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Contents

1	Introduction	1
2	Symbol Description	
2.1	Symbol Structure	1
2.2	Symbol Character Encodation	1
2.3	Start and Stop Character	1
2.4	Quiet Zones	1
2.5	Symbol Length	2
2.6	Symbol Height	2
2.7	Check Character	2
2.8	Transmitted Data	2
3	Symbol Quality	3
3.1	Additional Pass/Fail Parameters	3
3.2	Traditional Measurements	3
4	Reference Decode Algorithm	3
Appendix A (Informative)		
	Autodiscrimination Compatibility	4
Appendix B (Informative)		
	Human Readable Interpretation	4
Appendix C (Informative)		
	Systems Considerations	
C.1	System Components	4
C.2	X Dimension	4
C.3	Specular Reflectance	4
C.4	Printing Considerations	5
C.5	Other Considerations	5
Appendix D (Informative)		
	Traditional Measurements	
D.1	Dimensional Print Tolerances	5
D.2	Visual Inspection	5
Appendix E (Informative)		
	Optional Characteristics	7
E.1	Append	7
E.2	Full ASCII Mode	7
E.3	Check Character	7
	AIM Glossary of Terms	8
	Reference Documents	10

1 Introduction

Code 39 (also called Code 3-of-9) is a bar code symbology with a full alphanumeric character set, a unique start/stop character and seven additional characters. Each Code 39 character has three wide elements out of a total of nine elements. The nine elements consist of five bars and four spaces. The characteristics of Code 39 are summarized in Table 1.

2 Symbol Description

2.1 Symbol Structure

Every Code 39 symbol consists of a leading quiet zone, a start symbol character, symbol characters representing data, a stop symbol character and a trailing quiet zone.

Figure 1 illustrates a complete symbol encoding the data "IA" in Code 39.

2.2 Symbol Character Encodation

Each Code 39 symbol consists of a series of symbol characters, each represented by five bars and the four intervening spaces. Characters are separated by an intercharacter gap. Figure 2 illustrates the character "A" encoded in Code 39, showing intercharacter gaps.

Each element (bar or space) is one of two widths, referred to as "wide" and "narrow." The narrow element width is referred to as the X dimension. The ratio of the wide to narrow element widths is referred to as N. The values of X and N remain constant throughout the symbol.

The particular pattern of wide and narrow elements determines the character being encoded. Every character consists of three wide and six narrow elements.

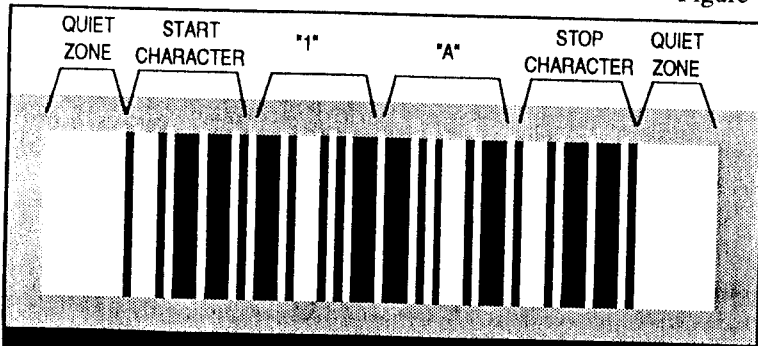


Figure 1: Code 39 Symbol Structure

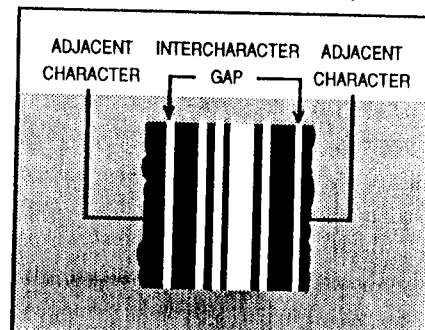


Figure 2: Code 39 "A" With Intercharacter Gaps

Encodable Character Set	All 36 Alphanumeric Seven Additional Characters - . SPACE \$ / + %
Code Type	Discrete
Elements per Symbol Character	9 (5 bars, 4 spaces)
Modules per Symbol Character	13-16 (inclusive of minimum intercharacter gap, depending on wide-to-narrow ratio)
Representative Data Character Density	6.25 CPI (based on X = 0.010 inch (0.25 mm), N = 3:1)
Non-Data Overhead	Equivalent to 2 symbol characters
Character Self-Checking	Yes
Symbol Length	Variable
Symbol Check Character	One, Optional (see Appendix E.3)
Bidirectionally Decodable	Yes
Options	Full ASCII Mode Message Append

Table 1: Code 39 Characteristics

Table 2 defines all of the Code 39 character assignments.

The intercharacter gaps are spaces with a minimum nominal width of 1X.

2.3 Start and Stop Character

The unique start/stop character is used to identify the leading and trailing ends of the bar code symbol. This symbol character shall be used only at the beginning and end of the symbol. Figure 1 illustrates the start/stop character in a complete bar code symbol.

2.4 Quiet Zones

Quiet zones are spaces preceding the start character and following the stop character. Quiet zones should be at least 10X wide each.

Figure 1 illustrates a complete bar code symbol

showing the necessary quiet zones.

2.5 Symbol Length

The physical length of a Code 39 symbol, including quiet zones, is given in Formula 1.

2.6 Symbol Height

For general application the minimum bar height of Code 39 symbols should be 0.2 inch (5 mm) or 15 percent of the symbol length, whichever is greater.

2.7 Check Character

A check character is not required for Code 39. However, the use of a check character significantly enhances data security. Appendix E.3 defines the check character position and calculation.

2.8 Transmitted Data

2.8.1 Decoded Data

When decoding Code 39 symbols, a bar code reader does not transmit the start and stop characters. All data characters are transmitted. The check character (if present) may be transmitted.

There are 36 two-character symbols which are reserved for use as control symbols. Both characters in control symbols are from the set + - . / % and \$. Readers may be programmed to respond to these symbols by performing system-specific functions, and the literal translation of these symbols will not be transmitted.

An optional mode provides for Code 39 to encode the full 128-character ASCII set. See Appendix E.2.

2.8.2 Symbology Identifier

The AIM USA Symbology Identifier Guideline provides a uniform methodology for reporting the symbology read, options set in the reader and any special features of the symbology encountered. Readers may be programmed to add the three-character symbology identifier prefix to the data message.

The symbology identifier for Code 39 is:

JAm

where:

J is the symbology identifier flag character (ASCII 93)

A is the symbology identification character for Code 39

m is the modifier character

Char.	Encodation Pattern	bsbsbsbsb	ASCII
0		000110100	48
1		100100001	49
2		001100001	50
3		101100000	51
4		000110001	52
5		100110000	53
6		001110000	54
7		000100101	55
8		100100100	56
9		001100100	57
A		100001001	65
B		001001001	66
C		101001000	67
D		000011001	68
E		100011000	69
F		001011000	70
G		000001101	71
H		100001100	72
I		001001100	73
J		000011100	74
K		100000011	75
L		001000011	76
M		101000010	77
N		000010011	78
O		100010010	79
P		001010010	80
Q		000000111	81
R		100000110	82
S		001000110	83
T		000010110	84
U		110000001	85
V		011000001	86
W		111000000	87
X		010010001	88
Y		110010000	89
Z		011010000	90
-		010000101	45
.		110000100	46
SPACE		011000100	32
\$		010101000	36
/		010100010	47
+		010001010	43
%		000101010	37
S/S		010010100	none

Note: "S/S" denotes special Code 39 Start and Stop Character .

Note: In the columns headed "b" and "s" 1 is used to represent a wide element and 0 is used to represent a narrow element.

Table 2: Code 39 Symbol Character Set

$$L = (3N+6)(C+2)X + (C+1)I + 2Q$$

where:

L = Length of symbol, including quiet zones

N = Wide-to-narrow ratio

C = Number of data message characters (including check character if used)

X = Narrow element width

I = Width of intercharacter gap $\geq 1X$

Q = Width of quiet zone $\geq 10X$

Formula 1: Code 39 Length Calculation

Option values for Code 39 are listed in Table 3. The sum of all appropriate option values is the modifier character *m*.

Option Value	Option
0	No check character and no full ASCII processing
1	Reader has validated the check character
2	Reader has stripped the check character before transmission
4	Reader has performed full ASCII character conversion

(Permissible values of *m*: 0, 1, 3, 4, 5, 7)

Table 3: Symbology Identifier Option Values for Code 39

3 Symbol Quality

The document, ANSI X3.182 "Bar Code Print Quality – Guideline," presents a standardized methodology for measuring and grading bar code symbols. Code 39 symbols shall be evaluated according to that document.

Section 4 describes the reference decode algorithm that shall be used for evaluating the parameters "decode" and "decodability." Code 39 test scans shall be graded using this algorithm.

3.1 Additional Pass/Fail Parameters

The ANSI print quality guideline allows for additional pass/fail criteria to be stipulated by a symbology specification. For Code 39, additional criteria for each scan profile are given below. Any individual scan reflectance profile which does not meet the requirements below shall receive a grade of "F" or "0" (zero).

3.1.1 Wide-to-Narrow Ratio

The measured value of *N* in any scan profile shall be in the range 1.8 to 3.4 inclusive. The nominal *N* for all symbols shall be 2.0 to 3.0 inclusive. For symbols with a nominal *X* dimension less than 0.020 inches (0.508 mm), the nominal *N* should be at least 2.5.

*Note: it is difficult to achieve satisfactory decoding performance with *N* less than 2.2. A nominal *N* of 3.0 is recommended.*

3.1.2 Intercharacter Gap

For symbols with an average measured narrow element width, *Z*, less than 0.0113 inch (0.287 mm), the maximum allowed intercharacter gap is 5.3*Z*. For symbols with *Z* greater than or equal to 0.0113 inch (0.287 mm), the maximum intercharacter gap is the greater of 3*Z* or 0.060 inch (1.52 mm).

3.1.3 Quiet Zone

The quiet zone at each end of the symbol shall be a minimum of 10*Z*, where *Z* is the average measured narrow element width.

3.2 Traditional Measurements

Since dimensional tolerances have historic precedence, they are described in Appendix D. Other printing guidance is also included in Appendices C and D.

4 Reference Decode Algorithm

This section describes the reference decode algorithm used in the computation of decodability when assessing the symbol quality using the method described in ANSI X3.182, "Bar Code Print Quality – Guideline." The algorithm was also used to derive the traditional tolerance, *t*, presented in Appendix D.1.

For Code 39, the reference decode algorithm is as follows:

1. Confirm presence of a leading quiet zone.
2. For each character:
 - a. Measure the total character width, *S*.
 - b. Compute the threshold value, $T = S/8$.
 - c. Compare each element width for that character to the value *T*: if element width is greater than *T*, assume element is wide, otherwise assume the element is narrow.
 - d. Determine if pattern of wide and narrow elements matches a valid character from the allowable set.
3. The first character read must be a start/stop character, from which the scan direction can be deduced.
4. Continue character reading until a valid start/stop character is encountered.
5. Confirm presence of a trailing quiet zone.
6. Perform such other secondary checks on quiet zones, intercharacter gaps, acceleration, absolute

timing counts, and so forth, as are deemed prudent and appropriate considering the specific reading device and intended application environment.

Appendix A (Informative) *Autodiscrimination Compatibility*

Some readers may be programmed to automatically discriminate among symbols encoded in other symbologies. Code 39 is compatible for use in an autodiscrimination environment with any of the following symbologies:

- Codabar
- Code 128
- Code 16K
- Code 49
- Code 93
- EAN
- Interleaved 2-of-5
- U.P.C.

When Code 39 is used in an autodiscrimination environment with Interleaved 2-of-5 symbols, the following guidelines should be followed:

1. The nominal intercharacter gaps in the Code 39 symbols should be no wider than the narrow elements.
2. The reading system should be constrained and the decoder programmed to ensure that the number of characters (including start and stop characters) in all Code 39 symbols be greater than one-half the number of data characters in the Interleaved 2-of-5 symbols.

It is advisable to limit the reader's valid set of symbologies and symbol lengths to those needed by a given application in order to maximize reading security.

Appendix B (Informative) *Human Readable Interpretation*

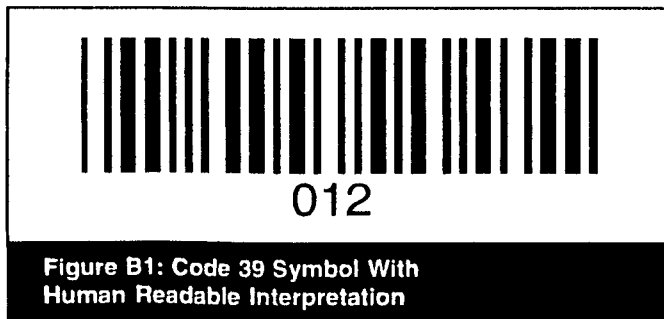


Figure B1: Code 39 Symbol With Human Readable Interpretation

A human readable interpretation of the data characters (and check character, if used) is generally printed along with the Code 39 symbol encoding them. Character size and font are not specified, and the message may be printed anywhere in the area surrounding the symbol, as long as quiet zone boundaries are not violated (see Section 3).

The human readable interpretation of the start/stop character is often represented as an asterisk. However, because of the potential confusion of this character with a data character it is recommended that a human readable interpretation of the start/stop character not be printed.

Figure B1 illustrates a typical Code 39 symbol incorporating human readable text.

Appendix C (Informative) *Systems Considerations*

C.1 System Components

It is important that the various components (printers, labels, readers) making up a bar code installation operate together as a system. A failure in any component, or a mismatch between them, can compromise the performance of the overall system.

When both readers and printers are specified by a single user or by cooperative agreement (closed system), symbology parameters can be allowed to deviate from those stated in this document. The characteristics of the printer, symbol, and reader must still be matched to achieve desired performance. Deviations should only be considered where standard specifications do not yield acceptable results.

C.2 X Dimension

Historically, the minimum X dimension for open systems was 0.0075 inches (0.191mm). When creating symbols where there is no existing application standard and the scanning environment is not known, X dimensions less than 0.0075 inches (0.191mm) may not be readable.

C.3 Specular Reflectance

The effects of specular (mirror-like) reflections from shiny symbol surfaces must be considered. Standard scanning systems are designed to detect variations in diffuse reflection between bars and

spaces. At some scanning angles, the specular component of the reflected light can greatly exceed the desired diffuse component, which reduces reading performance. Matte (non-glossy) finishes minimize this effect.

In cases where specular reflection effects are used to achieve the desired contrasts (as in some forms of printing or etching directly onto metal), extreme care must be exercised to assure that the optical properties are within specifications over the entire range of scanning angles and distances required by the particular application.

C.4 Printing Considerations

Graphics software used to create bar codes on pixel-based printers must scale each bar and space exactly to the pixel pitch of the printer being used.

For two-width symbologies, the number of pixels assigned to each element should be chosen to come the closest to achieving the nominal widths.

For edge-to-edge decodable symbologies, the number of pixels comprising each symbol character must be an integer multiple of the number of modules for each symbol character. Any compensation for uniform bar growth or shrinkage must be in equal offsetting amounts on all bars and spaces in the symbol.

Failure to follow these procedures often results in unreadable symbols.

C.5 Other Considerations

Compliance with specifications is one key to assuring overall system success but other considerations come into play which can influence performance as well. The following guidelines suggest some factors to keep in mind when specifying or implementing bar code systems:

1. Choose a symbology and print density which yield tolerance values which can be achieved by the printing technology to be used.
2. Choose a reader with resolution suitable for the symbol density and quality produced by the printing technology.
3. Be certain that the printed symbol's optical properties are compatible with the wavelength of the scanner's light source.
4. Be sure to verify symbol specification compliance in the final label or package configuration. Overlays, show-through, and curved or irregular surfaces can all affect symbol

readability.

5. Bar height should generally be set at the highest value that is practical given label, package, and printing technology constraints.

6. The system should be programmed to accept only the bar code symbol message lengths and formats expected in that application.

Appendix D (Informative)

Traditional Measurements

D.1 Dimensional Print Tolerances

The tolerance, or maximum allowable element width deviation from nominal, is constant for any given symbol and is designated by "t." This tolerance is defined in Formula D1.

Section 4 describes the reference decode algorithm used in the derivation of Formula D1.

Historically, a bar code symbol was required to have every element's width differ from its nominal

$$t = \pm (4/27)(N-(2/3))X$$

where:

N = Wide-to-narrow ratio

X = Narrow element width

Formula D1: Code 39 Tolerances

value by not more than the tolerance distance. Further, these errors should not accumulate within a single character. The sum of the widths of any number of adjacent elements within any character shall not deviate from nominal by more than 2t.

D.2 Visual Inspection

Visual methods are often used as a rough check of print quality and dimensions. However, the position of an edge as seen visually and as measured with an aperture differs. This difference remains relatively constant regardless of X dimension and, therefore, is proportionately larger for smaller X dimensions.

Visual inspection does not provide a quantitative measurement of other symbol characteristics such as spots, voids, effects caused by edge roughness, and bar and space reflectance variation.

In general, visual inspection can not guarantee that the symbol will pass a given grade level for a particular measuring aperture. However, visual

measurement will provide the best correspondence to an aperture measurement if the following criteria are met.

1. The substrate, inks, and printing process has previously been determined by other means to provide a reflectivity difference well in excess of that required. A reference symbol will be maintained for comparison for later steps. If a range of symbol contrast is expected due to reusable ribbons or other process variations, then a

previously tested set of symbols which cover that range should be available for comparison.

2. The symbol visually conforms to the bar and space reflectance difference and the reflectance uniformity between and within bars and spaces of a previously tested reference symbol from the same process.

3. The symbol contains no visible spots or voids. It also contains no edge irregularities beyond those in the reference symbol.

ASCII VALUE	ASCII CHAR.	CODE 39	ASCII VALUE	ASCII CHAR.	CODE 39	ASCII VALUE	ASCII CHAR.	CODE 39	ASCII VALUE	ASCII CHAR.	CODE 39
0	NUL	%U	32	SP	SPACE	64	@	%V	96	'	%W
1	SOH	\$A	33	!	/A	65	A	A	97	a	+A
2	STX	\$B	34	"	/B	66	B	B	98	b	+B
3	ETX	\$C	35	#	/C	67	C	C	99	c	+C
4	EOT	\$D	36	\$	/D	68	D	D	100	d	+D
5	ENQ	\$E	37	%	/E	69	E	E	101	e	+E
6	ACK	\$F	38	&	/F	70	F	F	102	f	+F
7	BEL	\$G	39	'	/G	71	G	G	103	g	+G
8	BS	\$H	40	(	/H	72	H	H	104	h	+H
9	HT	\$I	41	)	/I	73	I	I	105	i	+I
10	LF	\$J	42	*	/J	74	J	J	106	j	+J
11	VT	\$K	43	+	/K	75	K	K	107	k	+K
12	FF	\$L	44	,	/L	76	L	L	108	l	+L
13	CR	\$M	45	-	-	77	M	M	109	m	+M
14	SO	\$N	46	.	.	78	N	N	110	n	+N
15	SI	\$O	47	/	/O	79	O	O	111	o	+O
16	DLE	\$P	48	0	0	80	P	P	112	p	+P
17	DC1	\$Q	49	1	1	81	Q	Q	113	q	+Q
18	DC2	\$R	50	2	2	82	R	R	114	r	+R
19	DC3	\$S	51	3	3	83	S	S	115	s	+S
20	DC4	\$T	52	4	4	84	T	T	116	t	+T
21	NAK	\$U	53	5	5	85	U	U	117	u	+U
22	SYN	\$V	54	6	6	86	V	V	118	v	+V
23	ETB	\$W	55	7	7	87	W	W	119	w	+W
24	CAN	\$X	56	8	8	88	X	X	120	x	+X
25	EM	\$Y	57	9	9	89	Y	Y	121	y	+Y
26	SUB	\$Z	58	:	/Z	90	Z	Z	122	z	+Z
27	ESC	%A	59	;	%F	91	[	%K	123	{	%P
28	FS	%B	60	<	%G	92	\	%L	124	|	%Q
29	GS	%C	61	=	%H	93	]	%M	125	}	%R
30	RS	%D	62	>	%I	94	^	%N	126	~	%S
31	US	%E	63	?	%J	95	_	%O	127	DEL	%T, %X, %Y, %Z

Table E1: Encoding the Full 128 Character ASCII Set in Code 39

4. The dimensional tolerances defined in Appendix D.1 are met for all bars and spaces.

If the above criteria are met, and an appropriate aperture and wavelength are used, the symbol will generally meet or exceed a C grade for symbols with an X dimension greater than 0.010 inch (0.25 mm).

Appendix E (Informative)

Optional Characteristics

Readers can be programmed to respond to Code 39 symbols in non-standard ways to satisfy particular application requirements. Three such schemes are presented below: append, full ASCII, and check character. Since use of these features requires special reader programming, they are not recommended for general applications where there would exist the possibility of ambiguity of interpretation with standard Code 39 symbols. Other AIM USA symbologies (Code 128, Code 93, Code 49 and Code 16K) offer these features as part of their standard definition.

E.1 Append

It is sometimes advantageous to break up long messages into multiple, shorter symbols. If the first data character of a Code 39 symbol is a SPACE, the reader may be programmed to append the data following the space to a storage buffer. This operation continues for all successive Code 39 symbols with a leading SPACE, with messages being added to the end of previously stored ones. When a Code 39 message is read which does not contain a leading SPACE, the contents are appended to the buffer, the entire buffer is transmitted, and the buffer is cleared.

E.2 Full ASCII Mode

For closed systems it is possible to encode the entire ASCII character set (128 characters) by using two character sequences made up of one of the four Code 39 characters \$ + % / followed by one of the 26 letters, as shown in Table E1. Note that the characters follow the standard order of ASCII characters.

In order to decode full ASCII mode symbols, a suitably programmed reader is required. Such a reader may misinterpret standard Code 39 symbols. This is because a reader cannot determine in which mode the symbol was encoded.

E.3 Check Character

For applications requiring enhanced data security, a modulo 43 symbol check character should be used. Note that a symbol check character option can be used with the full ASCII and append options. The check character is determined as follows:

1. Assign a numerical value to each data character in the symbol as shown in Table E2.
2. Sum the numerical values for all of the data characters, and divide the sum by 43.
3. The remainder obtained in Step 2 is the value of the check character, shown in Table E2.

Example E1 shows the calculation of the check character for the message "CODE 39" in Code 39.

CHAR. VALUE	CHAR. VALUE	CHAR. VALUE
0 0	F 15	U 30
1 1	G 16	V 31
2 2	H 17	W 32
3 3	I 18	X 33
4 4	J 19	Y 34
5 5	K 20	Z 35
6 6	L 21	- 36
7 7	M 22	. 37
8 8	N 23	SPACE 38
9 9	O 24	\$ 39
A 10	P 25	/ 40
B 11	Q 26	+ 41
C 12	R 27	% 42
D 13	S 28	
E 14	T 29	

Table E2: Character Values for Modulo 43 Check Character Calculation for Code 39

For the data message "CODE 39"
 C=12, O=24, D=13, E=14, SPACE=38, 3=3, 9=9
 $12 + 24 + 13 + 14 + 38 + 3 + 9 = 113$
 $113/43 = 2$ with a remainder of 27
 27 = R
 Resultant data with check character:
 "CODE 39R"

Example E1: Code 39 Check Character Calculation

AIM Glossary of Terms

- ABC Codabar** — A variation of Codabar symbology, developed by the American Blood Commission for blood labeling, that incorporates a unique field concatenation capability based on patterns of start and stop codes in adjacent bar code symbols.
- Alphanumeric** — The character set which contains the letters A-Z and numbers 0-9.
- ANSI** — The American National Standards Institute, a non-governmental organization responsible for the development of voluntary industry standards.
- Aperture** — The effective opening in an optical system (scanner) that establishes the field of view.
- ASCII** — The character set and code described in American National Standard Code for Information Interchange, ANSI X3.4. The ASCII character set is used for information interchange between data processing systems, communication systems and associated equipment. The ASCII set consists of 128 characters including both control and printing characters.
- Autodiscrimination** — The ability of bar code reading equipment to recognize and correctly decode more than one symbology.
- Bar** — An element of lower reflectance in a printed bar code symbol.
- Bar Code** — An array of parallel rectangular bars and spaces that together represent data elements or characters in a particular symbology. The bars and spaces are arranged in a predetermined pattern following unambiguous rules defined by the symbology.
- Bar Height** — The dimension of a bar measured perpendicular to the bar width.
- Bidirectionally Decodable** — A bar code symbology capable of being read successfully independent of scanning direction.
- Character**
- Data Character** — A letter, digit or other member of the ASCII character set.
- Symbol Character** — A unique bar and/or space pattern which is defined for that symbology. There is not necessarily a one-to-one or unique correlation between symbol characters and data characters. Depending on the symbology, symbol characters may have a unique associated symbol value.
- Character Self-Checking** — The feature which allows a bar code reader to determine if a scanned group of elements is a valid symbol character. If a symbology is described as being character self-checking, a single printing defect (edge error) in any symbol character does not produce another valid character.
- Character Set** — Those characters available for encodation in a particular automatic identification technology.
- Check Character** — A character included within a symbol whose value is used for the purpose of performing a mathematical check to ensure the symbol has been decoded correctly.
- Check Digit** — See "Check Character."
- Clear Area** — See "Quiet Zone."
- Code Set** — The specific assignment of data characters to symbol characters.
- Continuous Code** — A bar code symbology where all spaces within the symbol are parts of characters, e.g., Interleaved 2-of-5. There is no intercharacter gap in a continuous bar code symbology.
- CPI** — Characters per inch (see "Density").
- Data Character** — See "Character."
- Decoder** — As part of a bar code reading system, the electronic package which receives the signals from the scanner, performs the algorithm to interpret the signals into meaningful data and provides the interface to other devices.
- Density** — The number of data characters which can be represented in a linear unit of measure. Bar code density is often expressed in characters per inch (CPI).
- Diffuse Reflection** — The component of reflected light which emanates in all directions from the reflecting surface.
- Discrete Code** — A bar code symbology where the spaces between characters (intercharacter gaps) are not part of the code, e.g., Code 39.
- Edge-to-Edge Symbologies** — A bar code symbology which can be decoded using edge-to-similar-edge measurements, such as from the start of one bar to the start of another or from the end of one bar to the end of another. Such symbologies are relatively insensitive to uniform bar growth or shrinkage. Code 93, Code 128, Code 49, and Code 16K are examples of edge-to-edge symbologies.
- Element** — A single bar or space.
- Element Width** — The thickness of an element measured from the edge closest to the symbol start character to the trailing edge of the same element.
- Extended ASCII** — Those characters represented

by values 128-255. These values represent different character sets, called Code Pages, in different computer systems. Code Pages are defined in the ISO 8859 standard.

Font — A specific size and style of type.

Human Readable Interpretation — The letters, digits or other characters associated with specific symbol characters and printed along with the bar code symbol.

Informative — Information provided as guidance but which is not part of the standard. See also "Normative."

Intercharacter Gap — The space between two adjacent bar code characters in a discrete code. For example, the space between characters in Code 39.

ISBT 128 — A variation of Code 128 symbology, developed by the International Society for Blood Transfusion for blood labeling, that incorporates a unique field concatenation capability based on specific data characters contained in adjacent symbols.

Module — The narrowest nominal width unit of measure in a symbol. One or more modules are used to construct an element.

Modulo — An arithmetic operation in which the result is the remainder after division.

Multi-Row Symbology — Symbologies where a long symbol is broken into sections and "stacked" one upon another similar to sentences in a paragraph, e.g., Code 16K and Code 49.

N — The wide-to-narrow element width ratio for two-width symbologies.

Nominal — The intended value for a specified parameter. Tolerances are specified as positive and negative deviations from this value.

Normative — Information which is part of the standard. See also "Informative."

Numeric — A character set that includes only the numbers 0-9.

Overhead — In a bar code system, the fixed number of characters required for start, stop and checking in a given symbol. For example, a symbol requiring a start/stop and two check characters contains four characters of overhead. Thus, to encode three characters, seven characters are required to be printed.

Quiet Zone — Spaces preceding the start character of a symbol and following the stop character. Sometimes called the "Clear Area."

Reader — A device comprised of a scanner and a decoder.

Reflectance — The measure of the amount of light reflected from an illuminated surface.

Resolution — In a bar code system, the narrowest element dimension which can be distinguished by a particular reading device or printed with a particular device or method.

Scanner — An electronic device to acquire and convert reflected light from the bars and spaces of a symbol into electrical signals for processing by the decoder.

Scan Profile — A record of the reflectance measured as a function of position during a scan across the entire bar code symbol.

Show-Through — The generally undesirable property of a substrate that permits underlying markings to be seen. This may adversely affect reader performance.

Space — An element of higher reflectance in a bar code symbol.

Spectral Band — The range of acceptable wavelengths of light, stated in nanometers, used by scanners or verification devices.

Specular Reflection — The mirror-like reflection of light from a surface where the angle of incidence equals the angle of reflection.

Spot — The undesirable presence of an area of low reflectance in a space.

Stacked Codes — See "Multi-row Symbology."

Start-Stop Character or Pattern — Special bar code patterns that indicate the ends of the symbol as well as scan direction. The start character is normally at the left-hand end of a horizontally oriented symbol. The stop character is normally at the right-hand end of a horizontally oriented symbol.

Symbol — A combination of bar code characters including start/stop characters, quiet zones, data characters, and check characters required by a particular symbology, which forms a complete, scannable entity.

Symbology — A specific bar code "language." Nine symbologies are defined below.

Codabar — A mostly-numeric bar code symbology. See AIM Uniform Symbology Specification for Codabar.

Code 128 — A full ASCII bar code symbology capable of encoding all 128 ASCII characters as well as the extended ASCII characters. See AIM Uniform Symbology Specification for Code 128.

Code 16K — A full ASCII, multi-row bar code symbology capable of encoding all 128 ASCII

characters. See AIM Uniform Symbology Specification for Code 16K.

Code 39 — (3 of 9 Code) A full alphanumeric bar code symbology. See AIM Uniform Symbology Specification for Code 39.

Code 49 — A full alphanumeric, multi-row bar code symbology capable of encoding all 128 ASCII characters. See AIM Uniform Symbology Specification for Code 49.

Code 93 — A full alphanumeric bar code symbology capable of encoding all 128 ASCII characters. See AIM Uniform Symbology Specification for Code 93.

EAN — A numeric bar code symbology that is the international standard for bar code identification goods that will be scanned at point-of-sale. Similar to U.P.C.

Interleaved Two-of-Five — (I-2/5, ITF) A numeric bar code symbology. See AIM Uniform Symbology Specification for Interleaved 2-of-5.

U.P.C. — Universal Product Code, a numeric bar code symbology (administered by the Uniform Code Council) that is the North American standard for bar code identification of goods that will be scanned at point-of-sale. Similar to EAN.

Symbology Identifier — An optional three character code which may prefix transmitted data from a bar code reader indicating the symbology read and any options enabled in the reader or special features of a symbology encountered (e.g., presence of FNC 1 in Code 128).

Two-Width Symbology — A bar code symbology whose bars and spaces are characterized simply as "wide" or "narrow." Codabar, Code 39, and Interleaved 2-of-5 are examples of two-width symbologies.

Void — The undesirable presence of an area of high reflectance in a bar.

"X" Dimension — The nominal dimension of the narrow bars and spaces in a bar code symbol.

"Z" Dimension — The average measured width dimension of the narrow bars and spaces in a bar code symbol.

Z — $((\text{average narrow bar}) + (\text{average narrow space})) / 2$.

Reference Documents

AIM USA "Guidelines on Symbology Identifiers" (Item X-50)
 AIM USA Code 49 Developers Diskette (Item Z-40)
 AIM USA "Uniform Symbology Specifications" Interleaved 2-of-5 (Item X5-1)
 Code 39 (Item X5-2)
 Codabar (Item X5-3)
 Code 128 (Item X5-4)
 Code 93 (Item X5-5)
 Code 16K (Item X5-6)
 Code 49 (Item X5-7)

Available from:
 AIM USA
 634 Alpha Drive
 Pittsburgh, PA 15238-2802
 Phone: 412-963-8588
 Fax: 412 963 8753

ANSI X3.182, "Bar Code Print Quality — Guideline"

Available from:
 The American National Standards Institute
 11 West 42nd St., 13th Floor
 New York, NY 10036
 Phone: 212-642-4900
 Fax: 212 398 0023
Also available from AIM USA (address above).

CEN Specifications

Available from:
 Commission for European Normalization
 36 Rue de Stassart
 B-1050 Bruxelles
 Belgium
 Phone: 32 2 519 6811
 Fax: 32 2 519 6819

EAN Specifications

Available from:
 EAN International
 Rue Royale 29
 B-1000 Bruxelles
 Belgium
 Phone: 32 2 218 76 74
 Fax: 322 218 75 85
Also available from EAN National Authorities around the world and from AIM USA (address above).

**ISBT 128 Symbology and Application
Specification**

Available from:

American Association of Blood Banks,
Regulatory Affairs Department
8101 Glenbrook Road
Bethesda, MD 20814
Phone: 301-215-6489
Fax: 301 907 6895

**ISO 8859 Information Processing: 8-bit Code
Processing Character Set**

Parts 1-4 Latin

Part 5 Latin and Cyrillic

Part 6 Latin and Arabic

Part 7 Latin and Greek

Part 8 Latin and Hebrew

Part 9 Latin Alphabet #5

Available from:

The American National Standards Institute
11 West 42nd St., 13th Floor
New York, NY 10036
Phone: 212-642-4900
Fax: 212 398 0023

U.P.C. Specifications

Available from:

The Uniform Code Council
8163 Old Yankee Road, Suite J
Dayton, OH 45458
Phone: 513-435-3870
Fax: 513 435 4749