

American National Standard

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FIPS PUB 33-1

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for information systems —
character set for
handprinting



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1430 broadway, new york, new york 10018

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**American National Standard
for Information Systems –
Character Set for Handprinting**

Secretariat

Computer and Business Equipment Manufacturers Association

Approved August 24, 1982

American National Standards Institute, Inc

American National Standard

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Foreword

(This Foreword is not part of American National Standard X3.45-1982.)

This standard presents a character set for handprinting and supporting specifications and recommendations for its use in Optical Character Recognition (OCR) systems and in man-to-man communications. A broad range of applications and international considerations are included.

The character set was developed by a group of experienced specialists representing users and manufacturers of Optical Character Recognition equipment. Important contributions relating to handprinting and reading were made by experts in human factors. This standard is, in part, an outgrowth of earlier work that was done on man-to-man communications by Subcommittee X3.6.3 of American National Standards Committee on Information Processing Systems, X3. Liaison was established with European Computer Manufacturers Association Technical Committee 4, and comments were received from them.

This standard is a revised version of the American National Standard Character Set for Handprinting, ANSI X3.45-1974. The original character set remains unchanged with the exception of the Yen symbol. The Yen character was redefined in conjunction with the Japanese Industrial Standards Committee on OCR.

Suggestions for improvement of this standard will be welcome. They should be sent to the Computer and Business Equipment Manufacturers Association, 1828 L Street, N.W., Washington, D.C. 20036.

This standard was processed and approved for submittal to ANSI by American National Standards Committee on Computers and 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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National Bureau of Standards	Robert E. Rountree
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Wang Laboratories, Inc.	Carl W. Schwarcz
	Marsha Hayek (Alt)
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Technical Committee X3A1 on Optical Character Recognition, which developed this standard, had the following members:

G. K. Godwin, Chairman
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T. Bagg	J. Hopkins	D. Newton
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W. Davidson	S. McIntosh	P. Traglia
J. Desautels	R. Mestler	N. Weiland
W. Foster	J. Miller	J. Wells
B. Frost	R. Monell	

Technical responsibility for the development of this standard was assigned to X3A1 Working Group 1 on Character Sets and Shapes. During the development period, this technical subcommittee had the following members:

P. J. Traglia, Chairman	C. Bliss	G. Korzeniewski
R. C. Bloss, Secretary	G. Brown	H. Lidkea
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	J. Desautels	R. Monell
	W. Foster	R. Robertson
	G. K. Godwin	H. Schantz
	J. Hopkins	N. Weiland
	R. Ireland	

Other persons who contributed to the development of this standard included the following:

J. P. Ancona	D. Freedman	A. L. Minto
L. M. Andrews	J. H. Freymeyer	W. D. Morgan
A. J. Atrubin	R. M. Fricano	W. Muldowney
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J. J. Forsythe	H. Lidkea	R. Zablocki
A. Frank	R. Maehofer	

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American National Standard for Information Systems — Character Set for Handprinting

1. Scope and Purpose

1.1 Scope. This standard prescribes shapes and sizes of handprinted characters to be used in Optical Character Recognition (OCR) systems and shapes of handprinted characters for man-to-man communication. The standard encompasses international requirements.

1.2 Purpose. This standard establishes a common frame of reference for man-to-machine (OCR) and man-to-man (for example, programmer to keypunch operator) communication requirements. The purpose in providing such a standard for man-to-man usage is to enable unambiguous communication between people when the accuracy of that communication is more important than the speed and flexibility usually associated with that mode of communication.

Two factors were considered especially important in order to avoid developing a standard that would have to be frequently modified and enlarged. These are the desirability of including characters for a broad range of applications and consideration of international requirements. Special consideration was given to human factors and the current state of OCR technology.

In order to achieve the objective of long-term stability, parts of this standard are, of necessity, anticipatory in nature. That is, some characters are included which, at the time of development of this standard, were not handled by OCR machines available in the marketplace. This is particularly true of some of the characters in the Programming and Universal subsets.

2. Character Shapes

Character shapes are shown in Fig. 1. The general rules for character shapes and sizes are stated in Section 3.

3. General Rules for Character Shapes and Sizes

3.1 Definitions

In this standard the following definitions shall apply:
centerline height. The vertical distance between the

highest and lowest points of the stroke centerline of the character.

centerline width. The horizontal distance between the leftmost and rightmost points of the stroke centerline of the character.

character space. The rectangular area which is reserved for a single character and which is delimited by the guidelines (see 3.10).

dimensions. The U.S. customary and metric dimensions in this standard are not precisely equivalent. Users may adopt either system but shall not intermix dimensions.

stroke centerline. The line drawn midway between the stroke edges. Its termination is a half stroke width from the end of the stroke.

stroke edge. The smoothed line of discontinuity between the character image and the background.

3.2 Character Shapes. The character shapes shown in Fig. 1 are the standard shapes for handprinting. Characters shall be drawn and placed as illustrated. A part of a character shown as a straight line is to be drawn as straight as practical; a part shown as a curve is to be drawn as smoothly as practical. Each character occupies one character space.

The objective is to print characters as close to the ideal shapes as is practical. As a general rule the accuracy of communicating by means of handprinting will deteriorate as the printed shapes depart from the ideal. It is difficult to determine the performance level of a person printing characters according to this standard. Nevertheless, in order to have available an indication of when handprinting deviates excessively from the ideal, the specifications and tolerances of Section 3 have been included.

3.3 Character Height and Width for OCR

3.3.1 The nominal character centerline height is 0.180 inch (4.5 mm) with the exception of overall characters. Variations of 0.040 inch (1.0 mm) about this nominal height will be allowed, resulting in a minimum character centerline height of 0.140 inch (3.5 mm) and a maximum character centerline height of 0.220 inch (5.5 mm); however, the vertical extremities of the stroke centerlines of the character shall be 0.110 inch

0 1 2 3 4 5 6 7 8 9

Number	0	Number	1	Number	2	Number	3	Number	4	Number	5	Number	6	Number	7	Number	8	Number	9
--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---

A B C D E F G H I J

Letter	A	Letter	B	Letter	C	Letter	D	Letter	E	Letter	F	Letter	G	Letter	H	Letter	I	Letter	J
--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---

K L M N O P Q R S T

Letter	K	Letter	L	Letter	M	Letter	N	Letter	O	Letter	P	Letter	Q	Letter	R	Letter	S	Letter	T
--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	--------	---

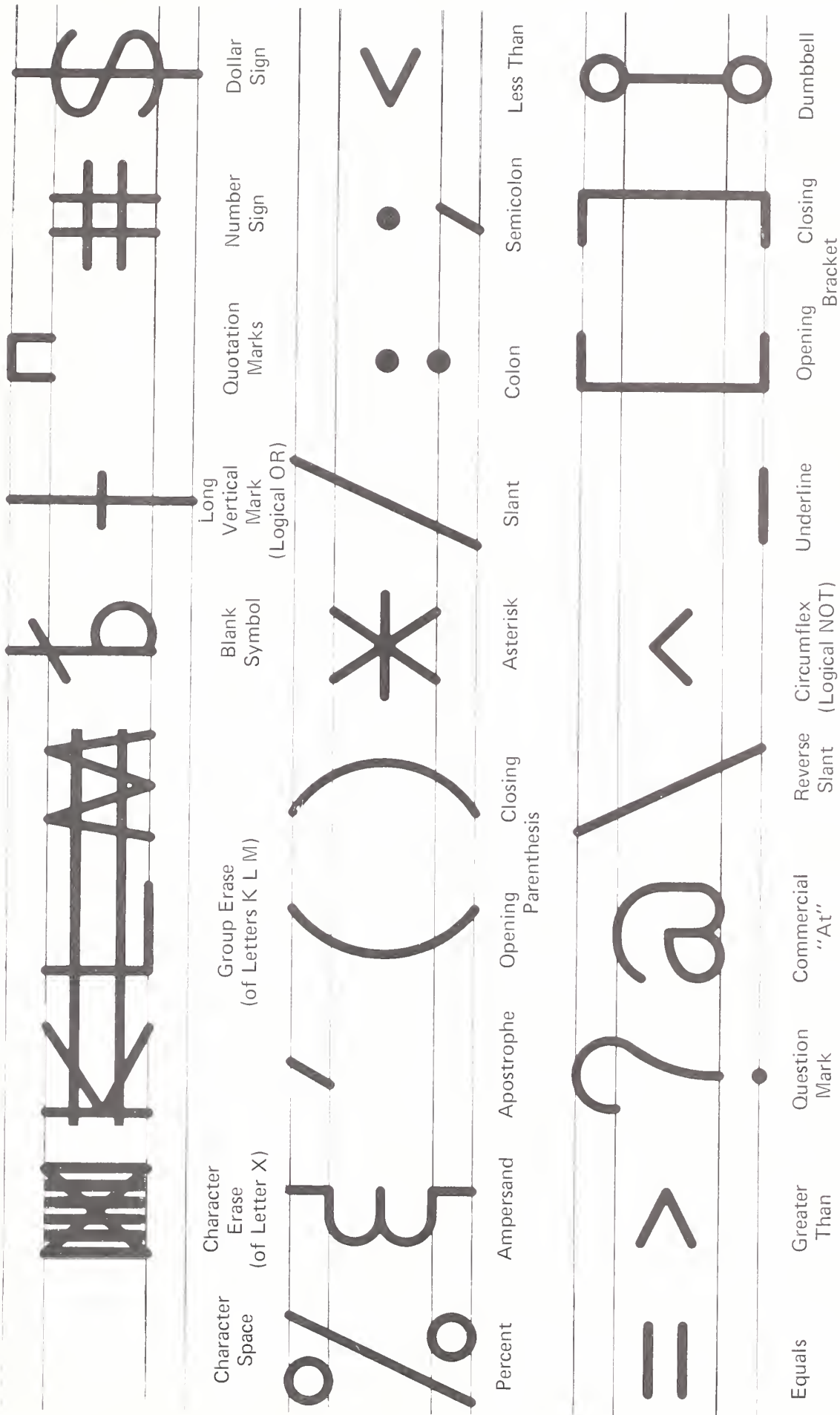
U V W X Y Z + - ,

Letter	U	Letter	V	Letter	W	Letter	X	Letter	Y	Letter	Z	Plus	Hyphen (Minus)	Period	Comma
--------	---	--------	---	--------	---	--------	---	--------	---	--------	---	------	-------------------	--------	-------

NOTE: Scale approximately 4:1.

Fig. 1
Standard Character Set for Handprinting

Continued on next page



NOTE: Scale approximately 4:1.

Fig. 1 — Continued

Continued on next page

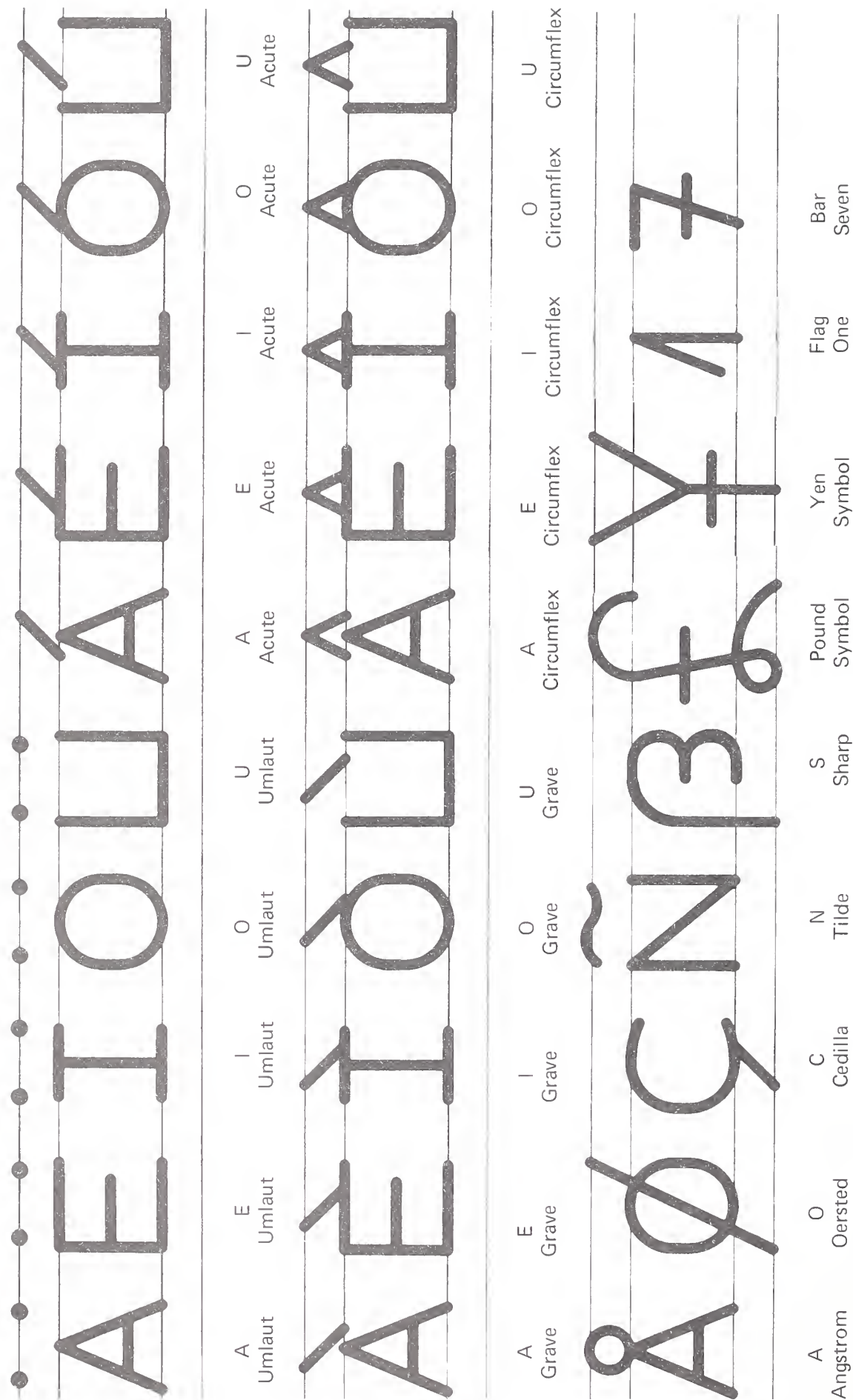


Fig. 1 — Continued

Table 1
Overall Characters

Characters	Centerline Height \pm Tolerance	
	in	mm
\dagger \$ % & () / ? \ } [] ! \emptyset & Y }	0.320 \pm 0.040 (Height of overall characters)	8.0 \pm 1.0
Ä Ë Ì Ö Ü Á É Í Ó Ú } À È Ì Ò Ò Â Ê Î Ò Û } Å Ç Ñ ß	0.250 \pm 0.040 (Height of accented characters)	6.3 \pm 1.0

(2.8 mm) or less from the horizontal centerline of the character space. For exceptions, see 3.3.3.

3.3.2 The minimum allowable centerline width of a character is 0.090 inch (2.3 mm). The maximum allowable overall width of a character is 0.160 inch (4.0 mm) for the Numeric subsets and 0.200 inch (5.0 mm) for all other subsets. For exceptions, see 3.3.3.

3.3.3 The characters shown in Table 1 and Table 2 are exceptions to the rules given in 3.3.1 and 3.3.2.

For the characters shown in Table 1, the vertical extremities of the stroke centerline shall be 0.180 inch (4.5 mm) or less from the horizontal centerline of the character space.

The centerline width of the loops of the Dumbbell shall be between 0.050 inch (1.25 mm) and 0.090 inch (2.25 mm). The overall width of each parenthesis shall be between 0.080 inch (2.0 mm) and 0.120 inch (3.0 mm). The width of all other characters shown in Table 1 shall be according to 3.3.2.

3.4 Gaps. Character shapes shall consist of connected strokes except where gaps are shown in the drawings of Fig. 1. Gaps (for example, in the characters 3 and G) should be 0.040 inch (1.0 mm) minimum.

3.5 Loops, Serifs, and Ticks. Loops, serifs, or tick marks shall not be used, except where explicitly specified.

3.6 Allowed Slopes for OCR

3.6.1 Where a vertical line is drawn in OCR characters, the horizontal distance between the end points of its stroke centerline shall be less than or equal to one-

fifth of the vertical distance between the same points. See Fig. 2.

3.6.2 Where a horizontal line is drawn in OCR characters, the vertical distance between the end points of its stroke centerline shall be less than or equal to one-eighth of the horizontal distance between the same points. See Fig. 2.

3.6.3 Horizontal and vertical distances are measured parallel to horizontal and vertical line segments of guidelines (see 3.10).

3.7 Stroke Width for OCR. Stroke width shall be limited to the range 0.010 to 0.040 inch (0.25 to 1.0

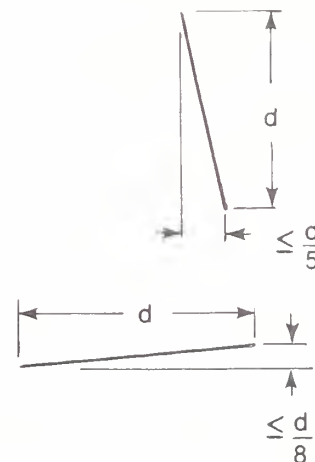


Fig. 2
Allowed Slope Variation

Table 2
Specified Character Usage

Character	Centerline Height \pm Tolerance		Comments
	in	mm	
|	0.180 ± 0.040	4.5 ± 1.0	Plain One. Single stroke width.
⌈	0.180 ± 0.040	4.5 ± 1.0	Flag One. Centerline width: ≤ 0.060 in (1.5 mm). Horizontal distance between lowest point of flag and lowest point of staff: ≤ 0.060 in (1.5 mm).
+	$0.090 + 0.045, - 0.015$	$2.3 + 1.1, - 0.4$	Plus. Overall width: 0.090 in $+ 0.045$ in, $- 0.015$ in (2.3 mm $+ 1.1$ mm, $- 0.4$ mm).
—	One stroke width		Hyphen (Minus). Overall width: 0.120 in ± 0.030 in (3.0 mm ± 0.8 mm).
•			Period (Decimal Point). Outside diameter: 0.045 in ± 0.015 in (1.1 mm ± 0.4 mm).
/			Comma, Apostrophe. Overall slant length: 0.090 in ± 0.015 in (2.3 mm ± 0.4 mm).
:			Colon. Centers of dots (Periods) are aligned vertically and separated: 0.090 in $+ 0.045$ in, $- 0.015$ in (2.3 mm $+ 1.1$ mm, $- 0.4$ mm).
;			Semicolon. Overall slant length: 0.090 in $+ 0.015$ in (2.3 mm $+ 0.4$ mm). Center of dot (Period) and highest point of the stroke centerline of Comma are aligned vertically and separated: 0.090 in $+ 0.045$ in, $- 0.015$ in (2.3 mm $+ 1.1$ mm, $- 0.4$ mm).
"	0.070 ± 0.015	1.8 ± 0.4	Quotation Marks. Centerline width: 0.070 in ± 0.015 in (1.8 mm ± 0.4 mm).
=	$0.060 + 0.030, - 0.000$	$1.5 + 0.8, - 0.0$	Equals. Overall width: 0.120 in ± 0.030 in (3.0 mm ± 0.8 mm).
<	0.090 ± 0.030	2.3 ± 0.8	Less Than. Centerline width: 0.090 in ± 0.030 in (2.3 mm ± 0.8 mm).
>	0.090 ± 0.030	2.3 ± 0.8	Greater Than. Centerline width: 0.090 in ± 0.030 in (2.3 mm ± 0.8 mm).
^	$0.060 + 0.030, - 0.000$	$1.5 + 0.8, - 0.0$	Circumflex (Logical NOT). Centerline width: 0.120 in ± 0.030 in (3.0 mm ± 0.8 mm).
—	One stroke width		Underline. Overall width: 0.120 in ± 0.030 in (3.0 mm ± 0.8 mm).
▬			Character Erase. $\geq 3/4$ of a character space blackened. (In some applications, a complete and clean erasure is permitted.)
▬▬▬			Group Erase. ≥ 2 horizontal lines connecting ≥ 3 adjacent characters.
Character Space			No mark on paper in one or more consecutive character spaces.

mm). For the Period and all symbols containing a dot, the interior of the loop may be filled in or not.

3.8 Character Separation for OCR

3.8.1 Horizontal Character Separation. Adjacent characters shall be separated by a blank area of at least the width specified here. The width of this blank area is measured as the horizontal distance between the leftmost point on the right character and rightmost point on the left character of an adjacent character pair. For the Numeric subsets this minimum separation is 0.040 inch (1.0 mm). For all other subsets it is 0.050 inch

(1.3 mm). For exceptions, see 3.11.

3.8.2 Horizontal Character Pitch. The maximum horizontal character pitch for OCR purposes shall be 5 characters per inch (25.4 mm) for the Numeric subsets and 4 characters per inch (25.4 mm) for all other subsets.

3.8.3 Line Spacing. The maximum line density for OCR purposes shall be 3 lines per inch (25.4 mm) for Numeric and Alphanumeric subsets and 2 lines per inch (25.4 mm) for all other subsets.

3.9 Clear Areas for OCR. "Clear" signifies the absence of material which is visible to the OCR scanner.

3.9.1 The Clear Band is that area surrounding the guidelines, and including the character space, which shall be left clear except for the intended handprinted characters. For the Numeric and Alphanumeric subsets, the Clear Band shall have a height of 0.333 inch (8.5 mm), centered on the character space. For all other subsets, the height shall be 0.500 inch (12.5 mm).

3.9.2 The Clear Space is the horizontal area which is required to be "clear" between the starting and ending vertical guidelines when changing from one of the subsets to another subset or to non-OCR readable material. The Clear Space shall be at least 0.300 inch (7.5 mm).

3.9.3 For exceptions to 3.9.1 and 3.9.2, see 3.11.

3.10 Preprinted Guidelines for OCR. Preprinted guidelines are usually required for OCR applications. The shapes and dimensions of two recommended forms of preprinted guidelines are given in Section A1 of Appendix A. The detailed structure and spectral response of preprinted guidelines are left to the discretion of the user or equipment manufacturer with the provision that, when used, the specifications given in 3.10.1 through 3.10.3 are adhered to.¹

3.10.1 The basic structure shall include horizontal and vertical lines or line segments.

3.10.2 The horizontal and vertical line segments shall be parallel or perpendicular to the aligning edge of the document. The specification of which edge is the aligning edge and the tolerance to which parallelism is to be maintained are matters for agreement between user and OCR manufacturer.

3.10.3 The spectral response of the preprinted guidelines shall have essentially the same reflectance as the background of the document in the range of the spectrum employed by the intended OCR equipment. For exceptions, see 3.11.

3.11 Preprinted Machine Reference Marks for OCR. (This material applies to 3.8.1, 3.9.1, 3.9.2, and 3.10.3.) Preprinted machine reference marks are allowed within the Clear Band in applications where document interchangeability between different OCR machines is not required or, if required, is not adversely affected.

3.12 Reproduction of Ideal Character Shapes. When it is deemed desirable for training or other purposes to print ideal handprinted character shapes by machine, these machine-printed shapes shall be obtained by a suitable photographic process from the shapes shown in this standard.

¹ For further discussion on read and nonread OCR inks, refer to American National Standard for Optical Character Recognition (OCR) Inks, ANSI X3.86-1980.

4. Character Repertoires

4.1 Subsets. Fig. 3 and Table 3 show the repertoires for use within the U.S. and for communications with users in foreign countries.

4.1.1 Both U.S. and International repertoires include Numeric, Alphanumeric, and Universal subsets. The U.S. repertoire also includes a subset for use in programming. The larger subsets include all characters of the corresponding smaller subsets.

4.1.2 The Numeric subsets include the digits 0-9, the letter X, Character Erase, Group Erase, and Character Space. For use within the U.S., only the Plain One (**1**) and the Plain Seven (**7**) shall be used. In international use, the Plain One (**1**) can be used in conjunction with the Plain Seven (**7**) or the Bar Seven (**7**); also the Bar Seven (**7**) can be used with the Plain One (**1**) or Flag One (**1**); however, the Flag One (**1**) shall not be used with the Plain Seven (**7**). In summary, the following combinations can be used in international communications: (**1** , **7**) or (**1** , **7**) or (**1** , **7**) or (**1** , **7** , **7**) or (**1** , **1** , **7**), but not (**1** , **7**).

4.1.3 The Alphanumeric subsets include the digits 0-9, the letters A-Z, Plus, Hyphen (Minus), Period (Decimal Point), Comma, Character Erase, Group Erase, and Character Space. The choice of shapes for digits One and Seven is governed by 4.1.2. In international use, national characters may be added as required.

4.1.4 The character shapes shown in Fig. A6 of Appendix A have been included in Table 3 for reference only. (These four symbols were not specified in the standard because it was thought that they could not be distinguished reliably from certain characters in the Universal subset with current OCR technologies.)

4.2 Recommended Usage

4.2.1 No specific meaning is prescribed for any of the graphics in Fig. 1 and Table 3 except that which is understood by the users.

4.2.2 The Numeric and Alphanumeric subsets contain the minimum number of characters required for useful numeric and alphanumeric OCR applications, respectively. For OCR applications that require additional characters, users and manufacturers may agree to add to these subsets characters chosen with discretion from the Universal subset.

4.2.3 The U.S. subset for programming includes symbols required for commonly used programming languages other than those normally programmed in a "conversational" mode. The shapes were designed to facilitate use of OCR equipment.

Table 3
Character Repertoires

Character	International Repertoire						U.S. Repertoire						International Repertoire						U.S. Repertoire					
	Alpha-numeric Subset			Numeric Subset			Alpha-numeric Subset			Universal Subset			Alpha-numeric Subset			Universal Subset			Alpha-numeric Subset			Universal Subset		
	Universal	Alpha-numeric	Numeric	Universal	Alpha-numeric	Numeric	Universal	Alpha-numeric	Numeric	Universal	Alpha-numeric	Numeric	Universal	Alpha-numeric	Numeric	Universal	Alpha-numeric	Numeric	Universal	Alpha-numeric	Numeric	Universal	Alpha-numeric	Numeric
0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	X	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	X	X	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	X	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Character Space	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Character Erase	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Group Erase	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Opening Bracket	X			X									X											
Closing Bracket	X				X									X										
Dumbbell	X			X									X											
Pound Symbol	X				X									X										
Yen Symbol	X			X										X										
Exclamation Point†																								
Up Arrow†																								
Left Arrow†																								
Preprinted Vertical Line†																								

*See 4.1.2.

†Supplemental characters for handprinting. Included for information purposes only.

Continued on next page

Table 3 — Continued

Character	International Repertoire			U.S. Repertoire			International Repertoire			U.S. Repertoire		
	Universal Subset	Alpha-numeric Subset	Numeric Subset	Universal Subset	Alpha-numeric Subset	Numeric Subset	Universal Subset	Alpha-numeric Subset	Numeric Subset	Universal Subset	Alpha-numeric Subset	Programming Subset
\$	X			X				A Umlaut	X			
+	X	X		X	X			E Umlaut	X			
-												
/	X	X		X	X			I Umlaut	X			
=	X	X		X	X			O Umlaut	X			
.	X	X		X	X			U Umlaut	X			
(	X	X		X	X			A Acute	X			
)	X	X		X	X			E Acute	X			
*	X	X		X	X			I Acute	X			
,	X	X		X	X			O Acute	X			
;	X	X		X	X			U Acute	X			
'	X	X		X	X			A Grave	X			
^	X	X		X	X			F Grave	X			
~	X	X		X	X			I Grave	X			
%	X	X		X	X			O Grave	X			
:	X	X		X	X			U Grave	X			
:	X	X		X	X			A Circumflex	X			
<	X	X		X	X			F Circumflex	X			
†	X			X				I Circumflex	X			
>	X	X		X	X			O Circumflex	X			
<	X	X		X	X			U Circumflex	X			
-	X	X		X	X			A Angstrom	X			
?	X	X		X	X			O Oersted	X			
@	X	X		X	X			C Cedilla	X			
#	X	X		X	X			N Tilde	X			
~	X	X		X	X			S Sharp	X			
/	X	X		X	X							

0 1 2 3 4 5 6 7 8 9 X ~~3 4 5~~

Numeric Subset

0 1 2 3 4 5 6 7 8 9 A B C D E F G H I J
K L M N O P Q R S T U V W X Y Z + - . ,
~~3 4 5~~

Alphanumeric Subset

0 1 2 3 4 5 6 7 8 9 A B C D E F G H I J
K L M N O P Q R S T U V W X Y Z + - . ,
~~3 4 5~~ ! " # \$ % & ' () * / : ; <
= > ? @ \ ^ _

Programming Subset

0 1 2 3 4 5 6 7 8 9 A B C D E F G H I J
K L M N O P Q R S T U V W X Y Z + - . ,
~~3 4 5~~ ! " # \$ % & ' () * / : ; <
= > ? @ \ ^ _ [] ¡ ¢ £ ¤ ¥ ¦ § ¨
© ª « ¬ ® ¯ ° ± ² ³ ´ µ ¶ · ¸ ¹ º » ¼ ½ ¾

Universal Subset

NOTE: Scale approximately 1:1.

Fig. 3
U.S. Character Repertoires

Appendixes (These Appendixes are not a part of American National Standard X3.45-1982, but are included for information purposes only.)

Appendix A

Design Considerations

A1. Preprinted Guidelines for OCR

A1.1 Purpose of Guidelines. It is usually required that preprinted guidelines be used when printing for OCR systems in order to aid in achieving the character shapes and sizes which are shown in this standard.

A1.2 Color of Guidelines. The color with which guidelines are printed is neither specified nor recommended. To do otherwise would, in effect, restrict the choice of critical components of the optical system. (See 3.10.3.)¹

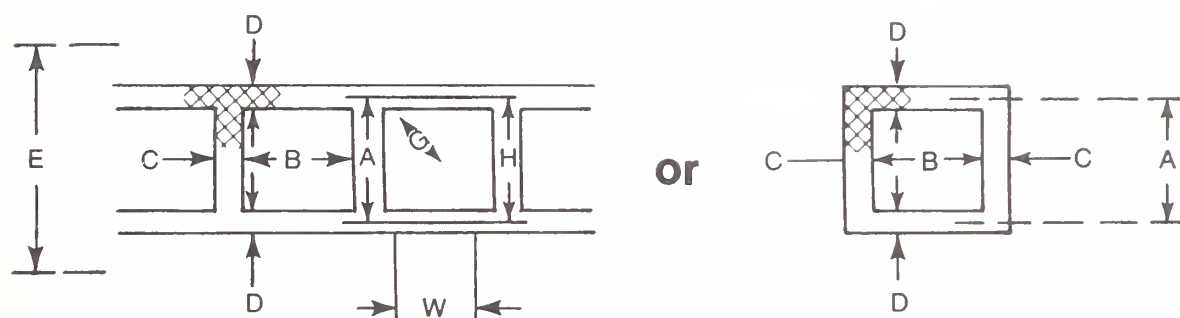
A1.3 Examples of Guidelines. Two examples of guide-

lines are given in A1.3.1 and A1.3.2. These are shown for illustrative purposes only, and there is no intention to preclude the usage of any other guideline which meets the requirements of the standard.

A1.3.1 Guideline Example – Railroad-Track Type. See Fig. A1, A2, and A3 for the dimensions of railroad-track-type guidelines and character placement for the Numeric subsets (Fig. A1), Alphanumeric subsets (Fig. A2), and the Programming and Universal subsets (Fig. A3).

The ideal placement of the characters is shown in Fig. A1. The horizontal reference lines shown in Fig. A1 represent the centerlines of the horizontal elements of

¹ For further discussion on read and nonread OCR inks, refer to ANSI X3.86-1980.



Parameters	Dimensions	
	Thousandths of an Inch (Mils)	mm
Guidelines		
A Centerline height	180	4.5
B Inside width	160	4.0
C Vertical guideline width	≥ 40	≥ 1.0
D Horizontal guideline width	20-40	0.5-1.0
E Clear Band	≥ 333	≥ 8.5
- Clear Space (see 3.9.2)	≥ 300	≥ 7.5
Characters		
H Centerline height	180 ± 40	4.5 ± 1.0
W Centerline width (except Number 1)	≥ 90	≥ 2.3
- Maximum overall width	160	4.0
G Gap	≥ 40	≥ 1.0

NOTE: Scale approximately 4:1.

Fig. A1
Railroad-Track-Type Guidelines for Numeric Subsets

the railroad-track-type guidelines. Each alphanumeric character of full height is centered in its character space, the vertical extremities of the character stroke centerlines are located along the centerline of the horizontal elements of the guidelines, and the entire width of the character is contained inside the area defined by the vertical elements of the guidelines.

A1.3.2 Guideline Example – Box Type. See Fig. A4 and A5 for the dimensions of box-type guidelines and character placement for the Numeric subsets and the Alphanumeric subsets, respectively. The ideal placement of the characters is shown in Fig. A4. Each character of full height is centered in its character space; the entire character is contained within the area defined by the horizontal and vertical elements of the box-type guidelines.

A2. Additional Character Shapes

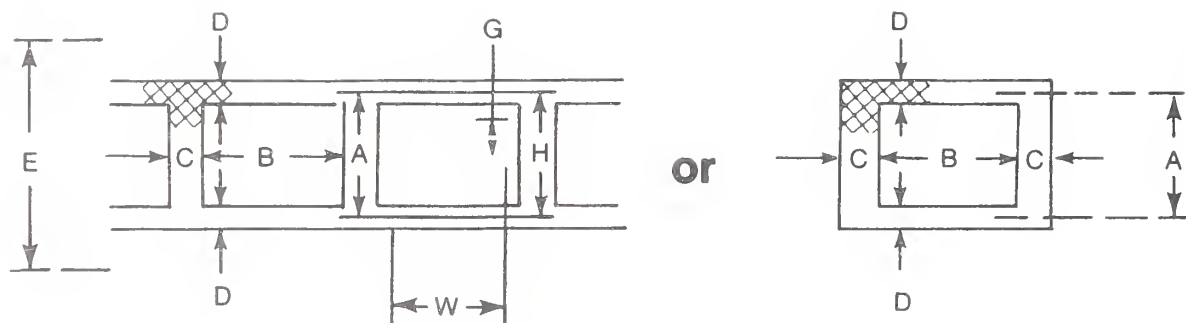
Four additional character shapes are shown in Fig. A6. These four symbols are not specified in this standard

because they cannot be distinguished reliably from certain other characters with current OCR technologies.

A3. Notes on Character Shapes

A3.1 Aids for Character Formation. Table A1 is included to assist the user in printing the characters to conform as nearly as possible to the ideal shapes.

In addition to the characters described in Table A1, the Universal subsets include twenty-five national characters which are used for handprinting in languages other than English. Twenty-two of these are conventional uppercase characters with a superimposed accent mark. It is permissible for the accents, except for the Umlaut and Tilde, to touch the top of the character. Where the character to be accented is the letter O, the tail should not be included, for example, \hat{O} . One national symbol, Ç (C-Cedilla), has the touching accent below the character. The remaining characters are the Ø (Oersted) – an untailed O with an overall diagonal



Parameters	Dimensions	
	Thousandths of an Inch (Mils)	mm
Guidelines		
A Centerline height	180	4.5
B Inside width	200	5.0
C Vertical Guideline width	≥ 50	≥ 1.3
D Horizontal guideline width	20-40	0.5-1.0
E Clear Band	≥ 333	≥ 8.5
- Clear Space (see 3.9.2)	≥ 300	≥ 7.5
Characters		
H Centerline height	180 ± 40	4.5 ± 1.0
W Centerline width (except Number 1 and special symbols)	≥ 90	≥ 2.3
- Maximum overall width	200	5.0
G Gap	≥ 40	≥ 1.0

NOTE: Scale approximately 4:1.

Fig. A2
Railroad-Track-Type Guidelines for Alphanumeric Subsets

stroke — and the β (S Sharp), which must be drawn with large, open gaps to avoid confusion with a B.

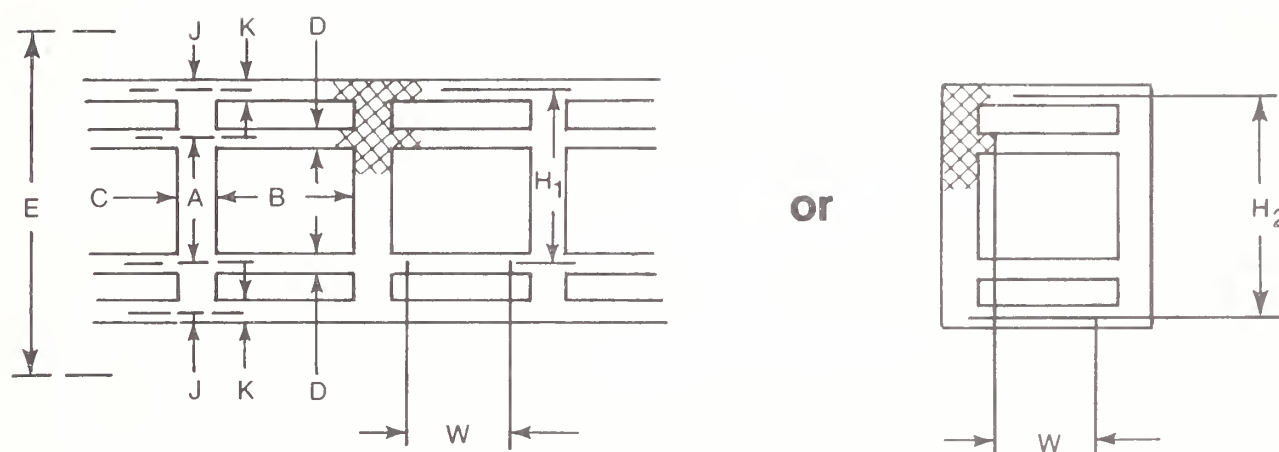
A3.2 Allowable Variations of Character Shapes. Since the characters which are the subject of this standard are printed by hand, the specifications are deliberately written in a somewhat loose and not completely precise manner. The main idea is to achieve a reasonable degree of control without imposing unduly on the skill or patience of the person who is printing.

Where the specifications are stated qualitatively (for example, “a straight line should be drawn as straight as practical”), the intent is to have the printer exercise enough control so that the characters are reasonably neat in appearance, but are not necessarily of a quality which one would expect from a draftsman. Where the specifications are stated quantitatively (for example,

“minimum character centerline height of 0.140 inch and a maximum character centerline height of 0.220 inch”), the intent is to allow for a reasonable variation from the intended nominal value rather than to control the precise dimensions of the character with machine tool precision.

Generally, the main objective is to provide a guide for the user so that he will be able to tell when an overall improvement in neatness, size regulation, or character placement is needed. The standard can be used to indicate when a character is in flagrant violation of the intended shape or size. However, it is not the purpose of this standard to provide a sufficiently precise description of the allowable variations so that all individual characters can be unequivocally said to qualify or not.

It is to be emphasized in the design of forms or



Parameters	Dimensions	
	Thousandths of an Inch (Mils)	mm
Guidelines		
A Inner track centerline height	180	4.5
B Inside width	200	5.0
C Vertical guideline width	≥ 50	≥ 1.3
D Inner track guideline width	20-40	0.5-1.0
E Clear Band	≥ 500	≥ 12.5
— Clear Space (see 3.9.2)	≥ 300	≥ 7.5
J Extension centerline height	70	1.8
K Outer track guideline width	15-30	0.4-0.8
Characters		
H ₁ Centerline height (accented characters)	250 ± 40	6.3 ± 1.0
H ₂ Centerline height (overtall characters)	320 ± 40	8.0 ± 1.0
W Centerline width	≥ 90	≥ 2.3
— Maximum overall width	200	5.0

NOTE: Scale approximately 4:1.

Fig. A3
Railroad-Track-Type Guidelines for Programming and Universal Subsets

guidelines or when giving instructions to the printer that the objective is to achieve the printing of characters which are as close as is reasonable to the nominal values given. Tolerances on the character height, for example, are given to allow the printer to deviate somewhat from the nominal objective which he is trying to achieve and not for the purpose of using different nominal character heights in different applications. In order to illustrate that the tolerances given in the standard do not unduly limit the printer, some examples of characters printed over the tolerance range of some of the parameters are shown in Fig. A7.

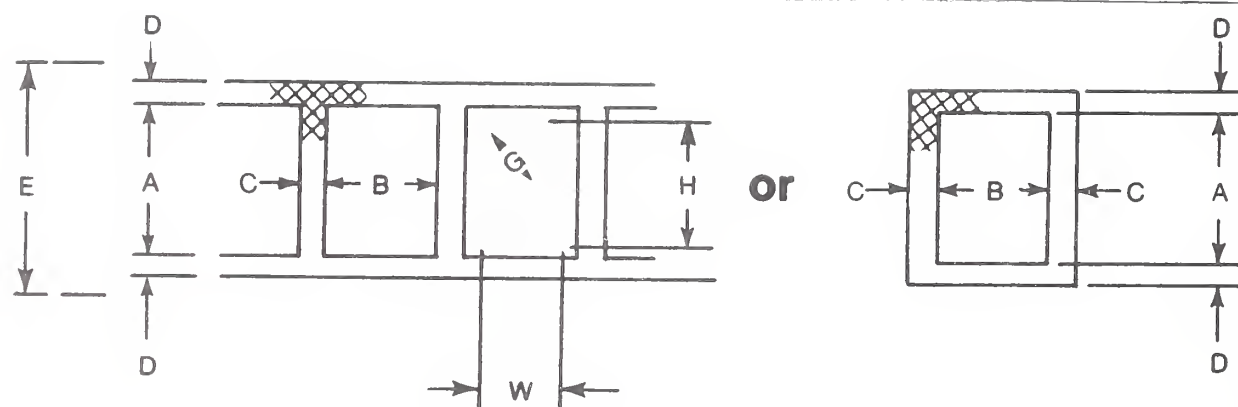
A4. Correspondence to the ASCII Code Table

Fig. A8 is included to indicate a correspondence between the character shapes of this standard and those

graphics used in Section 2 of American National Standard Code for Information Interchange, ANSI X3.4-1977. There is not an exact one-to-one correspondence between these two sets and, as a result, Fig. A8 includes blank positions and some positions with more than a single entry.

In four positions of Fig. A8 there are supplemental characters. Alternative character shapes are provided to facilitate usage for specific purposes as suggested in the note of 5.3 of ANSI X3.4-1977. In three of these four cases one of the alternate characters is from the supplemental set mentioned in Section A2. In the case of code position 2/0, the symbol $\frac{1}{2}$ and the Character Space are both suggested as acceptable graphics.

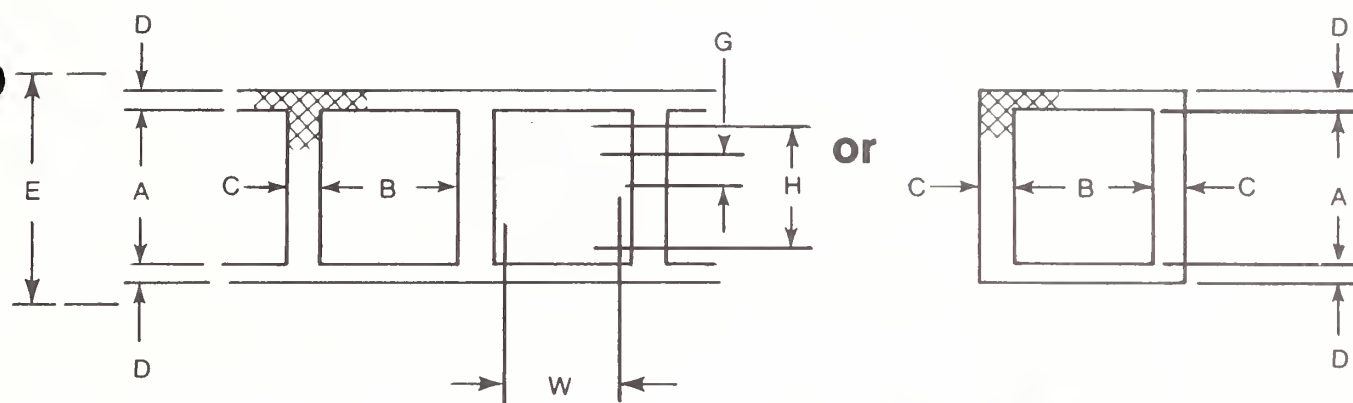
Fig. A8 is given as an example and for reference purposes only, and no specific correspondence is prescribed between the characters of this standard and those of ANSI X3.4-1977 other than that which is understood by the users.



Parameters	Dimensions	
	Thousandths of an Inch (Mils)	mm
Preprinted Guidelines		
A Inside height	220	5.5
B Inside width	160	4.0
C Vertical guideline width	≥ 40	≥ 1.0
D Horizontal guideline width	20-40	0.5-1.0
E Clear Band	≥ 333	≥ 8.5
- Clear Space (see 3.9.2)	≥ 300	≥ 7.5
Characters		
H Centerline height	180 ± 40	4.5 ± 1.0
W Centerline width (except Number 1)	≥ 90	≥ 2.3
- Maximum overall width	160	4.0
G Gap	≥ 40	≥ 1.0

NOTE: Scale approximately 4:1.

Fig. A4
Box-Type Guidelines for Numeric Subsets



Parameters	Dimensions	
	Thousandths of an Inch (Mils)	mm
Preprinted Guidelines		
A Inside height	220	5.5
B Inside width	200	5.0
C Vertical guideline width	≥ 50	≥ 1.3
D Horizontal guideline width	20-40	0.5-1.0
F Clear Band	≥ 333	≥ 8.5
G Clear Space (see 3.9.2)	≥ 300	≥ 7.5
Characters		
H Centerline height	180 ± 40	4.5 ± 1.0
W Centerline width (except Number 1 and special symbols)	≥ 90	≥ 2.3
Maximum overall width	200	5.0
G Gap	≥ 40	≥ 1.0

NOTE: Scale approximately 4:1.

Fig. A5
Box-Type Guidelines for Alphanumeric Subsets

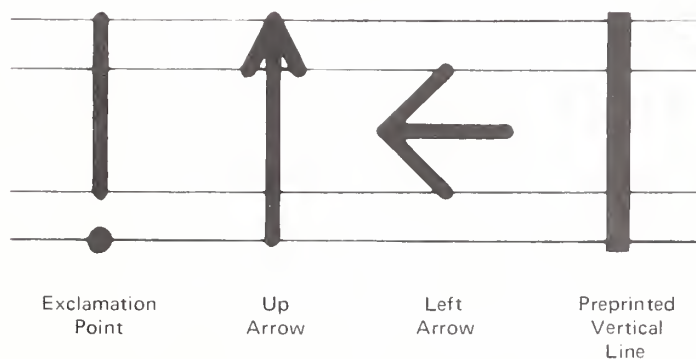



























Fig. A6
Supplemental Characters for Handprinting

Table A1
Suggested Handprinting Procedures

Shape	Name	Notes
0	Number 0	Full-height closed ellipse. Don't skimp height or width. No gap or overlap at closure.
1	Number 1 (Plain 1)	A single vertical stroke.
2	Number 2	Bottom angle must be acute. Bottom line flat.
3	Number 3	Approximately equal horseshoes meeting in a horizontal line.
4	Number 4	All square corners. Bar halfway up and good extension to the right. Top open.
5	Number 5	Top flat and connected. Corner square. Both gaps as large as practical.
6	Number 6	Upper end of vertical stroke points up and does not extend beyond left or right edges of loop. Loop is about half height and turns down to meet vertical stroke.
7	Number 7 (Plain 7)	Two straight lines. Slanted stroke does not extend beyond horizontal stroke.
8	Number 8	Equal loops with crossover at right angles. No gap or overlap at closure.
9	Number 9	Lower end of vertical stroke points down and does not extend beyond left or right edges of loop. Loop is about half height and turns up to meet vertical stroke.
A	Letter A	Symmetrical. Top pointed and closed.
B	Letter B	Large horizontal serifs. Semicircular loops meet on vertical stroke.
C	Letter C	Approximately three-quarters of an ellipse with ends in vertical alignment.
D	Letter D	Large horizontal serifs.
E	Letter E	Square corners. Substantially full-width horizontal lines, equally spaced.
F	Letter F	See Letter E.
G	Letter G	Horizontal serif approximately halfway up and bisected by vertical stroke. (The vertical stroke is an aid to obtaining a proper horizontal serif. It is not required for OCR purposes and may be omitted if the horizontal serif is placed as shown in Fig. 1.)
H	Letter H	Connected horizontal and vertical strokes. Don't skimp on width.
I	Letter I	Large symmetrical serifs top and bottom.
J	Letter J	Large symmetrical serif. Hook is approximately one-third character height with vertical end.
K	Letter K	Slant strokes meet vertical at same point approximately halfway up and ends are in vertical alignment.
L	Letter L	Square corner. Don't skimp on horizontal length.
M	Letter M	Approximately equal slopes and lengths for all strokes.
N	Letter N	Don't skimp on width.

Continued on next page

Table A1 – Continued

Shape	Name	Notes
	Letter O	Large tail ends before center of loop and has equal portions inside and outside of loop.
	Letter P	No serifs. Ends of loop are horizontal. Loop is about half height.
	Letter Q	Large tail ends before center of loop and has equal portions inside and outside of loop.
	Letter R	Like P. Slant and loop meet vertical at same point approximately halfway up. Slant end does not extend beyond loop.
	Letter S	Large serif should extend below rest of character.
	Letter T	Vertical bisects horizontal with no gap or crossover.
	Letter U	Square corners.
	Letter V	Bottom pointed and closed. Straight sides.
	Letter W	Approximately equal slopes and lengths for all strokes.
	Letter X	Straight, equal legs crossing in middle.
	Letter Y	Three equal strokes. Bottom stroke vertical.
	Letter Z	Full-width center bar.
	Plus	About half-height character with equal legs at right angles and centered in character space.
	Hyphen (Minus)	Centered, normal-character-width horizontal stroke.
	Period	On baseline, circle about one-quarter character height in diameter which need not be filled in.
	Comma	Bisected by baseline. Straight line; no dot.
	Blank	Like lowercase <i>b</i> with diagonal crossbar. Same height as accented characters.
	Long Vertical Mark (Logical OR)	Long vertical line with centered short crossbar.
	Quotation Marks	Small inverted U above character tops.
	Number Sign	Keep lines separated. Maintain open areas.
	Dollar Sign	No serif on conventional S shape. Maintain open areas.
	Percent	Loops not connected to diagonal and not filled in.
	Ampersand	Don't use figure Eight ampersand shape.
	Apostrophe	Same shape as Comma.
	Opening Parenthesis	Overall smooth curve, centered in box.

Continued on next page

Table A1 -- *Continued*

Shape	Name	Notes
)	Closing Parenthesis	Overtall smooth curve, centered in box.
*	Asterisk	An X with horizontal bar. Use only three intersecting strokes.
/	Slant	Overtall diagonal line.
:	Colon	Top period centered in box. Lower period on baseline. Neither period need be filled in.
;	Semicolon	Period is centered in box, comma is below baseline. Period need not be filled in.
<	Less Than	Half-size centered character.
=	Equals	Keep lines separated and wide.
>	Greater Than	Half-size centered character. Should not look like small Seven.
?	Question Mark	Overtall character. Period need not be filled in.
@	Commercial "At"	Lowercase "a" is half-size character.
\	Reverse Slant	Overtall, diagonal line.
^	Circumflex (Logical NOT)	Centered half-size character.
_	Underline	Like minus sign below baseline. Not to be used as continuous underscore.
[	Opening Bracket	Overtall character, centered. Square corners. Substantial horizontal strokes.
]	Closing Bracket	See Opening Bracket.
o	Dumbbell	Overtall character, with loops approximately one-quarter character height, which must not be filled in.
l	Number 1 (Flag 1)	Flag must be at least two-thirds length of vertical, at least 2:1 slope.
7	Number 7 (Bar 7)	Three straight lines. Slanted stroke does not extend beyond horizontal stroke. Full-width bar.
£	Pound (currency)	Overtall character. Crossbar is approximately halfway up. Lower loop must not be filled in. Should not look like E.
¥	Yen	Overtall character with a single crossbar, approximately centered, between the baseline and junction of the Y.
!	Exclamation Point	Overtall character with bar ending on baseline. Period need not be filled in.
↑	Up Arrow	Overtall character with large barbs.
←	Left Arrow	Full-height and -width character. Large barbs.
|	Preprinted Vertical Line	Overtall character or taller. No limit on vertical extent.
||||	Character Erase	Blacken at least three-quarters of the space of the character to be erased. Five or more vertical lines may be used.
===	Group Erase	Two or more horizontal lines connecting three or more adjacent characters, approximately centered vertically.



NOTE: Scale approximately 4:1 and 1:1.

Aspect Ratio	Line	Line Width
2.4/1	Top line	0.010 in (0.25 mm)
1.2/1	Middle line	0.020 in (0.5 mm)
0.8/1	Bottom line	0.040 in (1.0 mm)

Fig. A7
Examples of Allowable Line Variations in
Aspect Ratio and Line Width

COLUMN ROW	0	1	2	3	4	5	6	7
0			¢ or SP	0	@	P		
1			! [⊙]	1	A	Q		
2			π	2	B	R		
3			#	3	C	S		
4			\$	4	D	T		
5			%	5	E	U		
6			£	6	F	V		
7			'	7	G	W		
8			(	8	H	X		
9			)	9	I	Y		
10			*	:	J	Z		
11		⌋	+	;	K	[
12			,	<	L	\		+ or [⊙]
13			-	=	M]		
14			.	>	N	^ or ↑ [⊙]		
15			/	?	Ø	_ or ← [⊙]		CE or GE

Legend

- SP Character Space
- CE Character Erase
- GE Group Erase
- ⊙ Supplemental characters (see Fig. A6)

Fig. A8
Correspondence between Handprinted Character Set and ASCII Code Table

Appendix B

Criteria for Character Shape Development

B1. Development History

The development of this standard was initiated in 1965. One of the first tasks of the then Working Group was to survey existing practices in the data processing community. Accordingly, a press release was published in several technical journals, announcing the formation of the Working Group and soliciting comment. More than twenty responses indicated a community desire for such a standard. Subsequent extensive circulations of successive drafts, both within the United States and in Europe and Japan, have resulted in many constructive comments and strong expressions of interest.

B2. Character Design Selection Criteria

B2.1 Characters should be prepared using the fewest number of strokes compatible with legibility, uniqueness, and understanding. A stroke made with a straight line is counted as ending when direction is changed or line is broken. A stroke made with a curved line is counted as ending when direction is abruptly changed or line is broken.

B2.2 Fluidity of movement of the writing implement is desirable.

B2.3 Characters should resemble standard lettering (see American National Standard Line Conventions and Lettering, ANSI Y14.2M-1979), customary writing and lettering practices, and printed characters where possible. Optical Character Recognition efforts should be recognized and considered.

B2.4 Characters which require a mark or other special characteristic to insure identification should be of the same subset. For this purpose, only the alphabetic characters will be marked.

B2.5 For characters of similar design, the techniques used to aid identification will be similar for the sake of consistency.

B2.6 Underlines, overlines, and extraneous diagonals or bars will be avoided unless there is an overriding de facto standard or consensus to the contrary.

B3. Resolution of the Zero and Letter Oh Problem

B3.1 A majority of the respondents to the original sur-

vey reported they used a diagonal slash (Virgule) superimposed on the letter to distinguish it from Zero. This, in itself, did not seem conclusive. For one thing, the communications community (as distinct from data processing) was felt to favor the slashed Zero. Many different conventions were proposed for distinguishing these two characters. Indeed, the problem was frequently discussed in the literature. Programmers accustomed to use of business-type languages seemed to favor marking the Zero. Those using mathematical- or scientific-type languages conversely favored marking the letter. Most respondents qualified their comments to indicate that, while they used a certain convention locally, they would favor a standard of *any* convention.

B3.2 The following basic rules were agreed upon:

(1) The shape of the basic graphic "O" must be maintained as in everyday usage (no teardrop, etc).

(2) An extra identifying feature will be added to the basic shape to facilitate discrimination.

(3) The Oh, rather than the Zero, should have any extra feature.

B3.3 The Oh was chosen for accent out of consideration for the user. In most applications, the Zero appears more frequently, so this character was left simple, placing a minimum burden on the user. The final choice of "O" for Oh was considered the most easily learned, easily made, and easily read alternative.

B3.4 Many excellent character shapes were suggested and considered for the Oh. These shapes and the committee's conclusions are as follows:

- Ⓚ Too many strokes, do not want to go inside continuous characters.
- ⓐ Susceptible to noise or clutter in OCRs.
- ⓧ Too busy, too many strokes.
- ⓐ Too hard to make.
- ⓐ Possible conflict with an 8 or B, too much variability with dash.
- ⓐ Cursive character, loop too variable, possible conflict with an 8 or 6.
- ⓐ Danger of a detached bar, slanted bar confused with 6.

- Q Danger of a detached bar, separation.
- σ Possible conflict with a 6, possible short line would not show, the temptation to form strings, such as \overline{OOO} , which would extend to the next character.
- τ Temptation to form strings, such as \overline{OOO} , which would extend to the previous character; possible short line would not show lines outside box.
- ∅ Conflict with the Oersted and Zero as presently used in communications procedures.
- Q Possible conflict with an 8 or 9. Many individuals have previously been conditioned to make Oh like ∅. Psychological factors indicate it is easier to learn an all-new shape than to change the previously learned ∅ to Q. Also, the Q shape is difficult to form accurately without reducing speed since it involves a reversal of writing direction.
- Q Possible conflict with a 6, if line comes at top of Oh.
- Q The preferred shape — easy to make, minimum conflict, rotational symmetry with the Q which is aesthetically pleasing.

X3.115-1984 Unformatted 80 Megabyte Trident Pack for Use at 370 tpi and 6000 bpi (General, Physical, and Magnetic Characteristics)
X3.117-1984 Printable/Image Areas for Text and Facsimile Communication Equipment
X3.118-1984 Financial Services — Personal Identification Number — PIN Pad
X3.119-1984 Contact Start/Stop Storage Disk, 158361 Flux Transitions per Track, 8.268 Inch (210 mm) Outer Diameter and 3.937 inch (100 mm) Inner Diameter
X3.120-1984 Contact Start/Stop Storage Disk
X3.121-1985 Two-Sided, Double-Density, Unformatted 5.25-inch (130-mm), 48-tpi (1,9-tpmm), Flexible Disk Cartridge for 7958 bpr Use

X11.1-1977 Programming Language MUMPS
IEEE 416-1978 Abbreviated Test Language for All Systems (ATLAS)
IEEE 716-1982 Standard C/ATLAS Language
IEEE 717-1982 Standard C/ATLAS Syntax
IEEE 770X3.97-1983 Programming Language PASCAL
IEEE 771-1980 Guide to the Use of ATLAS
MIL-STD-1815A-1983 Reference Manual for the Ada Programming Language

X3/TRI-82 Dictionary for Information Processing Systems (Technical Report)

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American National Standards for Information Processing

- X3.1-1976** Synchronous Signaling Rates for Data Transmission
- X3.2-1970** Print Specifications for Magnetic Ink Character Recognition
- X3.4-1977** Code for Information Interchange
- X3.5-1970** Flowchart Symbols and Their Usage
- X3.6-1965** Perforated Tape Code
- X3.9-1978** Programming Language FORTRAN
- X3.11-1969** General Purpose Paper Cards
- X3.14-1983** Recorded Magnetic Tape (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
- X3.17-1981** Character Set for Optical Character Recognition (OCR-A)
- X3.18-1974** One-Inch Perforated Paper Tape
- X3.19-1974** Eleven-Sixteenths-Inch Perforated Paper Tape
- X3.20-1967** Take-Up Reels for One-Inch Perforated Tape
- X3.21-1967** Rectangular Holes in Twelve-Row Punched Cards
- X3.22-1983** Recorded Magnetic Tape (800 CPI, NRZI)
- X3.23-1974** Programming Language COBOL
- 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
- 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
- X3.31-1973** Structure for the Identification of the Counties of the United States
- 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
- 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** Identification of States of the United States (Including the District of Columbia)
- X3.39-1973** Recorded Magnetic Tape (1600 CPI, PE)
- X3.40-1983** Unrecorded Magnetic Tape (9-Track 800 CPI, NRZI; 1600 CPI, PE; and 6250 CPI, GCR)
- 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
- X3.43-1977** Representations of Local Time of the Day
- X3.44-1974** Determination of the Performance of Data Communication Systems
- X3.45-1982** 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 (3.810-mm [0.150-Inch] Tape at 32 bps [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
- 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 (6250 CPI, Group Coded Recording)
- X3.55-1982** Unrecorded Magnetic Tape Cartridge, 0.250 Inch (6.30 mm), 1600 bpi (63 bps), Phase encoded
- X3.56-1977** Recorded Magnetic Tape Cartridge, 4 Track, 0.250 Inch (6.30 mm), 1600 bpi (63 bps), Phase Encoded
- X3.57-1977** Structure for Formatting Message Headings 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, 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
- X3.62-1979** Paper Used in Optical Character Recognition (OCR) Systems
- X3.63-1981** Unrecorded Twelve-Disk Pack (100 Megabytes) (General, Physical, and Magnetic Requirements)
- 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, 4 Track, 0.250 Inch (6.30 mm), 1600 bpi (63 bps), 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
- X3.76-1981** Unformatted Single-Disk Cartridge (Top Loading, 200 tpi 4400 bpi) (General, Physical, and Magnetic Requirements)
- X3.77-1980** Representation of Pocket Select Characters
- X3.78-1981** Representation of Vertical Carriage Positioning 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
- X3.84-1981** Unformatted Twelve-Disk Pack (200 Megabytes) (General, Physical, and Magnetic Requirements)
- X3.85-1981** 1/2-Inch Magnetic Tape Interchange Using a Self Loading Cartridge
- 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)
- X3.91M-1982** Storage Module Interfaces
- X3.92-1981** Data Encryption Algorithm
- X3.93M-1981** OCR Character Positioning
- X3.95-1982** Microprocessors — Hexadecimal Input/Output, Using 5-Bit and 7-Bit Teleprinters
- X3.96-1983** Continuous Business Forms (Single-Part)
- X3.98-1983** Text Information Interchange in Page Image Format (PIF)
- X3.99-1983** Print Quality Guideline for Optical Character Recognition (OCR)
- X3.100-1983** Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment for Packet Mode Operation with Packet Switched Data Communications Network
- X3.101-1984** Interfaces Between Rigid Disk Drive(s) and Host(s)
- X3.102-1983** Data Communication Systems and Services — User-Oriented Performance Parameters
- X3.103-1983** Unrecorded Magnetic Tape Minicassette for Information Interchange, Coplanar 3.81 mm (0.150 in)
- X3.104-1983** Recorded Magnetic Tape Minicassette for Information Interchange, Coplanar 3.81 mm (0.150 in), Phase Encoded
- X3.105-1983** Data Link Encryption
- X3.106-1983** Modes of Operation for the Data Encryption Algorithm
- X3.110-1983** Videotex/Teletext Presentation Level Protocol Syntax
- X3.112-1984** 14-in (356-mm) Diameter Low-Surface-Friction Magnetic Storage Disk
- X3.114-1984** Alphanumeric Machines; Coded Character Sets for Keyboard Arrangements in ANSI X4.23-1982 and X4.22-1983

(continued on reverse)