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MILITARY STANDARD

STANDARD SYMBOLOGY FOR MARKING UNIT PACKS, OUTER CONTAINERS, AND SELECTED DOCUMENTS

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AREA PACK

DEPARTMENT OF DEFENSE

WASHINGTON, DC 20402

Standard Symbology for Marking Unit Packs, Outer Containers, and Selected Documents

MIL-STD-1189

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14. ABSTRACT

The purpose of this standard is to define the standard DoD symbology for marking unit packs, outer containers, and selected documents by means of bar coding.

15. SUBJECT TERMS

Barcodes, symbology, logistics, containers, barcoding

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1. SCOPE

1.1 Purpose. The purpose of this standard is to define the standard DOD symbology for marking unit packs, outer containers, and selected documents by means of bar coding.

1.2 Application. The standard DOD symbology shall be used whenever bar code marking/reading operations are employed within logistics operations.

2. REFERENCED DOCUMENTS

FIPS PUB 32 - Character Set and Print Quality for Optical Character Recognition (OCR-A).

3. DEFINITIONS

3.1 Bar - the darker element of a bar code.

3.2 Bar code - an array of rectangular marks and spaces in a predetermined pattern.

3.3 Bidirectional code - a bar code format which permits reading in complementary (opposite) directions across the bars and spaces.

3.4 Binary - pertaining to a characteristic or property involving a selection, choice, or condition in which there are two possibilities.

3.5 Binary code - a code which makes use of exactly two distinct characters, usually 0 and 1.

3.6 Character - a letter, digit, or other special form that is used as part of the organization, control, or representation of data. A character is often in the form of a spatial arrangement of adjacent or connected strokes.

3.7 Character set - those characters which are available for encoding within the bar code.

3.8 Code density - the number of characters that can appear per unit of length.

3.9 Discrete code - a bar code in which the intercharacter gap is not part of the code and is allowed to vary dimensionally within wide tolerance limits.

3.10 Element - a generic term used to refer to either a bar or a space.

3.11 Intercharacter gap - the space between the last element of one character and the first element of the adjacent character of a bar code.

3.12 Margin (quiet zone) - the area immediately preceding the start character and following the stop character which contains no markings.

3.13 Message - the string of characters encoded in a bar code.

3.14 Standard DOD symbology - the 3-of-9 bar code with Optical Character Recognition (style A) alphanumeric clear-text printed above or below the 3-of-9 bar code. The 3-of-9 bar code is defined in terms of size, density, contrast, and code pattern.

3.15 Self-checking bar code - a bar code which uses a checking algorithm which can be applied against each character to guard against undetected errors.

3.16 Space - the lighter element of a bar code.

3.17 Start and stop characters - distinct characters used at the beginning and end of each bar code which provide initial timing references and direction of read information to the coding logic.

3.18 Symbol - a complete bar code containing margins, start character, data characters, check digit, if any, and stop character.

4. GENERAL REQUIREMENTS

4.1 Code description. The 3-of-9 code is a variable length, discrete, self-checking, bidirectional, alphanumeric bar code. Its character set contains 43 characters: 0-9, A-Z, -, ., $, /, +, %, and space. Each character is composed of 9 elements: five bars and four spaces. Three of the nine elements are wide (binary value 1) and six elements are narrow (binary value 0). Spaces between characters are not significant, therefore, 3-of-9 code is discrete. A common character (*) is used for both start and stop delimiters. An example of 3-of-9 code message containing the string "ABC," is shown in Figure 1.

4.2 Code configuration. A message consists of any number of data character symbols enclosed between two start/stop code characters. Table 1 presents the code symbology for 3-of-9 bar characters.

4.3 Human-readable interpretation. The human-readable interpretation of the 3-of-9 bar code shall represent the encoded characters. The shapes and sizes of the human-readable interpretation shall conform to FIPS PUBS 32. The shapes and sizes of the human-readable characters shall be optional but shall conform to one of the three character sizes shown in the above referenced document. The encoded start/stop characters (asterisks) must be suppressed when the human-readable information is printed, since an asterisk is not an OCR recognizable character. The OCR-A may be printed above or below the bar code.

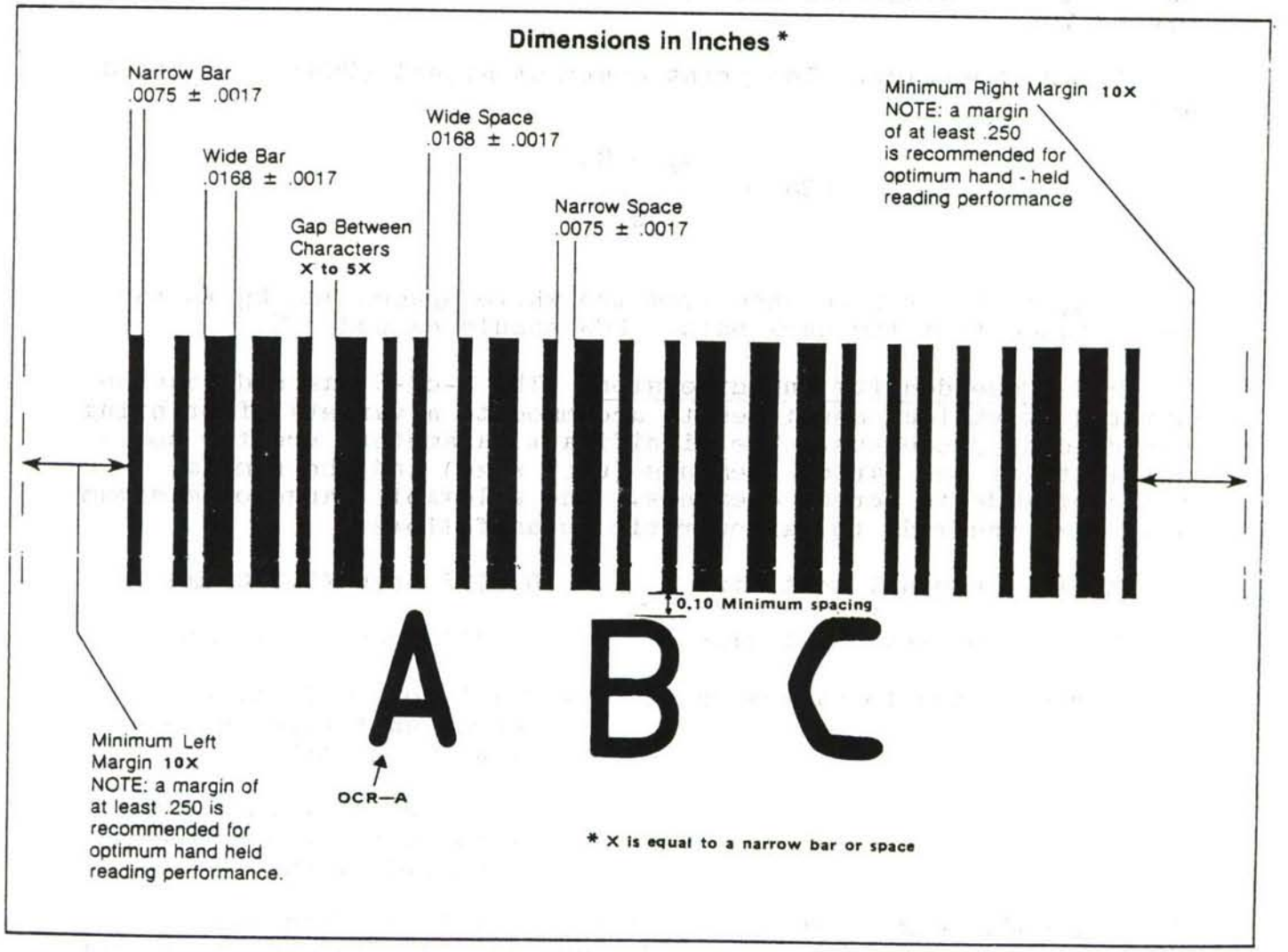

FIGURE 1. Standard code, 9.4 characters per inch density (enlarged).

5. Print Requirements

5.1 Reflectivity and Contrast.

5.1.1 Reflectivity. Reflectivity measurements are to be made at a wave length of 900 nm (nanometer) with a bandwidth to the 50% level of 40 nm or less. Incident irradiation should be 45° to the normal and reflected flux collected within a 15° angle centered on the normal. Reflectance values are referred to a magnesium oxide or barium sulfate standard at 100%. The reflectance of the background and white spaces within the code should exceed 70%.

5.1.2 Contrast. The print contrast signal (PCS) is defined as:

$$PCS = \frac{R_w - R_b}{R_w}$$

where R_w is the reflectance from the white spaces and R_b is the reflectance from the dark bars. PCS should exceed 65%.

5.2 Code density and dimension. The 3-of-9 bar code can be printed at various densities to accommodate a variety of printing and reading processes. The significant parameters are the nominal width of the narrow elements (unit size) and the nominal ratio of wide to narrow elements. The allowable range of minimum unit size and wide to narrow ratio is as follows:

Minimum nominal unit size	- 0.0075 inch (0.190 mm)
Maximum nominal unit size	- 0.0400 inch (0.571 mm)
Nominal wide to narrow ratio	- 2.2:1 to 3.0:1 for codes whose unit size is less than 0.02 inch
	- 2.0:1 to 3.0:1 for codes whose unit size is more than 0.02 inch

The bar code height can vary to suit specific reading and printing requirements. For hand scanning, the minimum bar height shall be 0.25 inch (6.4 mm) or 15 percent of the bar code length, whichever is greater. For noncontact reading, the minimum bar height shall be 1.25 inches (31.8 mm) or 25 percent of the bar code length, whichever is greater.

5.2.1 Intercharacter gap. The minimum gap between characters is the same as the dimension of a minimum unit of (x - t). The maximum intercharacter gap width shall be no more than three times the width of a wide element, or 0.060 inch, whichever is greater.

5.2.2 Margins (quiet zones). The minimum left and right margins shall be 10 times the width of one narrow element or 0.10 inch (2.5 mm), whichever is greater. For hand scanning, the margins shall be at least 0.25 inch (6.4 mm).

5.2.3 Spacing between bar code and OCR-A. The minimum spacing between the bar code and the OCR-A shall be at least 0.10 inch.

TABLE I. Code Configuration.

CHAR.	PATTERN	BARS	SPACES	CHAR.	PATTERN	BARS	SPACES
1		10001	0100	M		11000	0001
2		01001	0100	N		00101	0001
3		11000	0100	O		10100	0001
4		00101	0100	P		01100	0001
5		10100	0100	Q		00011	0001
6		01100	0100	R		10010	0001
7		00011	0100	S		01010	0001
8		10010	0100	T		00110	0001
9		01010	0100	U		10001	1000
0		00110	0100	V		01001	1000
A		10001	0010	W		11000	1000
B		01001	0010	X		00101	1000
C		11000	0010	Y		10100	1000
D		00101	0010	Z		01100	1000
E		10100	0010	-		00011	1000
F		01100	0010	.		10010	1000
G		00011	0010	SPACE		01010	1000
H		10010	0010	*		00110	1000
I		01010	0010	$		00000	1110
J		00110	0010	/		00000	1101
K		10001	0001	+		00000	1011
L		01001	0001	%		00000	0111

* Denotes a start/stop code which must precede and follow every bar code message.
Note that * is used only for the start/stop code.

5.3 Bar code tolerances.

5.3.1 Measuring tolerance. The width of printed bars and spaces can be measured with an optical comparitor using reflected light incident at 30° to 45° from a normal to the printed surface. A magnification of 50X is recommended although with some loss of accuracy, 20X may be used. Printed bar codes with reasonably smooth bar edges are easily measured by visually averaging the edge roughness over a linear reticle on the comparitor screen.

5.3.2 Calculating Tolerance. The allowable printing width tolerance t is a function of the nominal width x and the nominal ratio n of wide to narrow. This tolerance is defined as:

$$t = \pm \frac{4}{27}\left(n - \frac{2}{3}\right)x$$

Note that the value of n shall be in the allowable range of 2 to 3. Table II shows the tolerances for the various commonly used nominal dimensions.

TABLE II. Tolerances of Common Nominal Dimensions.

Density characters per inch		Nominal width of narrow bars and spaces Inch	mm	Nominal width of wide bars and spaces Inch	mm	Bar and space width tolerances Inch	mm
Std.	9.4	.0075	.190	.0168	.427	± .0017	.043
Med.	5.5	.0115	.292	.0345	.876	± .0040	.102
Low	3.0	.021	.533	.063	1.600	± .0073	.185

5.4 Spots, voids, and bar edge roughness.

5.4.1 General. A major advantage of 3-of-9 bar code is that is can be correctly read in spite of localized printing defects. A defect of sufficient magnitude may cause a wand scanner not to read if the scanning line passes directly through the defect. However, a subsequent scan through a nondefective area of the bar code will typically result in a good read.

5.4.2 Edge roughness. Edge roughness is included in the bar and space width tolerances by determining the white-to-black and black-to-white transition points as the positions where the center of a .006 inch diameter circle is 50 percent covered by the dark area.

5.4.3 Spots and voids. Spots and voids which are small enough to be contained entirely within a .003 inch diameter circle or which occupy no more than 25 percent of the area of a .006-inch circle are allowed and should not have an adverse effect on properly configured reading equipment. Larger spots or voids can be expected to reduce the first-read-rate performance depending on the size of such larger spots and voids.

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