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ANSI X3.93M-1981

# American National Standard

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FIPS PUB 89  
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Front Cover

for optical character  
recognition (OCR)  
character positioning

ANSI X3.93M-1981



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**American National Standard  
for Optical Character Recognition (OCR)  
Character Positioning**

Secretariat

**Computer and Business Equipment Manufacturers Association**

Approved May 29, 1981

**American National Standards Institute, Inc**

## Foreword

(This Foreword is not a part of American National Standard for Optical Character Recognition (OCR) Character Positioning, ANSI X3.93M-1981.)

This standard is the result of a recognized need to have separate documents for character shapes, character positioning, print quality, inks, and paper (see Section 5 of this standard).

The material contained in this standard is taken from the text and appendix of American National Standard Character Set and Print Quality for Optical Character Recognition (OCR-A), ANSI X3.17-1977. This material was omitted from the revised edition, American National Standard Character Set for Optical Character Recognition (OCR-A), ANSI X3.17-1981, which covers character shapes and sizes only. The character positioning requirements in this standard apply to the constant stroke-width OCR-B characters specified in American National Standard Character Set for Optical Character Recognition (OCR-B), ANSI X3.49-1975, as well as the OCR-A characters.

It is recommended that machine-printed OCR fonts conform to this standard. Fonts with special character positioning requirements shall be treated on an individual basis.

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.

This standard was processed and approved for submittal to ANSI by American National Standards Committee on Information Processing, X3. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the X3 Committee had the following members:

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# American National Standard for Optical Character Recognition (OCR) Character Positioning

## 1. Scope, Purpose, and Application

**1.1 Scope.** This standard specifies the location of OCR-A and OCR-B characters in relationship to other characters on a document or page and to reference points of the document or page.

**1.2 Purpose.** The purpose of this standard is to establish definitions and tolerances for the positioning of OCR-A and OCR-B characters that will ensure satisfactory optical recognition.

**1.3 Application.** This standard shall be used in conjunction with American National Standards for OCR character shapes and sizes (ANSI X3.17-1981 and ANSI X3.49-1975), OCR paper (ANSI X3.62-1979), and OCR inks (ANSI X3.86-1980). These standards are listed in detail in Section 5 of this standard. For most OCR systems to function reliably, each OCR character should be located and positioned so that other OCR characters or non-OCR data cannot interfere with recognition.

The values in this standard are chosen on the basis that they are reasonably obtainable. Although each parameter is independently specified, a deterioration in reader performance may occur if the limits of two or more parameters are approached simultaneously. Every effort should be made to keep well within the specified limits. It is recognized, however, that in bulk printing from any device the limits will occasionally and randomly be exceeded.

## 2. Character Positioning

The position of a character is as important as the shape and quality of the printed character. Character positioning specifications (format rules) are needed to ensure that each OCR character is seen by the reading device without interference from other OCR characters or from non-OCR matter. The format rules given in this

standard are the minimum requirements and may need to be supplemented by further rules for specific systems. The four general conditions that must be considered are:

- (1) The position of the character relative to the edge of the document
- (2) Character separation
- (3) Character alignment
- (4) Character skew

## 3. Definitions

**3.1 Document Reference Edges.** Document reference edges are any edges used to locate the document (see Fig. 1).

**3.2 Printing Area.** A printing area is a rectangle inside the clear area in which OCR characters are to be printed (see Fig. 1). The sides of this rectangle should be parallel or perpendicular to a document reference edge.

**3.3 Clear Area.** A clear area is the printing area extended by dimensions *a*, *b*, *c*, and *d* as shown in Fig. 1. A document may contain more than one clear area. The locations and dimensions of clear areas will be determined by individual applications and the requirements specified in 4.2.1 and 4.2.2. This does not preclude the use of nonread inks.

**3.4 Margin.** A margin is the perpendicular distance between any boundary of the printing area and the nearest document edge (see Fig. 1).

**3.5 Field.** A field is any group of characters on one or more lines defined as a unit of information. A line may comprise several fields.

**3.6 Line Boundary.** A line boundary is the smallest rectangle with sides parallel and perpendicular to the document reference edge and containing all the boundaries of the component characters of the line (see Fig. 2).

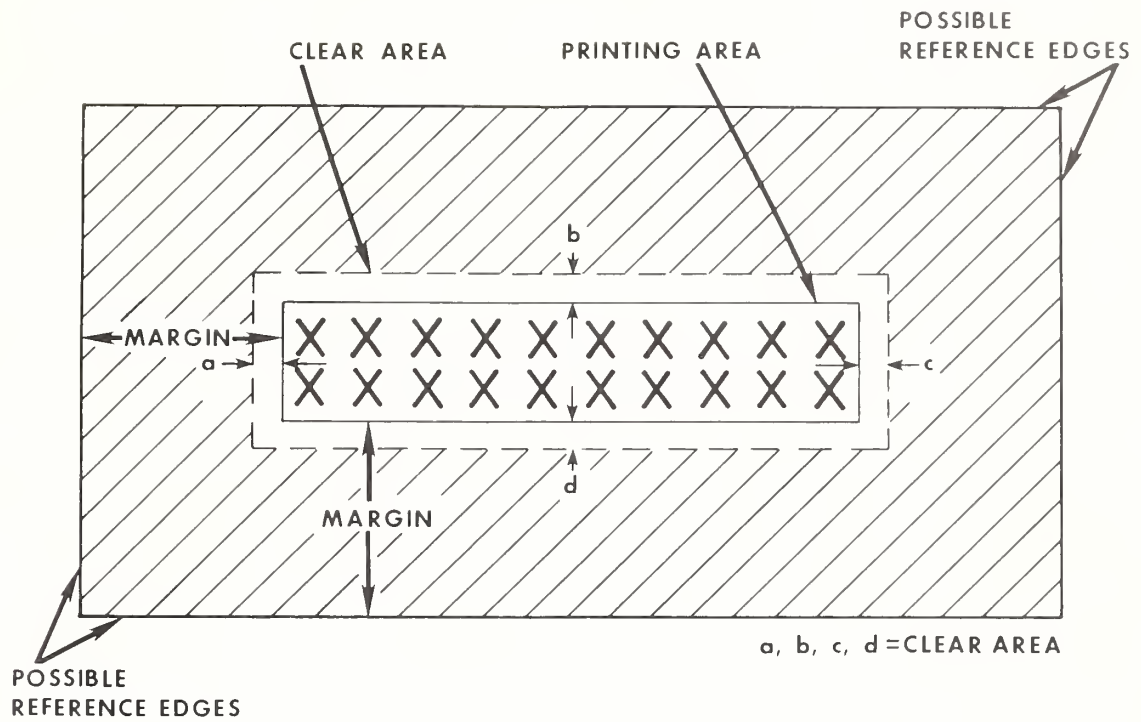


Fig. 1  
Margin Definition

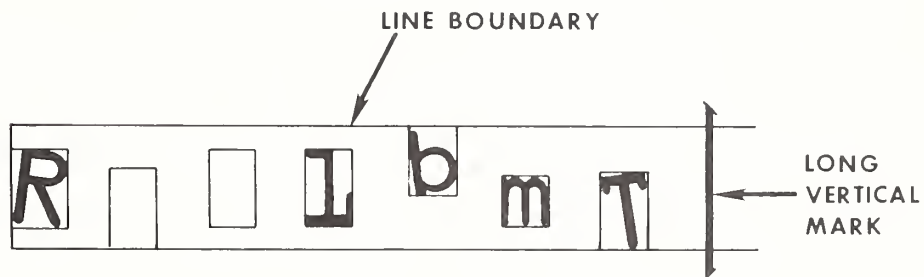


Fig. 2  
Line Boundary

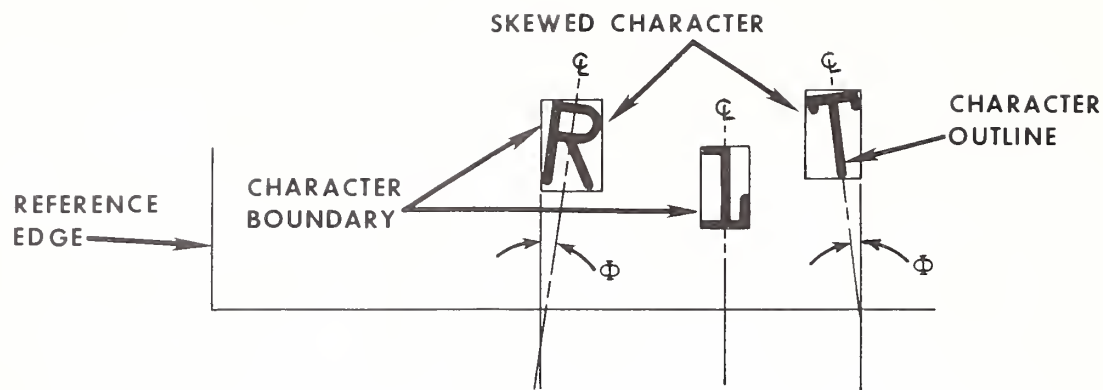


Fig. 3  
Character Boundaries and Character Skew

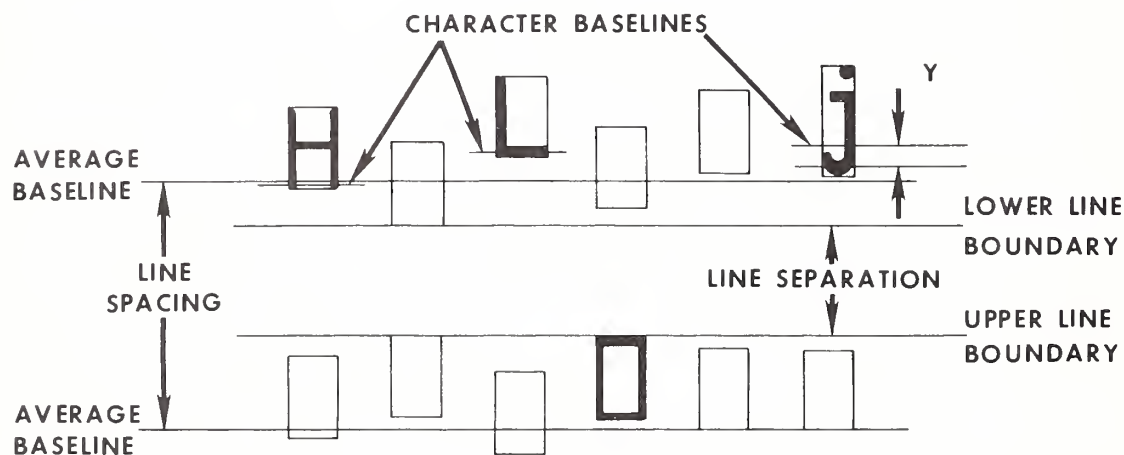


Fig. 4  
Line Spacing and Definition

**3.7 Character Boundary.** A character boundary is the rectangle with sides parallel and perpendicular to a document reference edge, which is drawn tangential to the character outline and contains the character completely. Skewed characters still have boundaries parallel or perpendicular to a document reference edge (see Fig. 3).

The character boundary is used to measure character and line separation and to determine line boundary.

For the purpose of determining the boundary of the *Long Vertical Mark*, only the portion of the *Long Vertical Mark* that lies between the extensions of the

uppermost and lowermost horizontal boundaries of the adjacent character(s) will be considered (see Fig. 2).

**3.8 Character Skew.** Character skew is the rotational deviation ( $\phi$ ) of the printed image from its intended orientation relative to a document reference edge (see Fig. 3).

**3.9 Character Baseline.** The character baseline is a reference line used to specify the nominal vertical position of all characters relative to the line of type (see Fig. 4). The position of the baseline is indicated on the drawings of all characters (see ANSI X3.17-1981 or

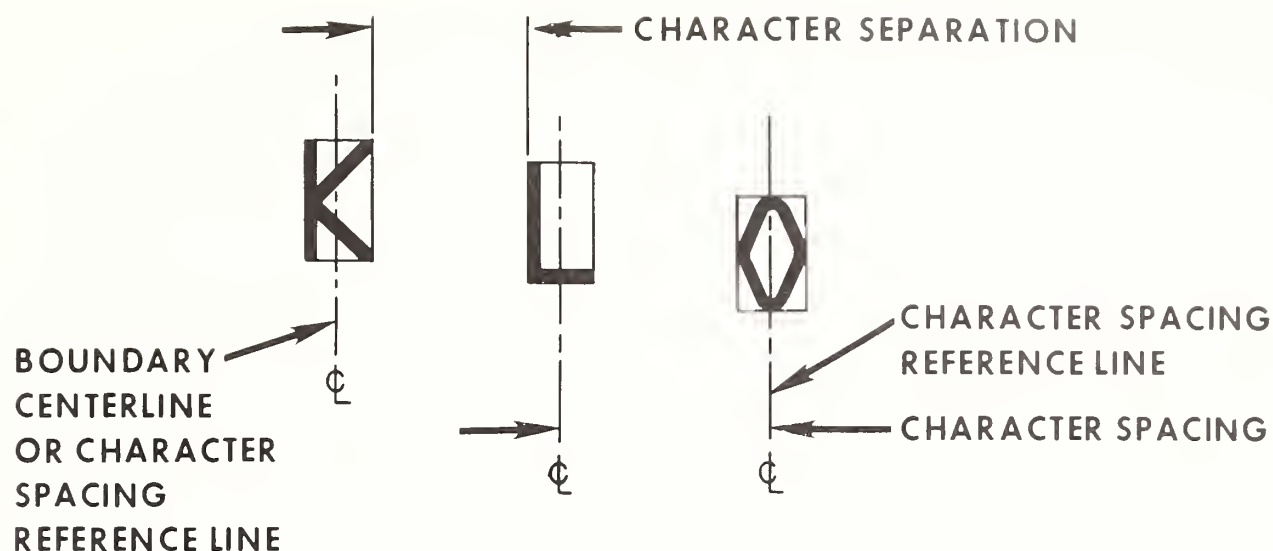


Fig. 5  
Character Separation and Spacing

ANSI X3.49-1975, as appropriate). For some characters, the indicated baseline is deliberately offset from the horizontal centerline of the lowest stroke by a defined distance  $Y$ . This may be positive (for example, OCR-A “,”) or negative (for example, OCR-A lowercase descenders: g, j, p, q, and y) as indicated in the corresponding character drawing.

**3.10 Average Baseline.** The average baseline for a line of characters or line segment is a horizontal line parallel or perpendicular to a reference edge. It is the average of the individual baselines of all the characters in that line (see Fig. 4). For baseline location of skewed characters, refer to 4.6.4.

**3.11 Character-Spacing Reference Line.** The character-spacing reference line is the vertical centerline of the characters as shown in the appropriate character set shape standard (see Fig. 5). Some OCR characters (for example, 4, f, and j, of the OCR-A set) are exceptions. For these characters, the character-spacing reference line is displaced from the vertical centerline of the character by the value of  $\Delta X$ , as indicated on the corresponding character drawings.

**3.12 Character Spacing.** Character spacing is the horizontal distance between the character spacing reference lines of two adjacent characters including the *Long Vertical Mark* (see Fig. 5).

**3.13 Character Separation.** Character separation is the horizontal distance between adjacent character boundaries (see Fig. 5).

**3.14 Adjacent-Character Misalignment.** Adjacent-character misalignment ( $M_A$ ) is the vertical distance between the baselines of adjacent characters (see Fig. 6).

**3.15 Line-Character Misalignment.** Line-character misalignment ( $M_L$ ) is the vertical distance between the baselines of the uppermost and the lowest characters in the same line (see Fig. 6).

**3.16 Line Spacing.** Line spacing is the vertical distance between the average baseline of one line to the average baseline of the next line (see Fig. 4).

**3.17 Line Separation.** Line separation is the vertical distance between the upper line boundary (see 3.6) for a line of print and the lower line boundary for the line immediately above (see Fig. 4).

## 4. Character Positioning Requirements

**4.1 Reference Edge(s).** One or more reference edges are required to position a document for printing or reading of OCR information.

**4.2 Clear Area, Printing Area, and Margin.** OCR printing shall be isolated from all other machine-detectable printing, patterns, or embossing to allow the reading



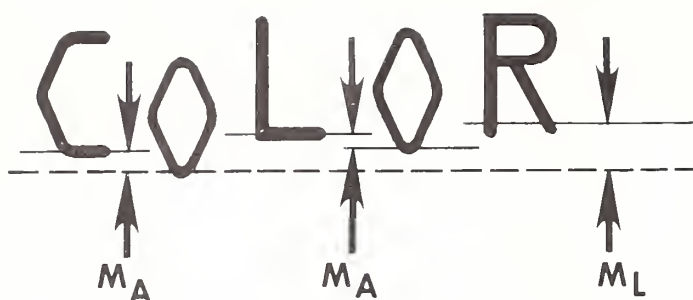


Fig. 6  
Character Misalignment

device to distinguish the OCR information more readily. This isolation is provided by maintaining a clear area or printing in nonread inks between the OCR information and the remainder of the document.

Relaxation of these requirements is permissible only when it has been established that all OCR devices in the system can handle the variations in the documents.

**4.2.1 Clearance around Printing Area.** The distances  $a$ ,  $b$ ,  $c$ , and  $d$  shown in Fig. 1 shall be not less than 2.5 mm (0.1 in) except where the minimum margin requirement is less (see Table 1).

**4.2.2 Margins.** Margins shall be at least 6.3 mm (0.25 in) unless otherwise specified. It is recognized however that for some common applications the margin requirements may be different. Some examples are given in Table 1.

**4.3 Character Skew.** Character skew shall not exceed 3 degrees (see Fig. 3).

**4.4 Character Spacing.** The character spacing (see Fig. 5) shall not exceed the specified minimum and maximum values shown in Table 2. Character spacing that approaches the maximum spacing allowable may result in a recognized character space. The reader manufacturers' specifications should be consulted.

NOTE: Journal-tape printers not providing a full character space for the decimal point will not meet the minimum requirements of this section. Some OCR scanners may allow this exception (the reader manufacturers' specifications should be consulted).

**4.5 Minimum Character Separation.** The minimum character separation shall be not less than the nominal stroke width as shown in 4.9. Some OCR readers may require a greater separation (the manufacturers' specifications should be consulted).

#### 4.6 Character Misalignment

**4.6.1 Adjacent-Character Misalignment.** The adjacent-character misalignment ( $M_A$ ) is measured accord-

ing to the procedures described in 3.14. It shall not exceed the values given in Table 3.

**4.6.2 Line-Character Misalignment.** The line-character misalignment ( $M_L$ ) within a line is measured according to the procedures given in 3.15. It shall not exceed the values given in Table 4.

If more than one character size is used within a line or a line segment, such that the characters of different sizes are adjacent (or considered as part of the same data field), then the limitation applying to the smallest character size applies to the whole line or line segment.

**4.6.3 Long Vertical Mark Alignment.** The *Long Vertical Mark* shall extend beyond the top and the bottom boundaries of any adjacent character (except when lowercase characters with descenders are used). A *Long Vertical Mark* should not extend nearer than 2.54 mm (0.1 in) to an adjacent line boundary to which it does not apply. See the appropriate character set shape standard (ANSI X3.17-1981 or ANSI X3.49-1975).

**4.6.4 Misalignment of Skewed Characters.** In measuring character misalignment all the character baselines are assumed to be parallel, and character skewness does not need to be considered. Skewness, when within specifications, has a negligible effect in determining misalignment. If it is considered desirable to account for character skew, then baseline measurements shall be made to the point of intersection of the character baseline and character centerline as shown in the drawings of the appropriate shape standard (ANSI X3.17-1981 or ANSI X3.49-1975).

**4.7 Line Spacing.** The line spacing shall be not less than the values given in Table 5. If character sizes are intermixed, the limitation applying to the largest size applies.

When the line spacing is more dense than 3 lines per inch, the user is advised to consult with the OCR equipment manufacturer.

For the line spacing values to be acceptable, the tolerances on the parameters influencing line separation should be below the maximum specified, which apply for wider spacing. The parameters that influence line separation are line pitch tolerance, vertical misalignment, character height, and stroke width.

In general, line spacing should be kept as large as possible, consistent with the other requirements of the system.

**4.8 Line Separation.** The minimum line separation (see Fig. 4) when taking misalignment tolerances into account shall be not less than the values given in Table 6 for each of the three character sizes. If character sizes are intermixed, the minimum values for line separation of the largest character size should be used. *Long Vertical Marks*, when used collinearly, are an exception to this rule. See ANSI X3.17-1981 or ANSI X3.49-1975 for added requirements.

**4.9 Summary of Character Positioning Specifications.** The specifications described in 4.5 through 4.8 are summarized in Table 7.

NOTE: The inch-to-millimeter conversions in this standard are not precisely equivalent. The values given in this standard are those adopted by the International Organization for Standardization and approved for use in the United States. For consistency, designers should adopt one system or the other but should not intermix them.

## 5. Revision of American National Standards Referred to in This Document

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

American National Standard Character Set for Optical Character Recognition (OCR-A), ANSI X3.17-1981

American National Standard Character Set for Optical Character Recognition (OCR-B), ANSI X3.49-1975

American National Standard for Paper Used in Optical Character Recognition (OCR) Systems, ANSI X3.62-1979

American National Standard for Optical Character Recognition (OCR) Inks, ANSI X3.86-1980

American National Standard Specifications for Credit Cards, ANSI X4.13-1971

**Table 1**  
**Minimum Margin Requirements**

Type of Device	Minimum Margin Requirements
Typewriters	25.4 mm (1.0 in), top and bottom
Journal tapes	0.36 mm (0.014 in)
Credit cards	3.18 mm (0.125 in)*
For hand-held	2.41 mm (0.095 in), left and right;
OCR readers	3.43 mm (0.135 in) top and bottom
(tags, labels, etc)	(a perforation is considered to be an edge)

\*See American National Standard Specifications for Credit Cards, ANSI X4.13-1971.

**Table 2**  
**Character Spacing**

Size	Minimum Spacing	Maximum Spacing
I	2.29 mm (0.090 in)	4.57 mm (0.180 in)
III	2.29 mm (0.090 in)	4.57 mm (0.180 in)
IV	3.30 mm (0.130 in)	6.60 mm (0.260 in)

**Table 3**  
**Maximum Adjacent-Character Misalignment**

Size	Maximum Misalignment
I	0.69 mm (0.027 in)
III	0.89 mm (0.035 in)
IV	1.07 mm (0.042 in)

**Table 4**  
**Maximum Line-Character Misalignment**

Size	Maximum Misalignment
I	1.37 mm (0.054 in)
III	1.78 mm (0.070 in)
IV	2.16 mm (0.085 in)

**Table 5**  
**Minimum Line Spacing**

Size	Minimum Line Spacing	Maximum Lines per Inch
I	3.99 mm (0.157 in)	6 (when all characters are uppercase)
III	4.78 mm (0.188 in)	5 (when lowercase characters are used)
IV	5.33 mm (0.210 in)	4

**Table 6**  
**Minimum Line Separation**

Size	Minimum Line Separation
I	0.64 mm (0.025 in)
III	1.52 mm (0.060 in)
IV	2.03 mm (0.080 in)



Table 7  
Summary of Character Positioning Specifications

Size	Height*		Minimum Line Spacing		Minimum Line Separation		Maximum Adjacent-Character Spacing		Minimum Character Spacing		Minimal Character Separation (Nominal Stroke Width)		Maximum Adjacent-Character Misalignment		Maximum Line-Character Misalignment	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
I	2.40	0.094	3.99	0.157	0.64	0.025	4.57	0.180	2.29	0.090	0.36	0.014	0.69	0.027	1.37	0.054
III	3.20	0.126	4.78	0.188	1.52	0.060	4.57	0.180	2.29	0.090	0.38	0.015	0.89	0.035	1.78	0.070
IV	3.80	0.150	5.33	0.210	2.03	0.080	6.60	0.260	3.30	0.130	0.51	0.020	1.07	0.042	2.16	0.085

\*The height of OCR-B characters differ slightly from character to character. However, the largest characters are no larger than the values shown. Therefore, all positioning requirements specified in this standard are applicable.

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**X3.2-1970 (R1976)** Print Specifications for Magnetic Ink Character Recognition  
**X3.3-1970 (R1976)** Bank Check Specifications for Magnetic Ink Character Recognition  
**X3.4-1977** Code for Information Interchange  
**X3.5-1970** Flowchart Symbols and Their Usage in Information Processing  
**X3.6-1965 (R1973)** Perforated Tape Code for Information Interchange  
**X3.9-1978** Programming Language FORTRAN  
**X3.11-1969** Specification for General Purpose Paper Cards for Information Processing  
**X3.14-1973** Recorded Magnetic Tape for Information Interchange (200 CPI, NRZI)  
**X3.15-1976** Bit Sequencing of the American National Standard Code for Information Interchange in Serial-by-Bit Data Transmission  
**X3.16-1976** Character Structure and Character Parity Sense for Serial-by-Bit Data Communication in the American National Standard Code for Information Interchange  
**X3.17-1977** Character Set and Print Quality for Optical Character Recognition (OCR-A)  
**X3.18-1974** One-Inch Perforated Paper Tape for Information Interchange  
**X3.19-1974** Eleven-Sixteenths-Inch Perforated Paper Tape for Information Interchange  
**X3.20-1967 (R1974)** 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)  
**X3.23-1974** Programming Language COBOL  
**X3.24-1968** Signal Quality at Interface between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission  
**X3.25-1976** Character Structure and Character Parity Sense for Parallel-by-Bit Data Communication in the American National Standard Code for Information Interchange  
**X3.26-1980** Hollerith Punched Card Code  
**X3.27-1978** Magnetic Tape Labels and File Structure for Information Interchange  
**X3.28-1976** Procedures for the Use of the Communication Control Characters of American National Standard Code for Information Interchange in Specified Data Communication Links  
**X3.29-1971** Specifications for Properties of Unpunched Oiled Paper Perforator Tape  
**X3.30-1971** Representation for Calendar Date and Ordinal Date for Information Interchange  
**X3.31-1973** Structure for the Identification of the Counties of the United States for Information Interchange  
**X3.32-1973** Graphic Representation of the Control Characters of American National Standard Code for Information Interchange  
**X3.34-1972** Interchange Rolls of Perforated Tape for Information Interchange  
**X3.36-1975** Synchronous High-Speed Data Signaling Rates between Data Terminal Equipment and Data Communication Equipment  
**X3.37-1980** Programming Language APT  
**X3.38-1972 (R1977)** 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)  
**X3.40-1976** Unrecorded Magnetic Tape for Information Interchange (9-Track 200 and 800 CPI, NRZI, and 1600 CPI, PE)  
**X3.41-1974** Code Extension Techniques for Use with the 7-Bit Coded Character Set of American National Standard Code for Information Interchange  
**X3.42-1975** Representation of Numeric Values in Character Strings for Information Interchange  
**X3.43-1977** Representations of Local Time of the Day for Information Interchange  
**X3.44-1974** Determination of the Performance of Data Communication Systems  
**X3.45-1974** Character Set for Handprinting  
**X3.46-1974** Unrecorded Magnetic Six-Disk Pack (General, Physical, and Magnetic Characteristics)  
**X3.47-1977** Structure for the Identification of Named Populated Places and Related Entities of the States of the United States for Information Interchange  
**X3.48-1977** Magnetic Tape Cassettes for Information Interchange (3.810-mm [0.150-Inch] Tape at 32 b/mm [800 bpi], PE)  
**X3.49-1975** Character Set for Optical Character Recognition (OCR-B)  
**X3.50-1976** Representations for U.S. Customary, SI, and Other Units to Be Used in Systems with Limited Character Sets  
**X3.51-1975** Representations of Universal Time, Local Time Differentials, and United States Time Zone References for Information Interchange  
**X3.52-1976** Unrecorded Single-Disk Cartridge (Front Loading, 2200 BPI) (General, Physical, and Magnetic Requirements)  
**X3.53-1976** Programming Language PL/I  
**X3.54-1976** Recorded Magnetic Tape for Information Interchange (6250 CPI, Group Coded Recording)  
**X3.55-1977** Unrecorded Magnetic Tape Cartridge for Information Interchange, 0.250 Inch (6.30 mm), 1600 bpi (63 b/mm), Phase Encoded  
**X3.56-1977** Recorded Magnetic Tape Cartridge for Information Interchange, 4 Track, 0.250 Inch (6.30 mm), 1600 bpi (63 b/mm), Phase Encoded  
**X3.57-1977** Structure for Formatting Message Headings for Information Interchange Using the American National Standard Code for Information Interchange for Data Communication Systems Control  
**X3.58-1977** Unrecorded Eleven-Disk Pack (General, Physical, and Magnetic Requirements)  
**X3.59-1981** Magnetic Tape Cassettes for Information Interchange, Dual Track Complementary Return-to-Bias (CRB) Four-States Recording on 3.81-mm (0.150-Inch) Tape  
**X3.60-1978** Programming Language Minimal BASIC  
**X3.61-1978** Representation of Geographic Point Locations for Information Interchange  
**X3.62-1979** Paper Used in Optical Character Recognition (OCR) Systems  
**X3.64-1979** Additional Controls for Use with American National Standard Code for Information Interchange  
**X3.66-1979** Advanced Data Communication Control Procedures (ADCCP)  
**X3.72-1981** Parallel Recorded Magnetic Tape Cartridge for Information Interchange, 4 Track, 0.250 Inch (6.30 mm), 1600 bpi (63 b/mm), Phase Encoded  
**X3.73-1980** Single-Sided Unformatted Flexible Disk Cartridge (for 6631-BPR Use)  
**X3.74-1981** Programming Language PL/I, General-Purpose Subset  
**X3.77-1980** Representation of Pocket Select Characters in Information Interchange  
**X3.79-1981** Determination of Performance of Data Communications Systems That Use Bit-Oriented Communication Procedures  
**X3.80-1981** Interfaces between Flexible Disk Cartridge Drives and Their Host Controllers  
**X3.82-1980** One-Sided Single-Density Unformatted 5.25-Inch Flexible Disk Cartridge (for 3979-BPR Use)  
**X3.83-1980** ANSI Sponsorship Procedures for ISO Registration According to ISO 2375  
**X3.86-1980** Optical Character Recognition (OCR) Inks  
**X3.88-1981** Computer Program Abstracts  
**X3.89-1981** Unrecorded Single-Disk, Double-Density Cartridge (Front Loading, 2200 bpi, 200 tpi) (General, Physical, and Magnetic Requirements)  
**X3.92-1981** Data Encryption Algorithm  
**X3.93M-1981** OCR Character Positioning
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- X3/TRI-77** Dictionary for Information Processing (Technical Report)