byte.** A group of 8 data (10 encoded) bits operated on as a unit.

2.7 **Cartridge or Magnetic Tape Cartridge.** A cartridge containing 0.250 inch (6.30 mm) wide magnetic tape wound on two coplanar hubs with an internal drive belt to transport the tape between the hubs. (See Figure 1).

2.8 **CRC.** The CRC is a cyclic redundancy check that is recorded after the data block and preceding the postamble of each recorded block for the purpose of error detection.

2.9 **Data Density.** The nominal distribution of recorded information per unit length of track, usually expressed in bits per inch (bpi) or bits per millimeter (bpmm).

2.10 **Physical Recording Density.** The number of recorded flux transitions per unit length of track, usually expressed in flux transitions per inch (ftpi) or flux transitions per millimeter (ftpmm).

2.11 **Early Warning (EW) Marker.** The EW Marker is a single hole punched in the tape to indicate the approaching end of the usable recording area in the forward direction (See Figure 2).

2.12 **End of Tape (EOT) Marker.** The EOT Marker is a single hole punched in the tape. There are three EOT Markers to ensure reliability of detection. The EOT Marker indicates that the usable recording area has been exceeded, and the physical end of tape is approaching (See Figure 2).

2.13 **Erase.** To remove all magnetically recorded information from the tape.

2.14 **File Mark.** An identification mark following the last block in a file.

2.15 **Flux Transition.** A point on the magnetic tape which exhibits maximum free space flux density normal to the tape surface.

2.16 **Flux Transition Spacing.** The distance on the magnetic tape between flux transitions.

2.17 **Group Code Recording (GCR).** A data encoding method where a four bit group of data bits is encoded into a 5 bit group for recording on magnetic tape (ref. ANSI X3.54-1976).

2.18 **Load Point (LP) Marker.** The LP Marker is a single hole punched in the tape to indicate the approaching start of the usable recording area in the forward direction (See Figure 2).

2.19 **Nibble.** A group of 4 data (5 encoded) bits operated on as a unit.

2.20 **Postamble.** A special sequence of bits recorded at the end of each recorded block.

2.21 **Preamble.** A special sequence of bits recorded at the end of each recorded block.

2.22 **Recorded Block.** A group of consecutive bits comprising preamble, data block marker, data block, block address, CRC and postamble.

2.23 **Reference Tape Cartridge.** A tape cartridge selected for a given property for calibrating purposes.

2.24 **Secondary Reference Tape Cartridge.** A tape cartridge intended for routine calibrating purposes, the performance of which is known and stated n relation to that of the Reference Tape Cartridge.

2.25 **Typical Field.** This minimum field which, when applied to the tape under test, causes a signal output equal to 95% of the maximum signal output at the specified test density.

2.26 **Reference Field.** The minimum field which, when applied to the Signal Amplitude Reference Tape Cartridge, causes a signal output equal to 95% of the maximum signal output at the specified test density.

2.27 **Test Recording Current.** A recording current between 128% and 132% of the current required to produce the Reference Field at 12 500 ftpi (492 ftpmm).

2.28 **Signal Amplitude Reference Tape Cartridge.** A reference tape cartridge selected as a standard for signal amplitude and reference field.

NOTE: A Master Standard (Computer Amplitude Reference) Cartridge has been selected by the National Bureau of Standards (NBS) to establish the reference level for average peak-to-peak signal amplitudes when recorded at 12 500 ftpi (492 ftpmm).

Secondary Standard Amplitude Reference Tape Cartridges are available from NBS under Part Number SRM XXXX. For ordering information, contact: Office of Standard Reference Materials, Room B311, Chemistry Building, National Bureau of Standards, Gaithersburg, MD 20899.

2.29 **Standard Reference Amplitude.** The average peak-to-peak signal amplitude output of the Signal Amplitude Reference Tape Cartridge when it is recorded with the appropriate Test Recording current on the NBS measurement system of each test physical recording density. The signal amplitude shall be averaged over 12 500 flux transitions.

2.30 **Streaming.** A method of recording on magnetic tape that maintains continuous tape motion without the requirement to start and stop within an inter-record gap.

2.31 **Track.** A longitudinal area on the tape along which a series of magnetic signals may be recorded.

2.32 **Underrun.** A condition developed when host transmits or receives data at a rate less than that required by the device for streaming operation.

3. RECORDING

3.1 Method. The method of recording shall be the "non-return to zero, change on one" (NRZ1) when a ONE is represented by a flux transition occurring in the bit cell and a ZERO is represented by the absence of a flux transition in the bit cell.

3.2 Code. Each 8 bit data byte is separated into two 4-bit groups (nibbles). Each 4-bit data nibble is encoded into a 5-bit GCR nibble for recording on the streaming magnetic tape cartridge.
The most significant nibble is recorded first. The encoded data has the property that no more than two consecutive ZEROs shall occur. The translation able for data nibbles (B3, B2, B1, B0) and GCR nibbles (G4, G3, G2, G1, G0) shall be as follows:

Note: GCR bit G4 is recorded first.

HEX	B3	B2	B1	B0	<--->	G4	G3	G2	G1	G0	HEX
0	0	0	0	0	<--->	1	1	0	0	1	19
1	0	0	0	1	<--->	1	1	0	1	1	1B
2	0	0	1	0	<--->	1	0	0	1	0	12
3	0	0	1	1	<--->	1	0	0	1	1	13
4	0	1	0	0	<--->	1	1	1	0	1	1D
5	0	1	0	1	<--->	1	0	1	0	1	15
6	0	1	1	0	<--->	1	0	1	1	0	16
7	0	1	1	1	<--->	1	0	1	1	1	17
8	1	0	0	0	<--->	1	1	0	1	0	1A
9	1	0	0	1	<--->	0	1	0	0	1	09
A	1	0	1	0	<--->	0	1	0	1	0	08
B	1	0	1	1	<--->	0	1	0	1	1	0B
C	1	1	0	0	<--->	1	1	1	1	0	1E
D	1	1	0	1	<--->	0	1	1	0	1	0D
E	1	1	1	0	<--->	0	1	1	1	0	0E
F	1	1	1	1	<--->	0	1	1	1	1	0F

3.2.1 Byte and Code Requirements

3.2.1.1 Byte Length. The data shall be in eight-bit bytes.

3.2.1.2 Code. Bits b1 through b7 shall correspond to the bit assignments for 7-bit ASCII characters (ANSI X3.4-1977). Bit b8 shall always be ZERO when the seven bits b1 through b7 represent a 7-bit ASCII character.

Each of the bits b1 through b8 may be either a ZERO or a ONE when the representation is coded in accordance with a standard, as agreed upon by the interchange parties, which permits such encoding.

3.3 Density of Recording.

3.3.1 Density. The nominal recording density shall be 12 500 ftpi (492 ftpmm).

3.3.2 Bit Cell Length. The nominal bit cell length shall be 80 microinches (2.03 micrometers).

3.3.3 Average Bit Cell Length. The average bit cell length is the sum of distances over N bit cells divided by N.

3.3.4 Long Term Average Bit Cell Length. The long terms average bit cell length is the average bit cell length taken over a minimum of 900 000 bit cells. The long term average bit cell length shall be within +4% of the nominal bit cell length.

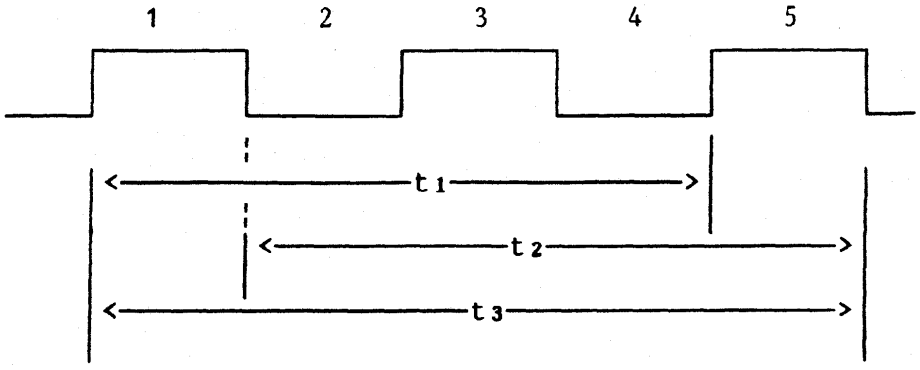
3.3.5 Short Term Average Bit Cell Length. The short term average bit cell length is he average taken over a minimum of 139 and a maximum of 143 bit cells. The short term average bit cell length shall be within +7% of the long term average.

3.3.6 Rate of Change of Bit Cell Length. The rate of change of bit cell length shall not exceed 0.26 %. The rate of change is given by the following relationship:

$$\text{Rate of Change} = \frac{|t_1/4 - t_2/4|}{t_3/5}$$

Where t_1, t_2, t_3 are the times between flux

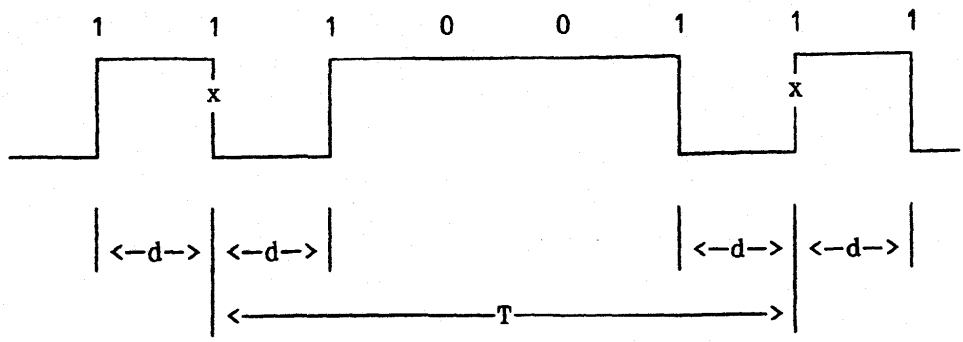
transitions as shown below. Periods 1 through 5 are contiguous and represent the repetitive data pattern 101010 within a data block, and frequency variations are less than 20 KHz.



3.3.7 **Instantaneous Flux Transition Spacing.** The instantaneous spacing between flux transitions is influenced by the reading and writing processes, the pattern recorded (pulse-crowding effect) and other factors.

Instantaneous spacings between flux transitions shall satisfy the following conditions:

In a sequence of flux transitions defined by the bit pattern 11100111, e.g. as occurs in the block marker (see 5.2), the center flux transition of each group of ONEs is called a reference flux transition. The maximum displacement of flux transitions on either side of the reference flux transitions shall not exceed +28% of the bit cell length d_1 averaged over the five bit cells between the reference flux transitions indicated in the bit pattern below.



$$d_1 = T/5$$

$$d1(1-0.28) < d < d1(1+0.28)$$

x denotes a reference flux transition

3.4 **Measurement of Signal Amplitude.** The signal amplitude shall be measured at a point in the read channel where the signal is proportional to the rate of change of flux induced in the read head.

3.5 **Signal Amplitude**

3.5.1 **Average Signal Amplitude.** When recorded at the physical recording density of 12 500 ftpi (492 ftpmm), the average peak-to-peak signal amplitude output of the interchange tape shall deviate no more than +50%, -35% from the Standard Reference Amplitude. This averaging shall be made over the central 100 flux transitions of any 120 contiguous flux transitions in a block and over at least 100 blocks.

3.5.2 **Maximum Signal Amplitude.** The peak-to-peak signal amplitude at 4167 ftpi (164 ftpmm) shall be less than three times the Standard Reference Amplitude at 12 500 ftpi (492 ftpmm).

3.5.3 **Minimum Signal Amplitude.** All transitions on the tape, that are intended for data interchange, shall have a peak-to-peak signal amplitude greater than or equal to 25% of the Standard Reference Amplitude.

3.6 **Erasure.** The magnetic tape cartridge shall be AC-erased prior to recording such that base-to-peak signal amplitude is less than 3% of half the Standard Reference Amplitude. When the tape cartridge is recorded, erasure shall be tested between the end of the recorded data and EOT.

3.7 **Azimuth.** On any track the angle hat a flux transition across the track makes with a line perpendicular to reference plane B shall not exceed 12.0 minutes (3.49 mrad).

4. TRACKS

4.1 **Number of Tracks.** There shall be fifteen tracks numbered 0 through 14 as specified in 4.4.

4.2 **Use of Tracks.** Tracks shall be recorded in the numerical order of their tracks numbers, starting with track 0. Track 0, 2, 4, 6, 8, 10, 12 and 14 shall be recorded in the direction from the BOT marker to the EOT marker. Tracks 1, 3, 5, 7, 9, 11, and 13 shall be recorded in the direction from the BOT marker to the BOT marker.

4.2.1 **Track Reference Burst.** (See Figure 2) A track reference burst recorded at the maximum recording density of 12 500 ftpi (492 ftpmm) shall be written between the BOT marker and the recorded data on track 0. The reference burst shall start a minimum of 0 inches (0mm) and a maximum of 15 inches (381mm) and a maximum of 4 inches (101.6mm). A long preamble shall precede the first data block.

4.2.2 **Even Tracks.** (See Figure 2) On tracks 0, 2, 4, 6, 8, 10, 12, and 14 data shall commence at a minimum of 3 inches (76.2mm) and at a maximum of 4 inches (101.6mm) past the LP marker. No data for interchange shall be recorded beyond 36 inches (914.4mm) past the EW marker.

4.2.3 **Odd Tracks.** (See Figure 2) On tracks 1, 3, 5, 7, 9, 11, and 13 data shall commence at a minimum of 1 inch (25.4mm) and at a maximum of 2 inches (50.8mm) past the EW marker.

On tracks 7, 9, and 11 the last data or file mark block written shall end at most 4 inches (101.6mm) and at least 0.1 inches (0.54mm) before the LP marker, measured from the center of the hole.

On tracks 1, 3, 5, and 13 the last block written shall end at a maximum of 27 inches (686mm) past the LP marker.

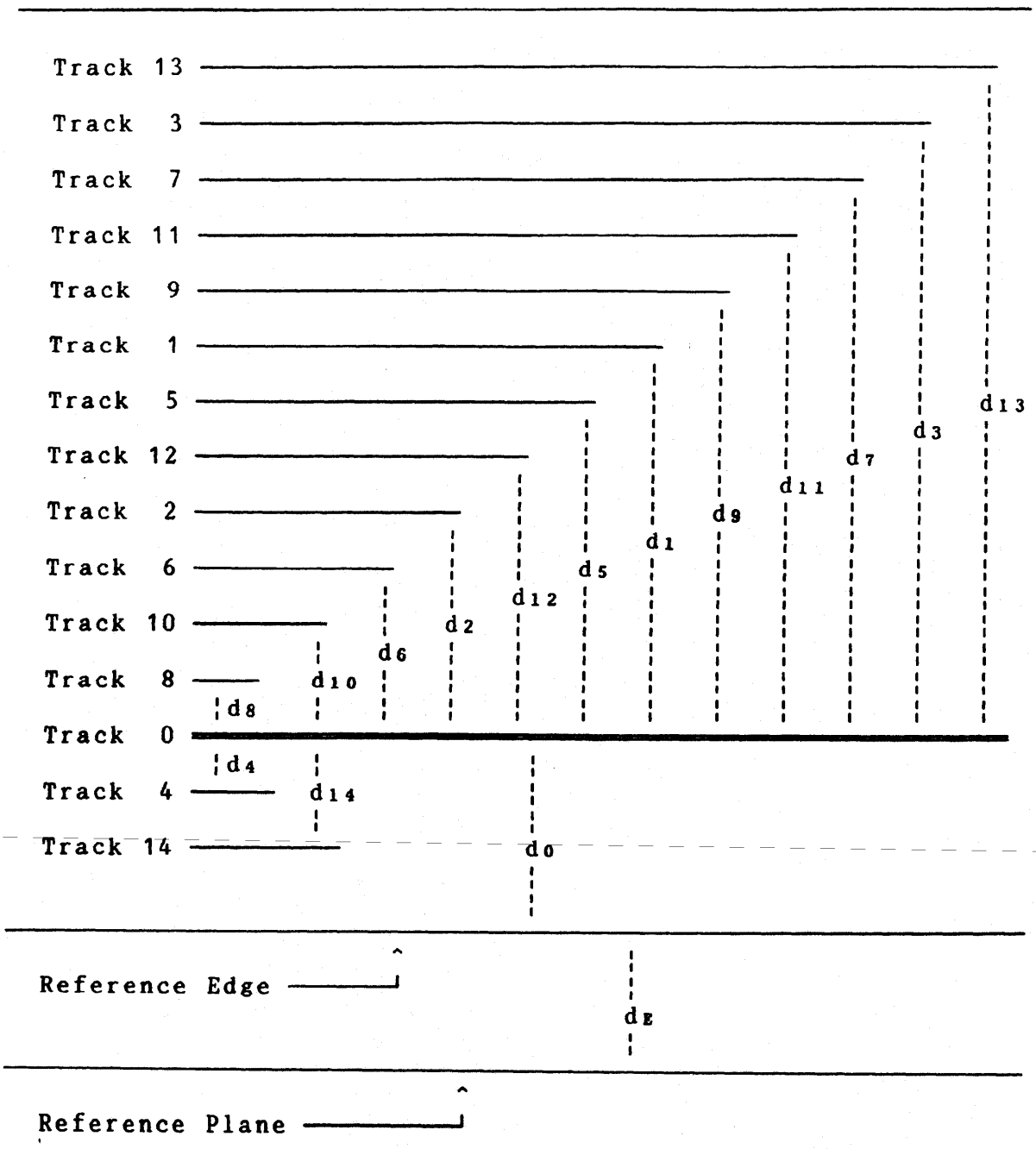
4.3 Reference Edge. The edge of the magnetic tape closer to Reference Plane B of the cartridge base. The location of the center line of track 0 is referred to the Reference Edge. All other track center lines are referred to track 0.

4.4 Track Center Line Locations

Track center lines shall be located as indicated below:

d0	=	0.043 + 0.003 in	(1.092 + 0.076 mm)
d1	=	0.122 ± 0.002 in	(2.845 ± 0.051 mm)
d2	=	0.064 ± 0.002 in	(1.626 ± 0.051 mm)
d3	=	0.176 ± 0.002 in	(4.470 ± 0.051 mm)
d4	=	0.016 ± 0.002 in	(0.406 ± 0.051 mm)
d5	=	0.096 ± 0.002 in	(2.438 ± 0.051 mm)
d6	=	0.048 ± 0.002 in	(1.219 ± 0.051 mm)
d7	=	0.160 ± 0.002 in	(4.064 ± 0.051 mm)
d8	=	0.016 ± 0.002 in	(0.406 ± 0.051 mm)
d9	=	0.128 ± 0.002 in	(3.251 ± 0.051 mm)
d10	=	0.032 ± 0.002 in	(0.813 ± 0.051 mm)
d11	=	0.144 ± 0.002 in	(3.658 ± 0.051 mm)
d12	=	0.080 ± 0.002 in	(2.032 ± 0.051 mm)
d13	=	0.192 ± 0.002 in	(4.877 ± 0.051 mm)
d14	=	0.032 ± 0.002 in	(0.813 ± 0.051 mm)

dE = 0.070 in (1.778mm) reference



4.5 **Track Width.** The width of the recorded track shall be 0.0065 ± 0.0005 inches (0.165 ± 0.013 mm).

5. Recorded Block

The recorded block format shall be as follows:

Pre-Amble	Data Block Marker	Data Area	Block Address	CRC	Post-amble
See Section 5.1	1 Byte	512 Bytes	4 Bytes	2 Bytes	See Section 5.6

5.1 Preamble

5.1.1 Normal. A normal preamble shall contain a minimum of 160 and a maximum of 300 flux transitions recorded at the maximum normal recording density of 12 500 ftpi (492 ftpmm). The preamble shall be used to synchronize the phase locked loop in the read electronics to the data frequency. The preamble shall also be used to measure the average signal amplitude.

5.1.2 Elongated. An elongated preamble shall contain a minimum of 5500 and a maximum of 8500 flux transitions and shall precede the first data block recorded after an underrun (see 8.2).

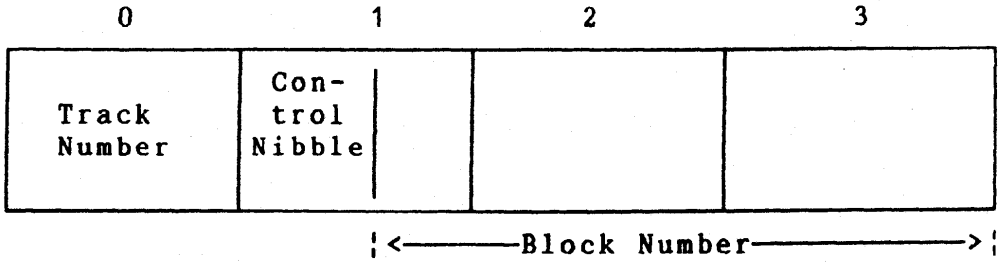
5.1.3 Long. A long preamble shall contain a minimum of 15 000 and a maximum of 30 000 flux transitions, and shall precede the first data block for interchange recorded at the beginning of a track.

5.2 Data Block Marker. The data block marker identifies the start of data and shall consist of the following GCR pattern:

G4	G3	G2	G1	G0		G4	G3	G2	G1	G0
1	1	1	1	1		0	0	1	1	1
	MS nibble						LS nibble			

5.3 Data Block. The data block shall contain 512 bytes of data of interchange encoded into GCR bytes in accordance with the CODE (see 3.2).

5.4 Block Address. The block address shall consist of 4 bytes which uniquely identify a block recorded on tape. The block address shall be encoded into GCR bytes in accordance with the CODE (see 3.2), and is defined below:



BYTE	BITS	FUNCTION
0	7	Track Number bit 7 Most Significant Bit (MSB)
	6	Track Number bit 6
	5	Track Number bit 5
	4	Track Number bit 4
	3	Track Number bit 3
	2	Track Number bit 2
	1	Track Number bit 1
	0	Track Number bit 0 Least Significant Bit (LSB)
1	7	Control Nibble bit 3 (MSB)
	6	Control Nibble bit 2
	5	Control Nibble bit 1
	4	Control Nibble bit 0 (LSB)
	3	Block Number bit 19 (MSB)
	2	Block Number bit 18
	1	Block Number bit 17
	0	Block Number bit 16

BYTE	BITS	FUNCTION
2	7	Block Number bit 15
	6	Block Number bit 14
	5	Block Number bit 13
	4	Block Number bit 12
	3	Block Number bit 11
	2	Block Number bit 10
	1	Block Number bit 9
	0	Block Number bit 8
3	7	Block Number bit 7
	6	Block Number bit 6
	5	Block Number bit 5
	4	Block Number bit 4
	3	Block Number bit 3
	2	Block Number bit 2
	1	Block Number bit 1
	0	Block Number bit 0 (LSB)

5.4.1 **Track Number:** The track number as specified in 4.4 shall be recorded in byte 0.

5.4.2 **Control Nibble.** Definition of control nibble shall be as follows:

Control Nibble 3 2 1 0	Value	Meaning
0 0 0 0	0	The current block contains user data or file mark.
0 0 0 1	1	The current block contains QIC-120 control information.
0010-1111	2-15	Reserved

Note: In order to minimize problems with future updates of this Standard, drives designed to meet this Standard shall ignore (skip) blocks having control nibbles with values in the "Reserved" area (2 through 15).

5.4.3 **Block Number.** The first block on the tape shall be block 1, and subsequent blocks shall be numbered sequentially. The block number shall not reset at the end of a track.

5.5 **Cyclical Redundancy Check.** The cyclical redundancy check (CRC) shall consist of two bytes calculated over the 512 bytes of interchange data and the 4-byte block address starting with all ONEs CRC initial value and using the CRC generating polynomial:

$$X^{16} + X^{12} + X^{5} + 1$$

The CRC shall be encoded into GCR bytes in accordance with the CODE (see 3.2).

5.6 **Postamble**

5.6.1 **Normal.** A normal postamble with a minimum of 5 and a maximum of 20 flux transitions, recorded at the maximum nominal flux density, shall be recorded following the CRC as a guard band.

5.6.2 **Elongated.** An elongated postamble with a minimum of 5500 and a maximum of 8500 flux transitions, recorded at the maximum nominal flux density, shall be recorded following an underrun sequence.

6. FILE MARK BLOCK

The file mark block format shall be identical to the data block format except that the data field shall contain 512 bytes consisting of the following GCR pattern:

G4	G3	G2	G1	G0		G4	G3	G2	G1	G0
0	0	1	0	1		0	0	1	0	1

The GCR nibble 00101 shall be converted to the data nibble 1111 to form the data field for CRC generation and checking.

A file mark may be recorded between blocks anywhere on the tape. The last block of an interchange tape shall be a file mark. It may be omitted if data blocks are recorded on track 14 beyond the EW marker.

7. CONTROL BLOCK

7.1 Data Field. When the control nibble value = 1, the current 512 byte data field contains control information. This control information is defined as follows:

BYTE	MEANING
0 (MS)	Drive type: 04H = 4 track device 09H = 9 track device 0FH = 15 track device All other combinations reserved.
1	Type of Control Block 00H = dummy 01H = first block on a track 02H = last block on a track 03H = extended file marks 04 - 1FH = Reserved. 20 - FFH = Not defined
2	File Mark Number (MSB)
3	File Mark Number (LSB)
4-0F	Reserved (Set to 00H)
10-1FF	Not defined in this Standard. If Byte 0 contains a reserved value, bytes 1 through 1FF are not defined in this Standard.

7.2 Use of Control Blocks. The use of control blocks is optional. A tape containing control blocks as specified in 5.4.2 and 7.1 shall be acceptable for interchange. The recipient of the cartridge shall read the whole contents of each control block in order to check the CRC and to maintain the sequence of block numbers, but may ignore the data field of control blocks with control nibble value = 1 or the whole control block if the control nibble has a value larger than 2. If control blocks are included, the following rules apply:

7.2.1 **Track 0.** On Track 0 the first block shall be a control block with control nibble value = 1 and with the first byte of the data field set to 0F. The remaining bytes are used as defined in 7.1.

7.2.2 **Further Uses of Control Blocks.** Control blocks with the control nibble value = 1 may be used in one or more of the following three cases:

(i) A control block shall be written as the first block on each track.

(ii) A control block shall be written as the last block on each track, provided that the writing is continued on the following track. In this case, the contents of the second byte of the data field depends on whether the preceding (last) data (or file mark) block was verified as good or bad.

If the last data (or file mark) block was verified as good, the second byte of the data field shall be set to 02H.

If the last data (or file mark) block was verified as bad, the second byte of the data field shall be set to 00H.

To allow time to verify the last block, an elongated preamble shall be recorded prior to writing the control block on all tracks except on tracks 7, 9 and 11.

On tracks 7, 9, and 11 a long preamble shall be recorded prior to writing the control block in such a way that the control block marker is located at least 0.1 inches (2.54 mm) after the LP marker.

(iii) A control block shall precede each file mark block. The second byte of the data field shall be set to 03H.

In this case, file mark blocks are numbered from 0 to 65 535 by using the third and fourth bytes of the data field in the control block as specified in 7.1. This is in addition to their block number specified in 5.4.3.

8. REWRITTEN BLOCKS

8.1 Error. When recording on tape, some blocks may have to be rewritten further down the tape. This is done to improve the system error rate. The decision criteria for the rewrite operation are not part of this standard, except as specified in 3.5.3.

A block N may be recognized as erroneous before or after block N+1 has been partly or completely written but it shall always be so recognized before the writing of block N+2 commences.

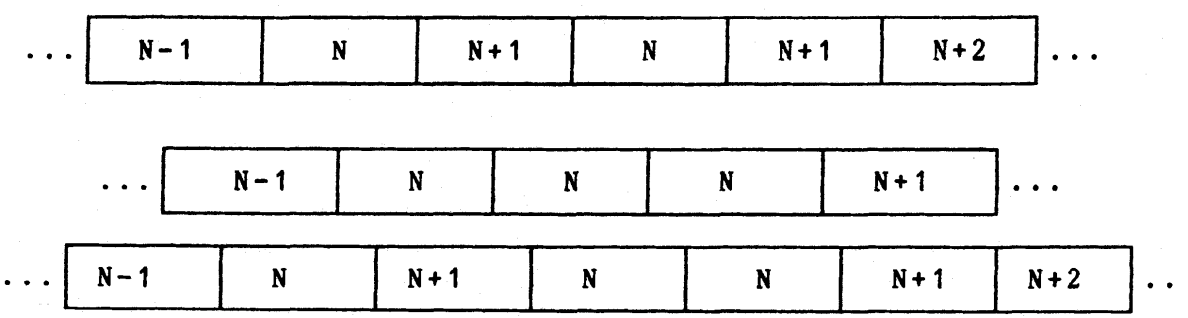
An erroneous block shall not be erased, it shall be rewritten further down tape.

A correct block N shall be followed, not necessarily immediately, by a correct block N+1.

An erroneous block shall not be rewritten more than 16 times.

Rewritten blocks shall retain their block number. In addition, if applicable, file mark blocks shall retain their file mark block number.

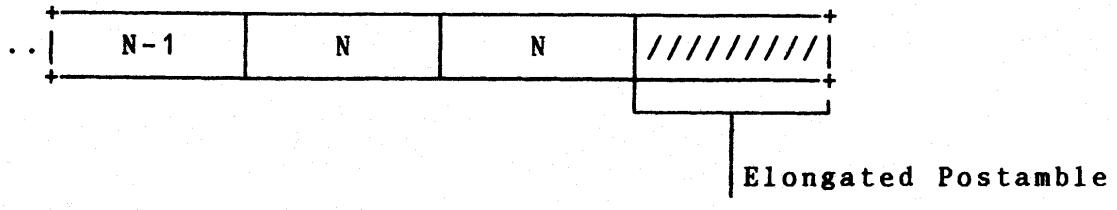
Various sequences of rewritten blocks are shown below.



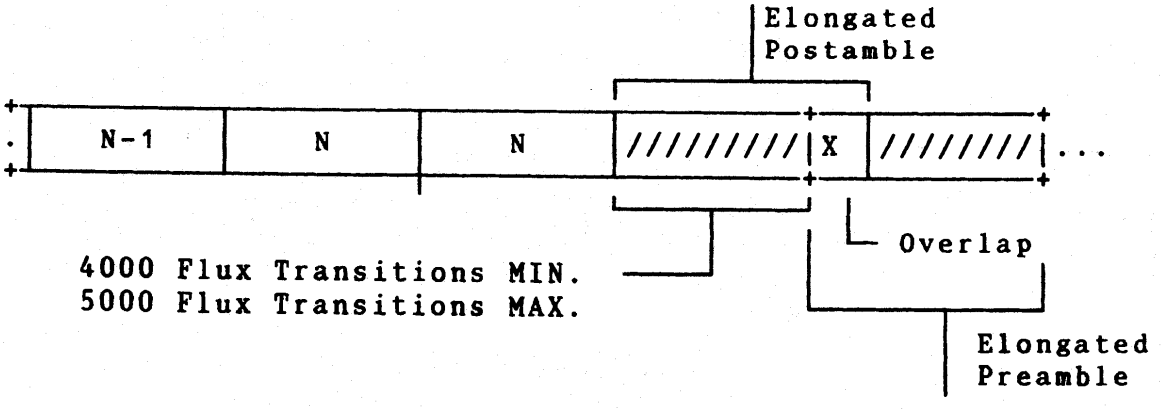
8.2 Streaming Termination. Streaming operation shall be terminated when an end of track condition exists, and may be terminated when underrun or end of file conditions exist.

8.2.1 End of Track. When an end of track condition is detected, the block currently being written will be completed and followed by an elongated postamble in order to allow the block to be verified. If the block does not meet the requirements for interchange, rewriting of the block shall commence at the beginning of the next track following a long preamble.

8.2.2 Underrun or End of File. When underrun or end of file conditions exist, the normal sequence of recording block N, N + 1, etc. shall be replaced by the sequence of blocks N, N, etc. until the recording of block N meets the requirements for interchange. When block N is recorded such that the requirements for interchange are met, the associated rewriting of block N is completed or truncated. An elongate postamble (see 5.6.2) shall be written as shown below.



Recording of the elongated preamble (see 5.1.2) following the elongated postamble shall begin at 4000 flux transitions minimum, 5000 flux transitions maximum from the end of the block preceding the elongated postamble.
An elongated preamble shall be recorded before recording any other field in the block.



8.3 **Forced Streaming.** Termination of streaming operation due to underrun may be prevented by continued recording of the last block until end of file or end of track occurs.
Standard length format fields shall be used during forced streaming operation.

8.4 **End of Recorded Data.** The end of recorded data (End of Recorded Area) shall be indicated by a file mark block followed by at least 45 inches (1140 mm) of erased track. If the end of the permissible recording area of the track is reached before this distance is passed, the measurement shall be continued on the next track, unless this was the last track.

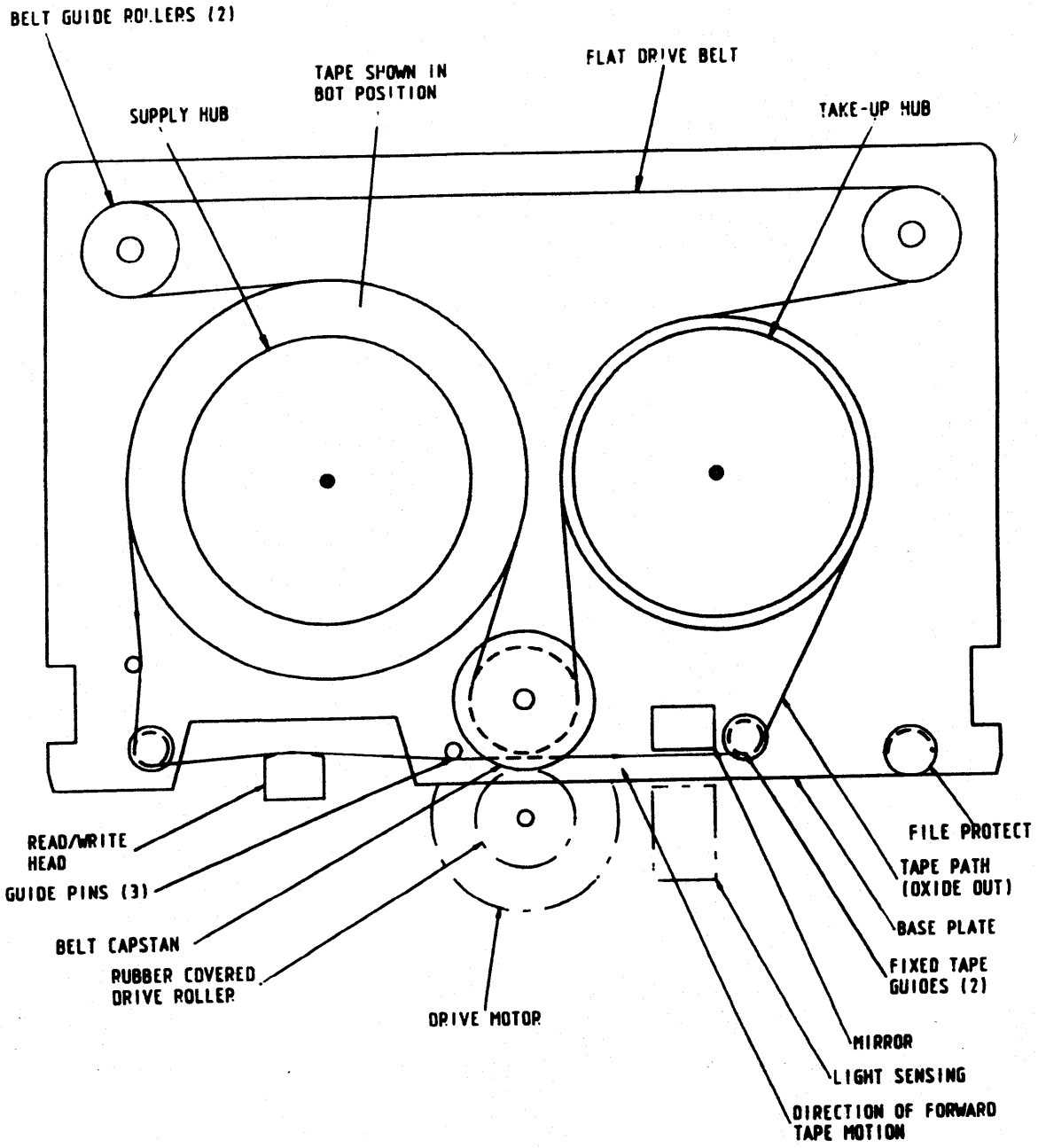
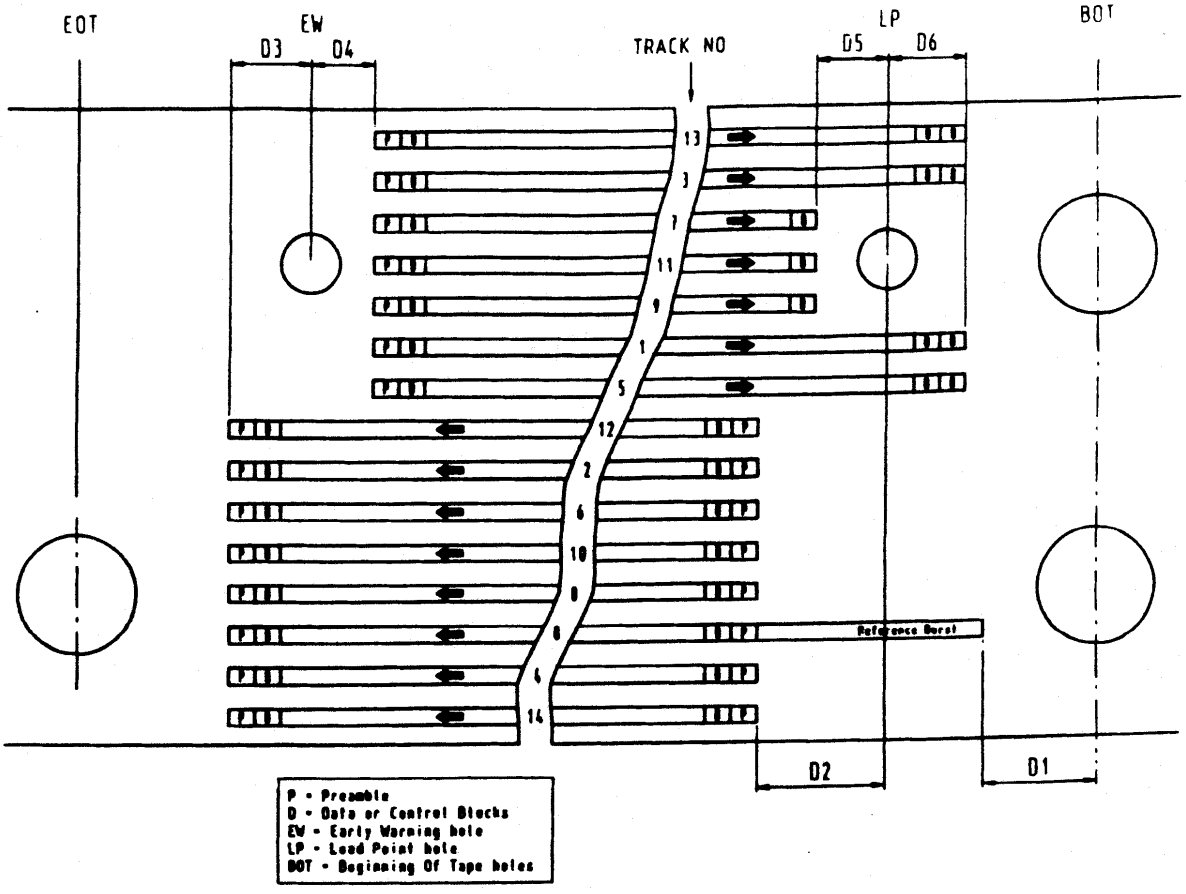


Figure 1. Possible Cartridge Configuration



Dimen-sions	Min. (in.)	Max. (in.)	Descriptions
D1	0	15	BOT to Start of Track Reference Burst
D2	3	4	Load Point to End of Track Reference Burst and Start of Preamble on Even Tracks
D3	-	36	Early Warning to End of Data on Even Tracks
D4	1	2	Early Warning to Start of Preamble on Odd Tracks
D5	0.1	4	End of Data to Load Point on Tracks 7, 9 & 11.
D6	-	27	Load Point to End of Data on Tracks 1, 3, 5 & 13.

Figure 2. Tape Position Holes