American National Standard

Adopted for Use by the Federal Government

FIPS 3-1
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recorded magnetic tape for information interchange (800 CPI, NRZI)

american national standards institute, inc.
1430 broadway, new york, new york 10018

With minor exception, this standard was approved as a Federal Information Processing Standard by the Office of Management and Budget on April 2, 1973.

Details concerning the use of this standard within the Federal Government are contained in FIPS PUB 3-1, Recorded Magnetic Tape For Information Interchange (800 CPI, NRZI). For a complete list of the publications available in the FEDERAL INFORMATION PROCESSING STANDARDS Series, write to the Office of Technical Information and Publications, National Bureau of Standards, Washington, D.C. 20234.

ANSI
X3.22-1973
Revision of
X3.22-1967

American National Standard Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI)

Secretariat

Computer and Business Equipment Manufacturers Association

Approved December 6, 1972

American National Standards Institute, Inc

American National Standard

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Foreword

(This Foreword is not a part of American National Standard Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI), X3.22-1973.)

This American National Standard presents the technique for recording the American National Standard Code for Information Interchange (ASCII), X3.4-1968, on magnetic tape at 800 characters per inch (CPI) using nonreturn-to-zero – change on ones (NRZI) recording techniques. It is one of a series of standards implementing the ASCII in media.

Related standards specify higher densities and define more fully the physical and magnetic properties of magnetic tape, and specify a standard record format and labels. Work is continuing on definitions, higher performance, and future requirements.

The X3B1 Technical Committee which developed this document consists of a group of experienced and qualified specialists on recording of digital information on magnetic tape. In the development of this standard careful consideration was given to current practices, existing equipment and supplies, and the broadest possible acceptance, while providing a basis for future improvement in the use of the medium.

This standard was approved as an American National Standard by ANSI on December 6, 1972.

Suggestions for improvement of this standard will be welcome. They should be sent to the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

American National Standards Committee on Computers and Information Processing, X3, which processed and approved this standard, had the following members at the time of approval:

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Contents

American National Standard Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI)

1. Scope

This standard provides specifications for format and recording for 1/2-inch, 9-track magnetic tape to be used for information interchange among information processing systems, communication systems, and associated equipment utilizing the American National Standard Code for Information Interchange (ASCII), X3.4-1968. This standard deals solely with recording on magnetic tape and supports and complements American National Standard Unrecorded Magnetic Tape for Information Interchange (9-Track 200 and 800 CPI, NRZI, and 1600 CPI, PE), X3.40-1973, where the following sections are dealt with in detail: general requirements, definitions, tape physical and magnetic requirements, tape reel, and write-enable ring. Compliance with the standard for unrecorded tape is a requirement for information interchange.

2. Definitions

beginning-of-tape (BOT) marker. A photoreflective marker placed on the tape for the purpose of indicating the beginning of the permissible recording area.

block. A group of contiguous recorded characters considered and transported as a unit containing one or more logical records. Blocks are separated by an interblock gap.

cyclic redundancy check (CRC) character. The next-to-last character placed in 9-track 800 CPI data blocks where a modified cyclic code is employed and which may be used for error detection and correction.

density. The nominal distribution per unit length of recorded information; usually expressed in characters per inch.

end-of-tape (EOT) marker. A photoreflective marker placed on the tape for the purpose of indicating the end of the permissible recording area.

flux reversal. The position of a flux reversal is defined as that point which exhibits the maximum free-space surface flux density normal to the tape surface.

interblock gap. A dc-erased section of tape separating blocks of information.

longitudinal redundancy check (LRC) character – NRZI. The last character placed in each block for the purpose of checking parity of each track in the block in the longitudinal direction, and for restoring all tracks to the dc-erase polarity.

skew. The deviation of bits within a tape character from the intended or ideal placement, which is perpendicular to the reference edge.

static skew. The component of skew that is unvarying and is independent of tape speed.

tape mark. A special control block recorded on magnetic tape to serve as a separator between files and file labels.

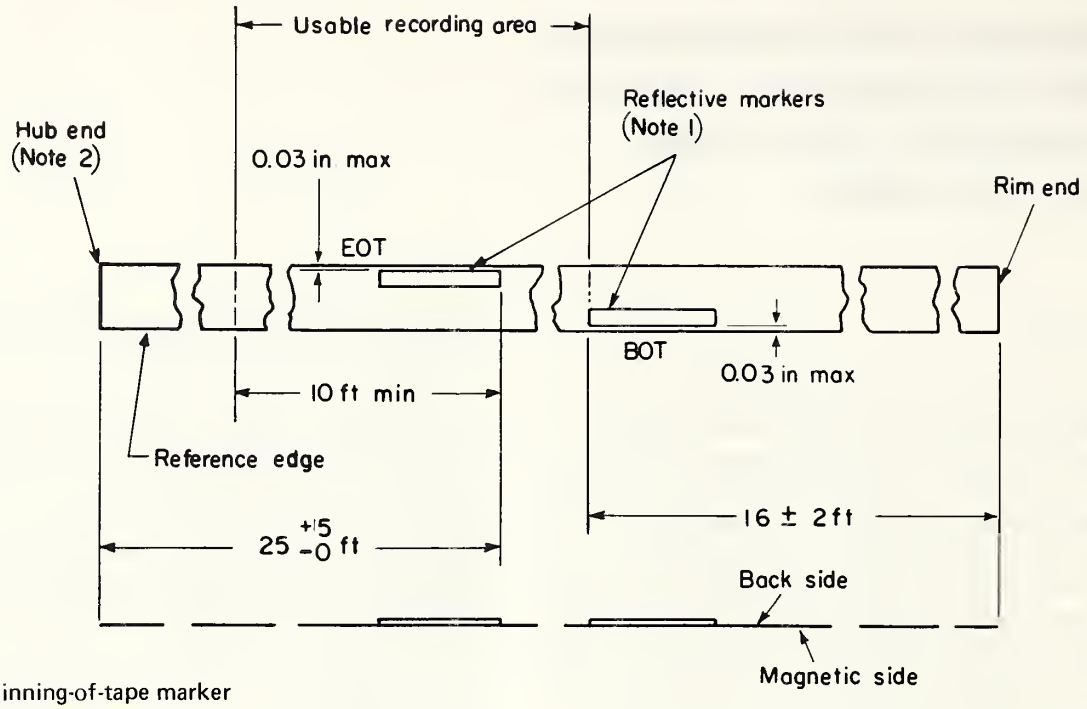
3. Recording Area Markers

Each reel of tape shall be furnished with two photoreflective markers, beginning-of-tape (BOT) and end-of-tape (EOT), as shown in Fig. 1.

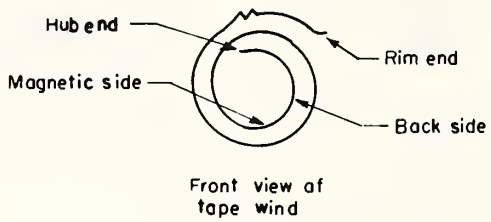
4. Recording

4.1 Method. The recording method shall be NRZI (nonreturn-to-zero – change on ones). A "1" bit is produced by reversal of flux polarity.

4.2 Density of Recording. The recording density shall be 800 characters per inch nominal. The equipment used for recording tapes at 800 CPI must be capable of



BOT: Beginning-of-tape marker
EOT: End-of-tape marker



NOTES:
(1) Photoreflective markers shall not protrude beyond the edge of the tape and shall be free of wrinkles and excessive adhesive. Marker dimensions: length, 1.1 inch ± 0.2 inch; width, 0.19 inch ± 0.02 inch; thickness, 0.0008 inch maximum.
(2) Tape shall not be attached to the hub.

Fig. 1
Usable Recording Area

recording at the nominal character spacing of 1250 μin (microinches) ± 3%. This capability shall be measured over a 150-inch minimum length of tape which has been recorded continuously with 800 in-phase flux reversals per inch (frpi) in all tracks.

4.3 Skew

4.3.1 Static Skew. The equipment used for recording tapes at 800 CPI must be capable of recording 150 μin or less of absolute static skew. This capability shall be measured on a tape which has been recorded continuously with 800 in-phase flux reversals per inch in all tracks. This maximum static deviation within a character is the value of static recorded skew. Both character polarities must meet the criterion.

4.3.2 Bit Timing. After writing on 800 CPI interchange tape, initial reading (either write check or read) on the same equipment determines bit timing (converted to microinches). To determine bit timing, from leading edge to leading edge, the following conditions must be considered together. It is not required that each character recorded on tape be checked for conformance to these parameters but that the hardware be designed and maintained in such a manner as to assure meeting these conditions:

(1) The timing between the first detected bit of

successive characters is nominally measured greater than 900 μin.

(2) The timing between the first detected bit and the last detected bit of a character is nominally measured less than 425 μin.

4.4 Erase

4.4.1 Erase Direction. The tape shall be magnetized so that the rim end of the tape is a north-seeking pole.

4.4.2 Erase Width. The full width of the tape is dc erased in the direction specified in 4.4.1.

4.4.3 Erase Function. The erase function, whether by the write head or the erase head, shall ensure that the level of the read-back signal amplitude is below 4% of the Standard Reference Amplitude at 800 frpi.

4.5 Standard Reference Amplitude. The Standard Reference Amplitude is the average peak-to-peak output signal amplitude derived from the NBS Amplitude Reference Tape (SRM 3200) on a measurement system using the 800 CPI recording system with the recording current of 2.1 × I_r. The longitudinal recording pattern in the tracks to be tested shall be 10001000 (200 frpi). The signal amplitude shall be averaged over a minimum of 4000 consecutive flux reversals.

The Standard Reference Current (I_r) is the minimum current applied to the Amplitude Reference Tape which causes an output signal amplitude equal to 95% of the maximum output signal.

4.6 Signal Amplitude

4.6.1 Average Signal Amplitude. The average peak-to-peak output signal amplitude of an interchanged tape at 800 frpi shall deviate no more than + 15%, − 30% from the Standard Reference Amplitude. Averaging shall be done over a minimum of 4000 flux reversals.

4.6.2 Maximum Signal Amplitude. An interchanged tape shall contain no adjacent reversals whose peak-to-peak output signal amplitude exceeds 1.2 times the Standard Reference Amplitude.

4.6.3 Minimum Signal Amplitude. An interchanged tape shall contain no adjacent flux reversals whose peak-to-peak output signal amplitude is less than 0.35 times the Standard Reference Amplitude.

5. Format

See Fig. 2.

5.1 Track Format. The track format shall consist of nine parallel tracks.

5.2 Track Dimensions

5.2.1 Track width on tape is 0.043 inch minimum.

5.2.2 Centerline distance between tracks is 0.055 inch nominal.

5.2.3 Centerline of track 1 is to be 0.029 inch ± 0.003 inch from reference edge.

5.3 Reference Edge. The reference edge of the tape shall be the top edge when viewing the oxide-coated side of the tape with the rim end of the tape to the observer's right.

5.4 Track Identification. Tracks shall be numbered consecutively, beginning at the reference edge with track No. 1, and assigned as follows:

Track:	1	2	3	4	5	6	7	8	9
Environment:	E3	E1	E5	P	E6	E7	E8	E2	E4
Binary weight:	2^2	2^0	2^4	P	2^5	2^6	2^7	2^1	2^3
ASCII bits:	b_3	b_1	b_5	P	b_6	b_7	Z	b_2	b_4

5.4.1 Bits b_1-b_7 correspond to the bit assignments in ASCII.

5.4.2 Bit P is the parity bit. Character parity is odd.

5.4.3 Bit Z shall be zero and treated as a bit of higher order than the ASCII bits.

5.5 Block Length (See Fig. 2)

5.5.1 The data portion of a block shall contain a minimum of 18 ASCII characters. The Tape Mark is excluded from the minimum block length requirements (see 5.8).

5.5.2 The data portion of a block shall contain a maximum of 2048 ASCII characters.

5.6 Density Identification Area. The identification area shall be fully saturated in the erased direction. This area begins 1.3 inches minimum before the trailing edge of the BOT marker and extends to the initial gap.

5.7 Gaps (See Fig. 2)

5.7.1 Interblock Gap

(1) Nominal – 0.6 inch

(2) Minimum – 0.5 inch

(3) Maximum – 25 feet

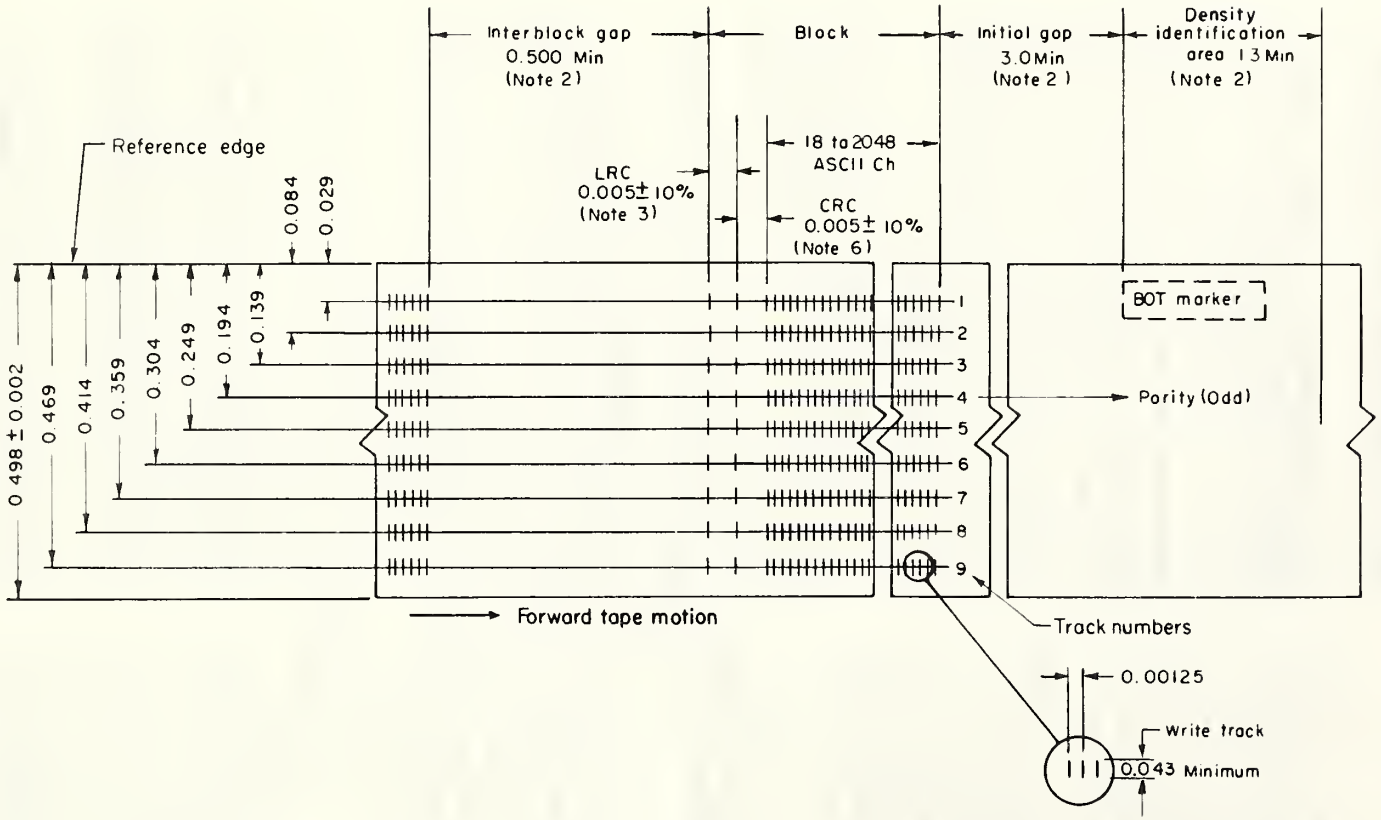
(Gap depends upon the number of consecutive erase operations.)

5.7.2 Initial Gap. The gap between the trailing edge of the BOT marker and the first recorded character shall be 3 inches minimum, 25 feet maximum.

5.8 Tape Mark. The Tape Mark shall be a single character block consisting of the Device Control Character, DC3 ("1" bits in tracks 2, 3, and 8 only).

5.9 CRC Character. At the end of each tape block a character shall be written on tape for the possible recovery of single-track errors. This character shall be called the Cyclic Redundancy Check (CRC) character. In Tape Mark blocks, zero bits are written in all tracks for the CRC character.

5.9.1 Consider the contents of a 9-position register



Legend

BOT: Beginning of tape
Ch: Characters
CPI: Characters per inch
CRC: Cyclic redundancy check
LRC: Longitudinal redundancy check
Min: Minimum

NOTES:

(1) Tape is shown with oxide side up, Read/Write head on same side as oxide.

(2) Tape to be fully saturated in the erased direction in the interblock gap, the initial gap, and density identification area.

(3) A longitudinal redundancy check bit is written in any track if the longitudinal count in that track is odd. Character parity is ignored in the longitudinal redundancy check character.

(4) All dimensions are given in inches.

(5) There is a track placement tolerance of ± 0.003 inch for each track.

(6) Parity of CRC character is odd, if an even number of data characters are written.

Fig. 2
Recording Format (800 CPI)

to be C_1 to C_9 with the following track assignments:

Regular position:	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
Track number:	4	7	6	5	3	9	1	8	2

5.9.2 The CRC character shall be derived as given in 5.9.2.1 through 5.9.2.5.

5.9.2.1 All data characters in the tape block are added to the CRC register without carry (each bit position is exclusive OR'ed to C_n).

5.9.2.2 Between additions, the CRC register is shifted one position C_1 to C_2, etc, and C_9 to C_1.

5.9.2.3 If shifting will cause C_1 to become "1," then the bits being shifted into positions C_4, C_5, C_6, and C_7 are inverted.

5.9.2.4 After the last data character has been added, the CRC register is shifted once more in accordance with 5.9.2.2 and 5.9.2.3.

5.9.2.5 To write the CRC character on tape, the contents of all positions except C_4 and C_6 are inverted. The parity of the CRC character will be odd, if the number of data characters within the block is even, and even, if the number of data characters within the block is odd. The CRC character may contain all zero bits, in which case the number of data characters was odd.

5.10 LRC Character. Following the CRC character a check character shall be written for the possible detection of read errors. This character shall be called the Longitudinal Redundancy Check (LRC) character. A longitudinal redundancy check bit is written in any track if the longitudinal count is otherwise odd.

6. Revision of American National Standard Referred to in This Document

When the following American National Standard referred to in this document is superseded by a revision approved by the American National Standards Institute, Inc, the revision shall apply:

American National Standard Code for Information Interchange, X3.4-1968

Appendixes

(These Appendixes are not a part of American National Standard Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI), X3.22-1973, but are included for information purposes only.)

Appendix A
Design Considerations

A1. Introduction

A1.1 This recorded magnetic tape standard is intended to implement the American National Standard Code for Information Interchange (ASCII), X3.4-1968, on magnetic tape for interchange among information processing systems, communication systems, and associated equipment.

A1.2 A related standard has been prepared to specify unrecorded magnetic tape. The scope of the unrecorded magnetic tape standard covers the specification and testing of physical and magnetic properties and also the operation and storage environments, identification, control devices, and attachments.

A1.3 A related standard has been prepared to specify a standard format for blocks recorded on 1/2-inch, 9-track magnetic tape. The scope of the magnetic tape label standard covers the definition, content, functions, and interrelationships of blocks.

A1.4 Consideration was given to:

(1) Definition of terms.

(2) Approaches permitting higher performance. The most common method used today is nonreturn-to-zero saturation recording. Consideration was given to possible future use of other recording techniques such as phase modulation for future standards work.

A2. Specification Support

A2.1 Tape

A2.1.1 The dimensions in the recorded tape standard are for reference and to facilitate the design and layout of the recording format.

A2.1.2 Additional signal level specifications are detailed in the unrecorded tape standard.

A2.1.3 The 1/2-inch tape width was selected due to its widespread and current usage throughout the industry and the large quantity in existence. Any changes would tend to obsolete this 1/2-inch tape and also discourage acceptance of the standard. (Similar consideration applies to existing tape transport designs.)

A2.1.4 Tape length must be agreed upon by the interchange parties. The maximum length is to be limited by the requirements for reel dimensions, tape thickness, "E" value, and moment of inertia as given in American National Standard Unrecorded Magnetic Tape for Information Interchange (9-Track 200 and 800 CPI, NRZI, and 1600 CPI, PE), X3.40-1973.

A2.1.5 Special leaders and trailers may be attached in order to meet special transport loading and control requirements wherever needed.

A2.1.6 The tape wind convention is specified to insure uniformity among all users.

A2.2 Recording Area Markers. The marker type and size have been provided in the recorded tape standard so that placement of BOT and EOT could be determined and set forth in the standard. The detail of the marker is set forth in the unrecorded tape standard.

A2.3 Recording Method

A2.3.1 NRZI is an accepted method of recording for the given density.

A2.3.2 DC erase of the full width of the tape is provided to insure that all previously recorded information is removed prior to recording new information.

A2.3.3 Skew, in this document as in the comparable 9-track 800 NRZI ISO document (ISO Recommendation R 1863), is the measurement of the deviation during read-back in the control device from time coincidence of the bits within or between a recorded character(s) converted to apparent length to remove the speed dependence. Nominal values are used for character skew and character spacing rather than definite limits since there are probable measurement variations. The exact range of these variations is not necessarily the same for different equipment. Even though these variations exist, the 440-μin minimum apparent spacing between the last bit of a character and the first bit of the next character, as stated in the ISO document, is readily met by equipment meeting the requirements of this American National Standard. "Nominally measured" and "Design center value" can be used interchangeably in a write quality check, in view of the foregoing interpretation, and imply only that protection (not a specific design) is to be provided.

A2.4 Format

A2.4.1 Number of Tracks. The 9-track format was selected for the following reasons:

(1) The de facto standard (7-track) is not capable of easily handling ASCII; a minimum of 8 tracks is required.

(2) The addition of the ninth track permits alternate, noninterchange uses of the same tape and equipment. (See Section A3 of this Appendix.)

A2.4.2 Track Dimensions

A2.4.2.1 The track locations (centerline of recorded data) are dimensioned from the reference edge of the tape. Tracks are numbered 1 through 9 starting at this reference edge. The track location tolerance of ± 0.003 inch is close enough to prevent undesirably wide deviation in track locations, thus allowing the widest possible read head track width. Wide read head track widths are desirable to provide adequate signal levels and enhance the freedom from defect-caused signal dropouts.

A2.4.2.2 The method of dimensioning allows equipment manufacturers to make distribution of design tolerances between the write head and the tape transport mechanism as desired.

A2.4.2.3 The minimum recorded track width was selected to provide maximum freedom from defect-caused signal dropouts consistent with reasonable head design practices.

A2.4.2.4 Width of read tracks is not specified. It is assumed that equipment manufacturers will select an optimum read track width for their particular equipment.

A2.4.3 Track Identification and Bit Assignment

A2.4.3.1 The track numbering is logically assigned 1 through 9, starting at the reference edge of the tape.

A2.4.3.2 The bit assignments were selected for maximum reliability and performance according to the following criteria:

(1) It is more probable that a "1" bit will be misinterpreted as a "0" than the converse.

(2) Errors as defined in (1) are more likely to occur near the edges of the tape than near the center.

(3) Certain portions of the code will be used more often than others. Most frequently used will be the numerics (0–9) and next in order will be the alpha characters.

A2.4.3.3 Based on these criteria the following bit assignment evolved:

(1) Bit Z was assigned to track 7. This bit will be used in non-ASCII code applications where the binary weight of 2^7 on track 7 is required. Compatibility with other 9-track systems, when recording binary information, is enhanced by this placement of bit Z.

(2) The parity bit is considered critical especially in double numeric packing since it is possible to generate a configuration that consists of the parity bit only; namely "zero," "zero." It is anticipated that this configuration will happen frequently; therefore P was placed near the center of the tape on track 4.

(3) Bits 5 and 6 are critical because "1" bits are always present in the numerics. Therefore b_5 and b_6 were placed adjacent to P on tracks 3 and 5, respectively.

(4) Since bit 7 is a "1" in all alpha characters, it is considered next in line and placed adjacent to b_6 on track 6.

(5) Bits 3 and 4 are considered the least critical for the criteria above and therefore were placed on the two edge tracks, 1 and 9.

(6) Bits 1 and 2 are each "0" or "1" with equal probability and were therefore assigned the two remaining tracks, 2 and 8.

A2.4.4 Parity

A2.4.4.1 Odd character parity was selected so that the NULL character may be recorded on magnetic tape.

A2.4.4.2 The Longitudinal Redundancy Check Character is automatically generated when the interblock gap magnetization direction is reestablished. Under certain circumstances all bits of the check character will be "0's."

A2.4.5 Block Length

A2.4.5.1 The minimum block length was selected to minimize the possibility of misinterpretation of spurious signals within the interblock gaps.

A2.4.5.2 The maximum block length was selected to permit processing on the smallest systems and accommodation by reasonably sized buffers.

A2.4.5.3 Although the Longitudinal Redundancy Check Character and the Cyclic Redundancy Check Character are part of any block, neither is considered to be an information character and neither is included in the statement of block length.

A2.4.6 Density Identification Area. Some ADP installations employ tape subsystems to record 9-track tapes in the 800 CPI NRZI mode and the 1600 CPI PE mode. In the 1600 CPI PE mode an identification burst is required to be recorded on the tapes to alert and condition the reading subsystem to recognize the proper recording mode. This burst of bits in track 4 (in the area of the BOT marker) identifies to the tape subsystem tapes written in the 1600 CPI PE mode. The lack of this burst identifies tape written in the 200 or 800 CPI NRZI mode. To insure proper reading of NRZI recorded tapes the specified identification area must be fully erased in all tracks.

A2.4.7 Gap Sizes. Gap sizes are specified according to existing usage. The maximum gap is specified to permit corrective action when gaps of excessive length are encountered (successive erase instructions).

A2.4.8 Tape Mark. The DC3 character, when used in the single character block, acts as a Tape Mark for control of the tape handling mechanism. This does not preclude use of DC3 as a datum within the context of non-Tape Mark blocks.

A3. Additional Considerations

A3.1 Introduction. With the standard objective in mind, that is, to provide interchange between systems utilizing digital magnetic tapes, this standard provides sufficient specifications to facilitate such interchange, yet provides considerable flexibility for purposes inherent within any given systems design. The possibilities given in A3.2 through A3.4 are feasible.

A3.2 Noninterchange Applications

A3.2.1 Increased character transfer rate.

(1) Density: No restrictions on any other recording technique.

(2) Tape speed: No restriction.

(3) Packing: Two numeric characters may be placed in one tape character, possibly by the use of track 7 for one of the bits in a numeric character.

A3.2.2 Further flexibilities allowed by 9 tracks, for example:

(1) Redundant recording.

(2) Search indices.

(3) Special control.

A3.3 Information Exchange Flexibility

A3.3.1 The ASCII concept does not prohibit a variety of inherent subsets and supersets. This American National Standard for recorded magnetic tape will accommodate this flexibility.

A3.3.2 Present equipment design and handling capability was given considerable weight in the choice of the particular attributes of this standard.

A3.3.3 Upon agreement between persons interchanging recorded tapes, nothing in this standard should be taken to prohibit the use of longer block lengths than that specified in this standard.

A3.4 A Technique for Improving Probability of Successful Interchange of Recorded Tapes. The following techniques may be used to enhance the successful reading of tapes recorded in accordance with 4.3 of this standard: A long block of consecutive characters containing all "ones" may be recorded after the end of data, which will allow readjustment of the static skew of the reading transport with respect to the static skew of the writing transport.

Appendix B
Cyclic Redundancy Check (CRC) Character

When reading, the CRC register is controlled as it was for writing until the last data character has been added and the final shift made. The CRC character on tape is then added to it.

To test for an error, the register is read out inverting all positions except C_4 and C_6. If the masked output of any position is a "one," an error has been detected.

To determine whether the errors occurred in a single track and, if so, which, an Error Pattern (EP) must be generated. This pattern must then be compared with the error-indicating pattern in the CRC register.

Consider the contents of a 9-position EP register to be E_1 to E_9, corresponding to C_1 to C_9 of the CRC register. The error pattern may be constructed as follows:

(1) Whenever a character parity error is detected for a data character, a one is added without carry to E_9 (1 exclusive OR'ed to E_9).

(2) Between the reading of characters the EP register is shifted one position E_1 to E_2, etc, to E_9 to E_1.

(3) If shifting will cause E_1 to become "1," then the bits being shifted into positions E_4, E_5, E_6, and E_7 are inverted.

To determine the track in error, a series of comparisons is made between the contents of the EP register and the CRC register. The CRC register read-out through the mask, which inverts all positions except C_4 and C_6, is compared with the EP register.

The first comparison is direct: E_1 to C_1, E_2 to C_2, etc. If all positions match, the error was in the track associated with C_9 (track 2).

The CRC register is then shifted once, according to the rules in 5.9.2.2 and 5.9.2.3, between each comparison. This is continued until a match is obtained or until a maximum of nine comparisons (eight shifts) have been made. The track in error corresponds to C_9

through C_1 for a match on the first through ninth comparisons, respectively.

There are two conditions for the final contents of the CRC register for which an uncorrectable error has been detected and for which an incorrect track in error indication will be obtained if comparisons are made. These are:

(1) C_1 through C_9 all zero

(2) C_4 and C_6 zero, all other positions containing "one" (the read-out mask)

Comparisons must not be made when either of these two conditions exists.

If a track in error indication is obtained, the error block may be reread. The output of the track in error is then inverted whenever the parity of a character is incorrect.

American National Standards on Computers and Information Processing

X3.1-1969 Synchronous Signaling Rates for Data Transmission

X3.2-1970 Print Specifications for Magnetic Ink Character Recognition

X3.3-1970 Bank Check Specifications for Magnetic Ink Character Recognition

X3.4-1968 Code for Information Interchange

X3.5-1970 Flowchart Symbols and Their Usage in Information Processing

X3.6-1965 Perforated Tape Code for Information Interchange

X3.9-1966 FORTRAN

X3.10-1966 Basic FORTRAN

X3.11-1969 Specifications for General Purpose Paper Cards for Information Processing

X3.12-1970 Vocabulary for Information Processing

X3.14-1973 Recorded Magnetic Tape for Information Interchange (200 CPI, NRZI)

X3.15-1966 Bit Sequencing of the American National Standard Code for Information Interchange in Serial-by-Bit Data Transmission

X3.16-1966 Character Structure and Character Parity Sense for Serial-by-Bit Data Communication in the American National Standard Code for Information Interchange

X3.17-1966 Character Set for Optical Character Recognition

X3.18-1967 One-Inch Perforated Paper Tape for Information Interchange

X3.19-1967 Eleven-Sixteenths Inch Perforated Paper Tape for Information Interchange

X3.20-1967 Take-Up Reels for One-Inch Perforated Tape for Information Interchange

X3.21-1967 Rectangular Holes in Twelve-Row Punched Cards

X3.22-1973 Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI)

X3.23-1968 COBOL

X3.24-1968 Signal Quality at Interface Between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission

X3.25-1968 Character Structure and Character Parity Sense for Parallel-by-Bit Communication in the American National Standard Code for Information Interchange

X3.26-1970 Hollerith Punched Card Code

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X3.38-1972 Identification of States of the United States (Including the District of Columbia) for Information Interchange

X3.39-1973 Recorded Magnetic Tape for Information Interchange (1600 CPI, PE)

X3.40-1973 Unrecorded Magnetic Tape for Information Interchange (9-Track 200 and 800 CPI, NRZI, and 1600 CPI, PE)

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