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Information technology — Automatic identification and data capture techniques — Bar code symbology specifications — Code 39

Technologies de l'information — Techniques automatiques d'identification et de capture des données — Spécifications des symbologies des codes à barres — Code 39

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Contents

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 16388 was prepared by BSI and was adopted, under a special "fast-track procedure", by Joint Technical Committee ISO/IEC JTC 1, *Information technology,* in parallel with its approval by national bodies of ISO and IEC.

Annexes A to D of this International Standard are for information only.

Introduction

The technology of bar coding is based on the recognition of patterns encoded in bars and spaces of defined dimensions. There is a number of methods of encoding information in bar code form, known as symbologies, and the rules defining the translation of characters into bar and space patterns and other essential features are known as the symbology specification. Code 39 is one such symbology.

Previously, symbology specifications have been developed and published by a number of organizations, resulting in certain instances in conflicting requirements for certain symbologies.

Manufacturers of bar code equipment and users of bar code technology require publicly available standard symbology specifications to which they can refer when developing equipment and application standards.

Information technology — Automatic identification and data capture techniques — Bar code symbology specifications — Code 39

1 Scope

This International Standard specifies the requirements for the bar code symbology known as Code 39; it specifies Code 39 symbology characteristics, data character encodation, dimensions, tolerances, decoding algorithms and application-defined parameters.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 646:1983, *Information technology — ISO 7-bit coded character set for information interchange.*

ISO 7064:1983, *Data processing — Check character systems.*

ISO/IEC 15416, *Automatic identification and data capture techniques — Bar code print quality test specification — Linear symbols.*

ISO/IEC 15424, *Automatic identification and data capture techniques — Data carrier/symbology identifiers.*

EN 1556:1997, *Bar Coding — Terminology.*

3 Definitions

For the purposes of this International Standard, the definitions given in EN 1556 apply.

4 Requirements

4.1 Symbology characteristics

The characteristics of Code 39 are:

a) Encodable character set:

   1) Full alphanumeric A to Z and 0 to 9 (ASCII characters 65 to 90 and 48 to 57 inclusive, in accordance with ISO 646);

   2) special characters: space $ % + - . / (ASCII characters 32, 36, 37, 43, 45, 46 and 47 respectively, in accordance with ISO 646);

   3) start/stop character;

b) Code type: discrete;

c) Elements per symbol character: 9, of which 3 wide and 6 narrow, comprising 5 bars and 4 spaces;

d) Character self-checking: yes;

e) Data string length encodable: variable;

f) Bidirectionally decodable: yes;

g) Symbol check character: one, optional (see annex A);

h) Symbol character density: 13 to 16 modules per symbol character, inclusive of minimum intercharacter gap, depending on wide/narrow ratio;

i) Non-data overhead: equivalent to 2 symbol characters.

4.2 Symbol structure

As illustrated in Figure 1, Code 39 symbols shall comprise:

a) leading quiet zone;

b) start character;

c) one or more symbol characters representing data (including symbol check character, if present);

d) stop character;

e) trailing quiet zone.

A space, the intercharacter gap, shall separate characters within the symbol.

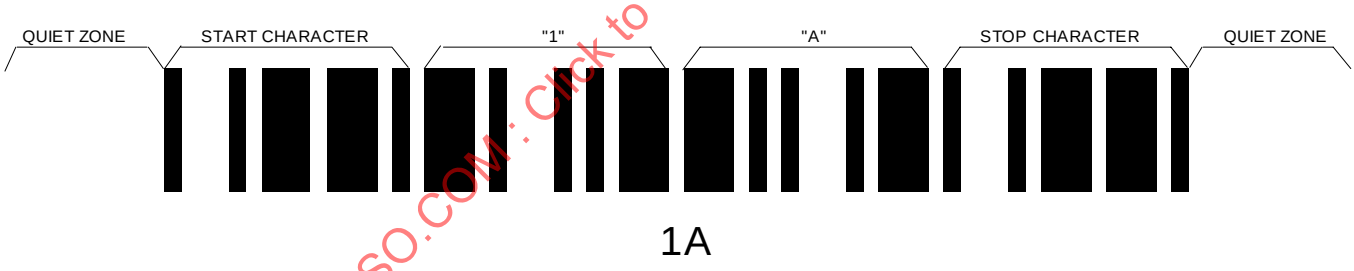


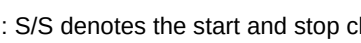
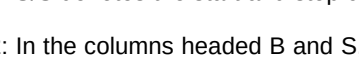
Figure 1 — Code 39 symbol

4.3 Character encodation

4.3.1 Symbol character encodation

Table 1 defines all the Code 39 character assignments.

Table 1 — Code 39 character assignments

Char.	Encodation Pattern	B	S	B	S	B	S	B	S	B	ASCII value
0		0	0	0	1	1	0	1	0	0	48
1		1	0	0	1	0	0	0	0	1	49
2		0	0	1	1	0	0	0	0	1	50
3		1	0	1	1	0	0	0	0	0	51
4		0	0	0	1	1	0	0	0	1	52
5		1	0	0	1	1	0	0	0	0	53
6		0	0	1	1	1	0	0	0	0	54
7		0	0	0	1	0	0	1	0	1	55
8		1	0	0	1	0	0	1	0	0	56
9		0	0	1	1	0	0	1	0	0	57
A		1	0	0	0	0	1	0	0	1	65
B		0	0	1	0	0	1	0	0	1	66
C		1	0	1	0	0	1	0	0	0	67
D		0	0	0	0	1	1	0	0	1	68
E		1	0	0	0	1	1	0	0	0	69
F		0	0	1	0	1	1	0	0	0	70
G		0	0	0	0	0	1	1	0	1	71
H		1	0	0	0	0	1	1	0	0	72
I		0	0	1	0	0	1	1	0	0	73
J		0	0	0	0	1	1	1	0	0	74
K		1	0	0	0	0	0	0	1	1	75
L		0	0	1	0	0	0	0	1	1	76
M		1	0	1	0	0	0	0	1	0	77
N		0	0	0	0	1	0	0	1	1	78
O		1	0	0	0	1	0	0	1	0	79
P		0	0	1	0	1	0	0	1	0	80
Q		0	0	0	0	0	0	1	1	1	81
R		1	0	0	0	0	0	1	1	0	82
S		0	0	1	0	0	0	1	1	0	83
T		0	0	0	0	1	0	1	1	0	84
U		1	1	0	0	0	0	0	0	1	85
V		0	1	1	0	0	0	0	0	1	86
W		1	1	1	0	0	0	0	0	0	87
X		0	1	0	0	1	0	0	0	1	88
Y		1	1	0	0	1	0	0	0	0	89
Z		0	1	1	0	1	0	0	0	0	90
hyphen		0	1	0	0	0	0	1	0	1	45
period		1	1	0	0	0	0	1	0	0	46
space		0	1	1	0	0	0	1	0	0	32
$		0	1	0	1	0	1	0	0	0	36
/		0	1	0	1	0	0	0	1	0	47
+		0	1	0	0	0	1	0	1	0	43
%		0	0	0	1	0	1	0	1	0	37
S/S or *		0	1	0	0	1	0	1	0	0	none

NOTE 1: S/S denotes the start and stop character, also represented as *

NOTE 2: In the columns headed B and S, 0 represents a narrow element and 1 a wide element.

4.3.2 Start and stop characters

The Code 39 start and stop character is usually depicted in human-readable form by a * (asterisk). This character shall not form part of the data encoded elsewhere in the symbol and shall not be transmitted by the decoder.

4.3.3 Optional symbol check character

Annex A defines the check character position and calculation.

4.4 Dimensions

Code 39 symbology shall use the following nominal dimensions:

a) width of narrow element (*X*): the *X* dimension of Code 39 symbols may be defined by the application specification in accordance with the needs of the application in question. See 4.6.1;

b) wide/narrow ratio (*N*): 2,0:1 to 3,0:1;

c) width of intercharacter gap (*I*):

1) minimum: equal to *X*;

2) maximum:

for $X < 0{,}287$ mm: $5{,}3X$;

for $X \geqslant 0{,}287$ mm: 1,52 mm or $3X$, whichever is greater;

d) minimum width of quiet zone: $10X$;

e) recommended minimum bar code height for manual scanning: 5,0 mm or 15 % of symbol width excluding quiet zones, whichever is greater.

NOTE The width, *W* (in millimetres), of a Code 39 symbol, including quiet zones, can be calculated from the following expression:

$$W = (C+2)\,(3N + 6)X + (C+1)I + 2Q$$

where:

— *C* is the number of data characters (including symbol check character if used);

— *N* is the wide/narrow ratio;

— *X* is the width of a narrow element in millimetres;

— *I* is the width of the intercharacter gap in millimetres;

— *Q* is the width of the quiet zone in millimetres.

4.5 Reference decode algorithm

Bar code reading systems are designed to read imperfect symbols to the extent that practical algorithms permit. This section describes the reference decode algorithm used in the computation of the decodability value described in ISO/IEC 15416.

a) confirm presence of a leading quiet zone.

b) for each symbol character (including start and stop characters):

1) measure the total width of 5 bars and 4 spaces; call this *S*.

2) compute a threshold value, $T = S/8$.

3) compare each element width for that character with the value T. If element width is greater than T, assume element is wide; if not, assume element is narrow.

4) determine if pattern of wide and narrow elements matches a valid character from the allowable set.

c) the first symbol character read must be a start/stop character, from which the scan direction can be deduced.

d) continue character reading until a valid start/stop character is encountered.

e) confirm presence of a trailing quiet zone.

4.6 Application-defined parameters

Application standards shall define parameters of Code 39 symbols specified in this International Standard as variable, as follows:

4.6.1 Symbology and dimensional characteristics

In order for a Code 39 symbol to be printed and to be scannable in a given application it is necessary for the following symbology and dimensional parameters to be specified:

a) selection of subset of the encodable character set;

b) the number of data characters in the symbol, which may be fixed, variable or variable up to a defined maximum;

c) whether the modulo 43 symbol check character is to be used (see A.1) and whether it is to be transmitted by the decoder;

d) whether a data check character is to be used and if so the algorithm for its calculation;

e) range of *X* dimension;

f) range of wide/narrow ratio;

g) intercharacter gap;

h) minimum bar height.

NOTE 1 For applications wishing to take advantage of enhanced data security, a symbol check character should be used.

NOTE 2 The wide/narrow ratio should be as high as possible within the range specified in 4.4 b) to maximize reading performance.

An example is given in annex D.

4.6.2 Optical specifications

In order for a bar code symbol to be scannable in a given application, it is necessary to specify certain optical parameters. The selection of the parameters shall be made in the application standard and shall include the specification of:

a) peak response wavelength;

b) spectral half power band width with which the symbol and the scanner should conform;

c) the spot size of the scanner;

d) the parameters for reflectance of the bars and spaces;

e) the conditions under which optical measurements should be made;

f) the extent of permissible imperfections within the bar code symbol.

An example is provided in annex D.

4.6.3 Test specifications

In order to verify whether a symbol meets the specifications in this International Standard it shall be tested using the test specification defined in ISO/IEC 15416, which lays down conditions under which measurements should be made; it defines methods of determining an overall quality grade based on the attributes of the bar code symbol and determining its conformity with this International Standard. This grade shall be expressed in the form:

1,5 / 10 / 660

where 1,5 is the overall symbol quality grade

10 is the measuring aperture reference number (in this example 0,25 mm diameter)

660 is the peak response wavelength in nanometers.

ISO/IEC 15416 allows for additional pass/fail criteria to be stipulated by a symbology specification. For Code 39, the additional criteria are given in 4.6.3.1 to 4.6.3.3. Any individual scan profile which does not meet these requirements shall receive a grade of 0.

NOTE In the following subclauses the requirements are based on the actual, rather than intended, measurements of the parameter; for this reason the *Z* dimension is appropriate rather than the *X* dimension.

4.6.3.1 Wide/narrow ratio

Symbols shall be produced with a nominal *N* from 2,0 to 3,0 inclusive. The measured value of *N* in any scan profile shall be in the range 1,8 to 3,4 inclusive.

4.6.3.2 Intercharacter gap

For symbols with a measured narrow element width (*Z*) less than 0,287 mm, the maximum allowed intercharacter gap is 5,3*Z*. For symbols with *Z* greater than or equal to 0,287 mm, the maximum intercharacter gap is the greater of 3*Z* or 1,52 mm.

4.6.3.3 Quiet zone

The minimum quiet zone at each end of the symbol shall be a minimum of 10*Z*.

Annex A
(informative)
Additional features

A.1 Check character

A.1.1 Symbol check character

For applications requiring enhanced data security, a symbol check character should be used, in which case the symbol check character should be positioned immediately following the final data character and before the stop character. The inclusion of the symbol check character should be determined by the application standard.

When included, the following symbol check character algorithm should be used.

a) Each data character is assigned a numerical value as shown in Table A.1 below.

b) Calculate the sum of the numerical values for all the data characters of a symbol.

c) Divide this sum by 43.

d) The character whose value (from Table A.1) is the remainder from the division in step c) is used as the check character.

Table A.1 — Numerical character values for modulo 43 check

Character	Value		Character	Value		Character	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			

The modulo 43 symbol check character may be transmitted by the decoder.

EXAMPLE: for the data "CODE 39":

Data characters	**C**	**O**	**D**	**E**	**SPACE**	**3**	**9**	
Character Values	12	24	13	14	38	3	9	
Sum of values	113							
Divide by 43		113/43 = 2		remainder 27				
Character value 27 corresponds to	R							
Data with symbol check character	**C**	**O**	**D**	**E**	**SPACE**	**3**	**9**	**R**

A.1.2 Data check character

When transmitted by the decoder, the modulo 43 check character may be used as a data check character.

Alternatively an algorithm as described in ISO 7064, or another algorithm defined in the application specification, may be used to calculate a data check character, provided that suitable provision for its calculation and verification is included in the symbol generation and message processing software. Such a data check character should be the final character of the data string and shall be transmitted by the decoder.

A.2 Human-readable interpretation

A human-readable interpretation of the data characters (and symbol check character, if used) should normally be printed with the Code 39 symbol encoding them. Start/stop characters may be printed. Character size and font are not specified, and the interpretation may be printed anywhere in the area surrounding the symbol, as long as quiet zones are not encroached upon.

A.3 Optional data transmission modes

Decoders may be programmed to respond to Code 39 symbols in non-standard ways to satisfy particular application requirements. Three such schemes are defined below: full ASCII (see A.3.1), message append (see A.3.2) and control functions (see A.3.3). Since the use of these features requires special decoder programming, they are not recommended for general applications, where there could be confusion with standard Code 39 symbols.

A.3.1 Full ASCII

The full 128 character ASCII character set in accordance with ISO 646 may be encoded using combinations of two symbol characters, made up of one of the four characters ($ + % /) followed by one of the 26 alphabetic characters. These combinations are shown in Table A.2. When the full ASCII option is enabled in the decoder, only the ASCII equivalent of the symbol character combinations and not their literal translation should be transmitted.

A.3.2 Message 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 decoder may be programmed to append the information contained in the remainder of the symbol to a storage buffer (data not transmitted). 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 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. Where the sequence of data is significant, provision should be made to ensure reading of the symbols in the correct sequence.

A.3.3 Control functions

An additional system-specific mode is also available, which may be used for closed systems but shall not be used in open systems. By using combinations of two symbol characters from the set ($ % + - . /) (ASCII characters 36, 37, 43, 45, 46, 47), 36 control functions may be programmed into a system. Decoders may be specially programmed to respond to these symbols and perform the defined functions. The literal translation of these character pairs shall not be transmitted and the symbology identifiers (see annex C) shall not be used.

Table A.2 — Encoding the Full ASCII character set in Code 39

ASCII	CODE	ASCII	CODE	ASCII	CODE	ASCII	CODE
NUL	%U	SP	SPACE	@	%V	'	%W
SOH	$A	!	/A	A	A	a	+A
STX	$B	"	/B	B	B	b	+B
ETX	$C	#	/C	C	C	c	+C
EOT	$D	$	/D	D	D	d	+D
ENQ	$E	%	/E	E	E	e	+E
ACK	$F	&	/F	F	F	f	+F
BEL	$G	'	/G	G	G	g	+G
BS	$H	(	/H	H	H	h	+H
HT	$I	)	/I	I	I	i	+I
LF	$J	*	/J	J	J	j	+J
VT	$K	+	/K	K	K	k	+K
FF	$L	,	/L	L	L	l	+L
CR	$M	-	-	M	M	m	+M
SO	$N	.	.	N	N	n	+N
SI	$O	/	/O	O	O	o	+O
DLE	$P	0	0	P	P	p	+P
DC1	$Q	1	1	Q	Q	q	+Q
DC2	$R	2	2	R	R	r	+R
DC3	$S	3	3	S	S	s	+S
DC4	$T	4	4	T	T	t	+T
NAK	$U	5	5	U	U	u	+U
SYN	$V	6	6	V	V	v	+V
ETB	$W	7	7	W	W	w	+W
CAN	$X	8	8	X	X	x	+X
EM	$Y	9	9	Y	Y	y	+Y
SUB	$Z	:	/Z	Z	Z	z	+Z
ESC	%A	;	%F	[	%K	{	%P
FS	%B	<	%G	\	%L	|	%Q
GS	%C	=	%H	]	%M	}	%R
RS	%D	>	%I	^	%N	~	%S
US	%E	?	%J	_	%O	DEL	%T or %X or %Y or %Z