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MILITARY STANDARD

STANDARD DEPARTMENT OF DEFENSE BAR CODE SYMBOLOGY

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DEPARTMENT OF DEFENSE

Washington, DC 20402

Standard Department of Defense Bar Code Symbology

MIL-STD-1189

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2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed: Director, AMC Packaging, Storage and Containerization Center, ATTN: SDSTO-TA, Tobyhanna, PA 18466-5097, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1. SCOPE

1.1 Purpose. The purpose of this standard is to define the Standard Department of Defense Bar Code Symbology (SDS).

1.2 Application. The SDS shall be used whenever bar code marking and reading operations are employed within logistics operations.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks for the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this standard to the extent specified herein.

MILITARY STANDARDS

MIL-STD-105, Procedures and Tables for Inspection by Attributes.

MIL-STD-130, Identification Marking of U.S. Military Property.

(Copies of specifications, standards, handbooks, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer).

2.2 Other publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. The issues of documents which have not been adopted shall be those in effect on the date of the cited DODISS.

Recommended practices for Uniform Container Symbol (UCS).

Transport Case Symbol (TCS) by the Distribution Symbology Study Group is available from the Automatic Identification Manufacturers (AIM).

(Application for copies should be addressed to the Material Handling Institute, Inc.k 1326 Freeport Road, Pittsburgh, PA 15238.)

(Non-Government standards are generally available for reference from libraries. They are also distributed among non-Government standards bodies and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard will take precedence.

3. DEFINITIONS

3.1. 3 of 9 bar code. The 3 of 9 bar code is a variable length, discrete, self-checking, bidirectional, alphanumeric bar code. Its character set contains 43 meaningful characters: 0-9, A-Z, -, ., $, /, +, %, and space. Each character is composed of nine elements: five bars and four spaces. Three of the nine elements are wide (binary value 1), and six elements are narrow (binary value 0). An additional common character (*) is used for both start and stop delimiters. Table I presents the code symbology for the 3 of 9 bar-code characters.

3.2 Bar. The darker element of a bar code.

3.3 Bar Code. An array of rectangular bars and spaces in a predetermined pattern.

3.4 Bar width. The perpendicular distance across a bar measured from a point on one edge to a point on the opposite edge. Each point will be defined as having a reflectance that is 50 percent of the difference between the background and bar reflectances.

3.5 Bearer bar. A rectangular bar pattern circumscribing the bar code, often used with a bar code directly printed on corrugated fiberboard.

3.6 Bidirectional code. A bar code format which permits reading in complementary (opposite) directions across the bars and spaces.

3.7 Binary. Pertaining to a characteristic or property involving a selection, choice, or condition in which there are two possibilities.

3.8 Binary code. A code which makes use of exactly two distinct characters, usually 0 and 1.

3.9 Carrier. In a transaction, the party that provides transportation services, e.g., truck, boat, rail, etc.

3.10 Character. 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.

3.11 Character set. Those characters which are available for encoding within the bar code.

3.12 Characters per inch (CPI). The number of bar coded characters that are displayed in each inch of bar code.

3.13 Closed System. A system in which a single authority has control over all elements, e.g., data content, bar code printing, bar code scanners; Opposite of "Open System".

3.14 Code density. The number of characters that can appear per unit of length, normally expressed in characters per inch (CPI).

3.15 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.

3.16 Element. A generic term used to refer to either a bar or a space.

3.17 Entity. A unique physical object about which information can be defined.

3.18 Field. See "Message".

3.19 Human Readable Interpretation (HRI). The exact interpretation of the encoded bar code data presented in a human-readable font.

3.20 Intercharacter gap. The space between the last element of one character and the first element of the adjacent character of a discrete bar code.

3.21 Manufacturer. Actual producer/fabricator of an entity; not necessarily the supplier in a transaction. Manufacturer's ID code is a property of an entity, not of a transaction. See "Supplier" for transaction.

3.22 Margin (quiet zone). The area immediately preceding the start character and following the stop character, which contains no markings and provides the same reflectance as the spaces.

3.23 Message. The string of data characters encoded in a bar code. (Also called a field.)

3.24 Non-Read. In a bar code system, the absence of data at the scanner output after an attempted scan due to no code, detective code, scanner failure or operator error.

3.25 Open System. A system which conforms to established standards and that therefore can be readily connected to other systems that comply with the same standard. Opposite of "Closed System".

3.26 Print Contrast Signal (PCS). A measure of the contrast between the bars and spaces of a symbol. It is based on reflectance measurements at a specified wavelength of light.

3.27 Print Qualtiy. The measure of compliance of a bar code symbol to the requirement of dimensional tolerance, edge roughness, spots, voids, reflectance, PCS, quiet zone, and encodation.

3.28 Read Rate. The ratio of the number of successful reads on the first attempt to the total number of attempts.

3.29 SDS (Standard DOD Bar Code Symbology). The 3 of 9 bar code with a human-readable interpretation (HRI). The 3 of 9 bar code is defined in terms of size, density, contrast, and code pattern. The 3 of 9 bar code is also referred to as Code 39 or Code 3 of 9.

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

3.31 Space. The lighter element of a bar code.

3.32 Start and stop character. A distinct character represented by an asterisk, or star (*), used at the beginning and end of each 3 of 9 bar code which provides initial timing references and direction of read information to the coding logic. The asterisk start and stop code is an integral part of and peculiar to the 3 of 9 bar code.

3.33 Supplier. In a transaction, the party that produces, provides, or furnishes an item of service, other than transportation services. Also see "Carrier".

3.34 Symbol. A complete bar code containing margins, start character, data characters, intercharter gaps, check digit (if any), and stop character.

3.35 Traceability Number. A number assigned by a controlling authority to provide unique identification to an entity or group of entities to permit tracking of the movement of that entity or group of entities from point to point through a series of transactions.

3.36 Unit size. The width of the narrow element. (The narrow bar and the narrow space are equal in the 3 of 9 bar code.) This width is referred to as the "x" dimension.

3.37 Vendor. See "Supplier".

4. GENERAL REQUIREMENTS

4.1 3 of 9 bar code description. The 3 of 9 bar code shall be used for all applications unless otherwise specified.

4.2 Human-readable interpretation (HRI). The HRI of the 3 of 9 bar code shall represent only the encoded characters. The HRI is intended to be used only for human recognition and is not intended to be machine readable. For example, a national stock number (NSN) normally would be marked 5960-00-127-4329. However, when bar coded, only the 13 digits are to be encoded and the HRI will be marked equally as 5960001274329. Note that the start and stop asterisks shall be suppressed when marking the HRI. The shapes and sizes of the characters can be in any easily read font and are to be a minimum of 0.094 inches (2.39 mm) in height. The HRI may be marked above beside or preferably below the bar code.

4.3 SDS configuration. (When specified by the procuring activity). An SDS message shall consist of a number of 3 of 9 bar code data character symbols enclosed between start and stop code characters, with the corresponding HRI characters. An example of an SDS message containing the data string "ABC" is shown in figure 1. The dimensioning requirements are detailed in section 5.2.

4.4 Optional code formats. See section 6 for the optional use of check characters, broken messages, and the full American Standard Code for Information Interchange (ASCII) character set. An encoded leading space shall be used when and only when the optional broken message format is being used. (See 6.2.1) When both the broken-message format and the check character are to be used, the encoded space shall also be considered when calculating the value of the check character.

4.5 Special requirements. There may be applications that require special considerations concerning the code format and density as well as the HRI contents, size, and location. The pertinent application standard or procurement document shall take precedence for these applications.

NOTE - An example of a special requirement is for a bar code with a density of 9.4 characters per inch and only 0.016 inch (0.406mm) high that is etched into the edge of a printed circuit board.

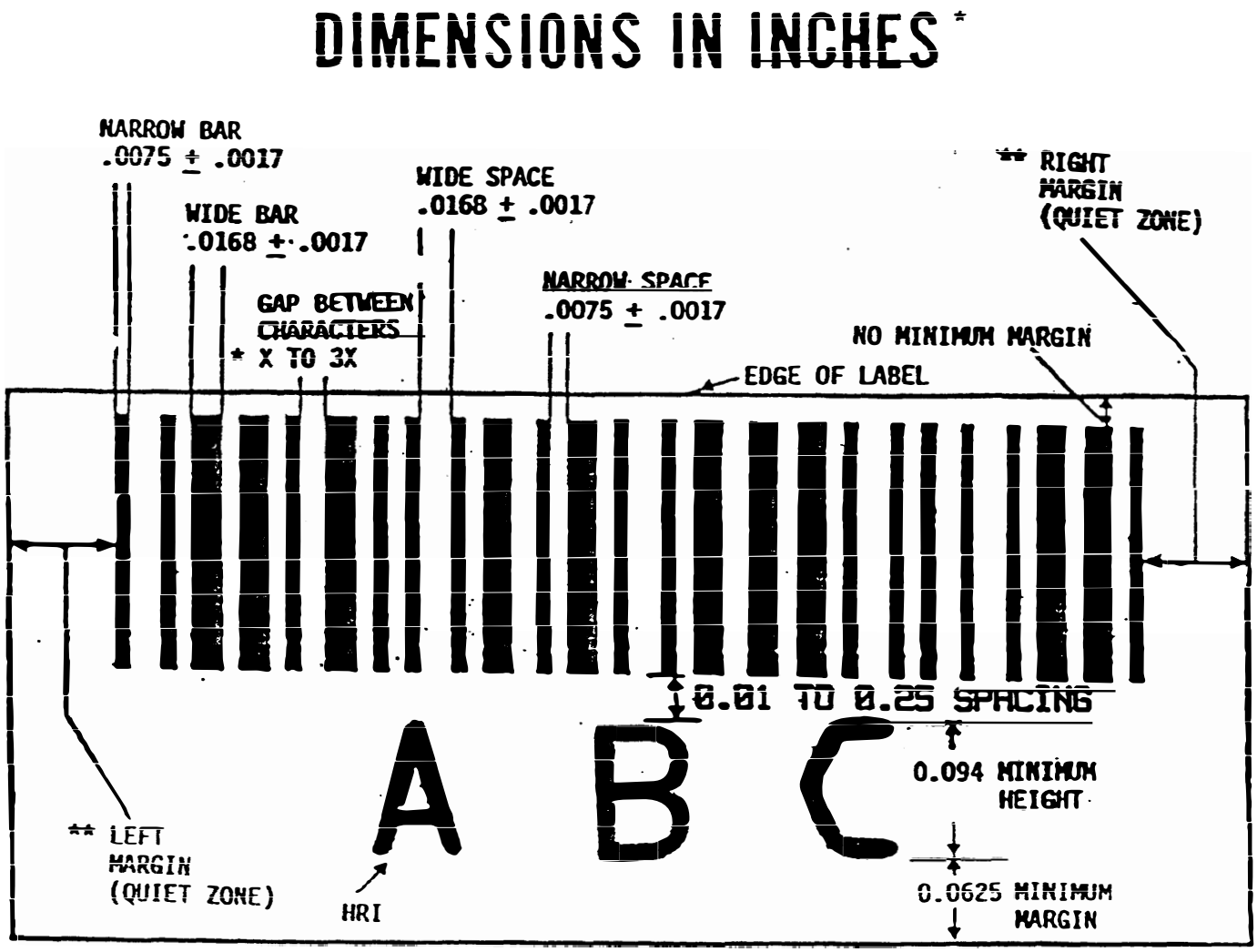
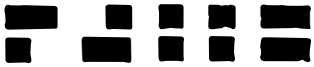


FIGURE 1. Example SDS with a high-density bar code of 9.4 characters per inch (CPI) (enlarged).

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

The * symbol denotes a unique start/stop character which must be the first and last character of every bar code message.

NOTE: Refer to Table VI for full ASCII encodation.

5. DETAILED REQUIREMENTS

5.1 Reflectivity and contrast.

5.1.1 Reflectivity.

5.1.1.1 Light sources. Four spectral bands are referenced:

Spectral Band	Wave Length (Peak Nanometers)	Typical Sources
B633	633 ± 5%	helium-neon (visible)
B680	680 ± 5%	visible laser diode
B800	800 ± 5%	solid-state laser diode
B900	900 ± 5%	invisible infrared sources

These bands represent spectral responses required from the measuring instrument (light source, filter, detector). Band B633 corresponds with scanners using sources emitting visible red light within the B633 spectral band. Band B680 corresponds to devices that respond to visible laser diode sources that operate within the visible B680 band. Band B800 corresponds to reading devices that respond to laser diode light sources that emit light within the near infrared B800 band. Band B900 corresponds to reading devices that use light sources and appropriate detectors operating in the infrared. All the measurements shall be made in the final package configuration as it is to be scanned. Some printing processes such as those using inks containing carbon will easily achieve adequate contrast in all three spectral bands. Other printing processes such as those using various colored dyes may satisfy the requirements of the B633 band but not for the B800 or B900 bands. As a minimum, the marked bar code symbol shall meet the contrast and reflectivity requirements for band B800 and for band B633 using barium sulfate ($BaSO_4$) or magnesium oxide (MgO) as a photometric standard. Reflectivity measurements shall be made with incident irradiation at 45 degrees from a normal (perpendicular) to the surface and reflected flux collected within a 15 degree angle centered on the normal. The bar codes shall be readable when utilizing scanners that operate in the band of wavelengths between the B633 and B800 bands inclusive unless otherwise specified.

5.1.1.2 Opacity. Reflectance values may be measured directly on bar code symbols, which have been marked on a material which has an opacity value exceeding 0.90. The calculated opacity value of a material shall be determined by two reflectance measurements (R_1 and R_2). The first measurement (R_1) shall be taken on a blank material sample backed with enough layers of the same material so that doubling the number of layers will not change the measured value of reflectance. The second measurement (R_2) shall be taken on the same blank material sample except that a black backing shall be placed directly behind the material sample instead of multiple layers. The reflectance value of the black backing shall not exceed 5 percent. The calculation of the opacity value is as follows:

$$\text{Opacity Value} = 1.00 - \frac{(R_1 - R_2)}{(R_1)} \text{ or } \frac{R_2}{R_1}$$

When bar code symbols are to be marked on nonopaque materials with opacity values less than or equal to 0.90, reflectance measurements shall be made on the bar code symbol with a backing material which has a reflectance value equal to that of the bar code symbol backing in the final packaging configuration. When the bar code symbol is applied to the final package configuration, there shall be no greater than 10 percent variation in the reflectance values of the white elements due to the interfering patters showing through nonopaque bar code symbol materials.

5.1.1.3 Bar reflectivity. The maximum allowable reflectivity of the dark bars is related to the reflectivity of the light spaces. Bar code symbols with spaces that are less reflective will require bars that are "darker" (less reflective). Table II illustrates the maximum bar reflectance R_b as functions of space reflectance R_w. The minimum space reflectance shall be 25 percent for bar code symbols with narrow bar widths equal to or greater than 0.020 inch (0.508 mm). The minimum space reflectance shall be 50 percent for bar code symbols with narrow bar widths less than 0.020 inch (0.508 mm).

TABLE II. Allowable values of bar reflectance.

Space Reflectance R_w(%)	Maximum Bar Reflectance R_b(%)
25	6.25
30	7.50
35	8.75
40	10.00
45	11.25
50	12.50
55	13.75
60	15.00
65	16.25
70	17.50
75	18.75
80	20.00
85	21.25
90	22.50
95	23.75
100	25.00

NOTE: In the above table, the minimum contrast ratio of R_w to R_b is 4.0, and the minimum print contrast signal (PCS) is 75 percent.

5.1.2 Print Contrast Signal (PCS). The 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. The minimum PCS allowed is 75 percent.

5.2 Code density and dimension. The 3 of 9 bar code can be marked at various densities to accommodate a variety of marking and reading processes. Examples of acceptable densities in CPI are: 9.4 = high; 5.7 = medium; and 3.0 = low. High density codes are commonly used where space is at a premium. Low density codes are commonly used on exterior shipping containers where lower density codes will facilitate automated materials handling by remote scanners. Ultra-high densities greater than 9.4 CPI may be used in closed-loop and special applications when required. (See 6.2.4) The significant parameters are the nominal width (x) of the narrow elements and the nominal ratio of wide-to-narrow elements. The allowable range for the nominal unit size and the nominal wide-to-narrow ratio is as follows:

Minimum nominal unit size (for special applications)	- 0.0044 inch (0.112 mm)
Minimum nominal unit size (for general applications)	- 0.0075 inch (0.190 mm).
Maximum nominal unit size (for general applications)	- 0.0200 incl (.508 mm)
Maximum nominal unit size (for special applications)	- 0.0400 inch (1.016 mm).
Nominal wide-to-narrow ratio	- 2.5:1 to 3.0:1 for codes whose unit size is less than 0.0075 inch (0.190 mm)
	- 2.2:1 to 3.0:1 for codes whose unit size is less than 0.015 inch (0.381 mm) and equal to or greater than 0.0075 inch (0.190 mm)
	- 2.0:1 to 3.0:1 for codes whose unit size is equal to or more than 0.015 inch (0.381 mm).

Nominal wide-to-narrow ratio of 3.0:1 is preferred for all unit sizes. The actual wide-to-narrow ratio will depend on the actual (marked) sizes of the narrow and wide element, but shall not exceed 3.3:1.

5.2.1 Code and HRI heights. The bar code height can vary to suit specific reading and marking requirements. The bar code heights listed in table III shall be used for the corresponding ranges of bar code density. For those applications where these heights are not suitable, height requirements will be as specified by the responsible procurement activity. The corresponding minimum HRI heights are also listed in table III.

TABLE III. Bar code and HRI heights*

A. Bar code and HRI heights for general use.

Bar Code Density Range	Bar Code Minimum Height		Bar Code Maximum Height		HRI Minimum Height	
	in	(mm)	in	(mm)	in	(mm)
1.7 ≤ CPI < 3.0	0.75	(19.05)	1.25	(31.75)	.125	3.18
3.0 ≤ CPI < 6.5	0.375	(9.53)	0.875	(22.23)	.094	2.39
6.5 ≤ CPI ≤ 9.4	0.25	(6.35)	0.50	(12.7)	.094	2.39

B. Bar code and HRI heights for special applications.

Bar Code Density Range	Bar Code Minimum Height		Bar Code Maximum Height		HRI Minimum Height	
	in	(mm)	in	(mm)	in	(mm)
9.4 ≤ CPI ≤ 12.5	0.125	(3.18)	0.375	(9.53)	.063	1.60
12.5 < CPI ≤ 15.5	0.0625	(1.59)	0.250	(6.35)	.035	0.89

*Special applications or conditions may dictate the use of height and density combinations other than those shown in TABLE III.

operations of a machine or process.

5.2.2 Intercharacter gap. The minimum gap between characters is the same as the minimum dimension (x) of a narrow element. The maximum intercharacter gap width shall be three times the width of a narrow element (3x) (see fig 1). In most cases, the minimum dimension (x) is used.

5.2.3 Margins (quiet zones). The minimum left and right margins shall be 10 times the width of one narrow element (10x) or 0.25 inch (6.35 mm), whichever is greater unless otherwise specified (see fig 1). Unique situations may exist, but in no case shall the width of the quiet zones be less than 0.125 inch (3.17 mm).

5.2.4 Spacing between bar code and HRI. The spacing between the bar code and the HRI shall be a minimum of 0.01 inch (0.25 mm) and a maximum of 0.25 inch (6.35 mm) (see fig. 1). When the HRI is in-line with the bar code, it shall be outside the quiet zones.

5.2.5 Spacing between edge of label and HRI. The minimum spacing between the horizontal edge of the label and the HRI shall be 0.0625 inch (1.588 mm) (see fig 1).

5.2.6 Spacing recommendations for SDS message formats. The following spacing requirements apply unless otherwise specified (refer to fig 2):

5.2.6.1 Stacked SDS messages. When SDS messages are in an over-and-under configuration (stacked), the messages shall have a minimum separation of 0.375 inch (9.53 mm) and a maximum separation of 0.75 inch (19.05 mm) from bar code to bar code (see fig 2).

5.2.6.2 Separated in-line SDS messages. The spacing between two separately coded SDS messages on the same line shall have a minimum separation of 0.5 inch (12.7 mm) (see fig 2).

5.2.7 Maximum number of encoded characters. The maximum number of encoded data characters in a single SDS message shall not exceed 30 data characters unless otherwise specified. The total number of encoded characters shall not exceed 32 characters including the start and stop characters and other control characters that may be used such as an encoded space.

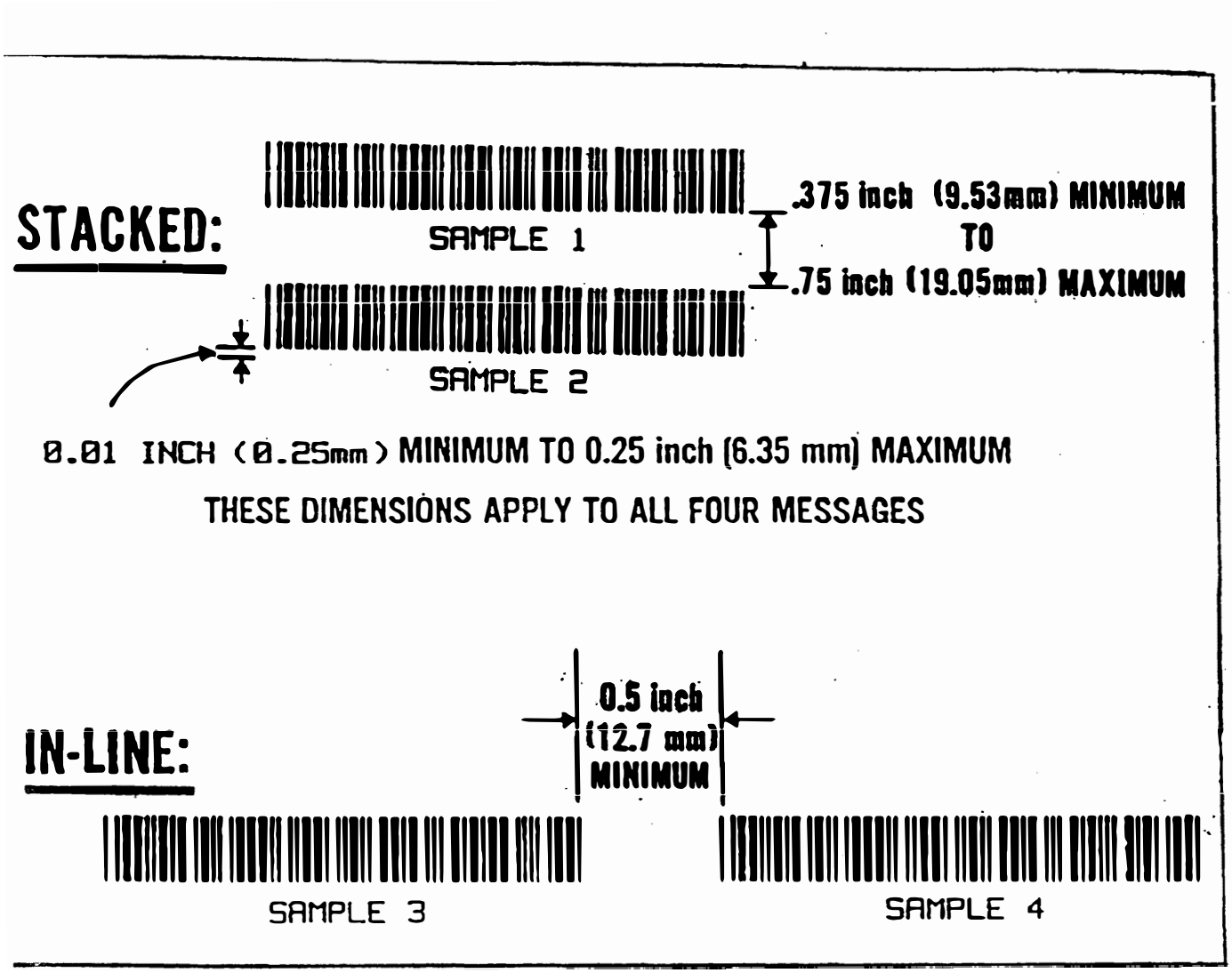


Figure 2. Spacing for multiple SDS message formats.

5.3 Bar code tolerances.

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

5.3.2 Calculating tolerance. The allowable marking width tolerance (t) is a function of the nominal width (x) of a narrow element and the nominal ratio (n) of the wide to narrow elements. This tolerance is defined as:

$$t = \pm\left(\frac{4}{27}\right)\left(n - \frac{2}{3}\right)x \quad \text{or} \quad t = \pm\,(.1481)\,(n - .6667)x$$

Note that the nominal value of n shall be in the allowable range of 2 to 3. The actual (marked) value of n shall be no less than 1.98 nor greater than 3.3. Table IV shows the tolerance for some of the commonly used dimensions and ratios. The actual density obtained may vary depending on the actual bar width and intercharacter space dimensions used.

TABLE IV. Tolerances for selected densities.

Density CPI	Nominal Width (x) Narrow Elements (in)	(mm)	Wide/Narrow Ratio n	Nominal Width (nx) Wide Elements (in)	(mm)	Element Tolerance (t) (in)	(mm)
15.5	0.0044	0.112	2.5	0.0110	0.279	0.0012	0.030
12.5	0.0055	0.140	2.5	0.0138	0.351	0.0015	0.038
9.4	0.0075	0.190	2.24	0.0168	0.427	0.0017	0.044
8.6	0.0080	0.203	2.5	0.0200	0.508	0.0022	0.055
7.4	0.0100	0.254	2.2	0.0220	0.559	0.0023	0.058
6.3	0.0100	0.254	3.0	0.0300	0.762	0.0035	0.088
5.7	0.0120	0.305	2.5	0.0300	0.762	0.0033	0.083
5.4	0.0115	0.292	3.0	0.0345	0.876	0.0040	0.101
4.8	0.0160	0.406	2.0	0.0320	0.813	0.0032	0.081
3.9	0.0160	0.406	3.0	0.0480	1.219	0.0055	0.140
3.0	0.0210	0.533	3.0	0.0630	1.600	0.0073	0.184
2.3	0.0300	0.762	2.5	0.0750	1.905	0.0081	0.207
1.7	0.0400	1.016	2.5	0.1000	2.540	0.0109	0.276

5.4 Spots, voids, and bar edge roughness.

5.4.1 General. A major advantage of using the 3 of 9 bar code is its self-checking property which leads to a very low character substitution error (misread) rate. The character substitution rate varies with the print quality of the bar code symbol and operator technique.

5.4.2 Bar edge roughness. A certain degree of bar edge roughness is permitted in the bar and space width tolerances. The white to black and black to white transition points are determined where the apparent reflectance of a circle with a diameter 0.8 times the nominal width of a narrow element is halfway between the reflectances of the bar and space reflectance values.

5.4.3 Spots and voids. A single spot or void of sufficient magnitude in an individual character code will cause a wand scanner to not read when the scanning line passes directly through the defect. However, two independent defects occurring along the same scan within the same character code could produce a substitution error. Such error can only result if a void in a wide bar is aligned with a spot on a narrow bar within the same character code. Spots and voids which meet either of the following criteria are permitted:

a. The spot or void can be contained within a circle whose diameter is 0.4 times the nominal width of the narrow element.

b. The spot or void occupies no more than 25 percent of the area of a circle whose diameter is 0.8 times the nominal width of the narrow element. Larger spots or voids can be expected to reduce the first read rate depending upon their size.

6. NOTES OF IMPORTANCE

6.1 Marking Methods.

6.1.1 SDS message marking. Any marking process that produces an SDS message meeting the requirements of this standard may be used.

6.1.2 Direct printing on corrugated fiberboard.

6.1.2.1. Printing practices. The specific printing practices for printing SDS messages directly on corrugated fiberboard are described in "Recommended Practices for Uniform Container Symbol (UCS) Transport Case Symbol (TCS)." These practices should be followed for direct printing of SDS messages on corrugated fiberboard. The recommended minimum nominal width of the narrow element for direct printing on corrugated fiberboard shall be 0.020 inch (0.508 mm). For direct printed bar codes, the recommended minimum ratio of wide-to-narrow element width is 2.5:1. Direct printed bar code densities greater than 1.7 CPI are acceptable when they meet the requirements of this standard.

6.1.2.2 Bearer bars. A bearer bar is a rectangular bar pattern circumscribing the SDS message horizontally and vertically. A bearer bar may be employed to provide uniform support for the printing plate at critical areas near the SDS message for direct printing on corrugated fiberboard. Recommended dimensions of the bearer bar are also contained in the report referenced in 6.1.2.1.

6.1.3 Thermal printing.

6.1.3.1 Methods. There are two thermal printing methods, direct and indirect (thermal transfer). Both methods can be used to achieve accurate sharply defined bar codes.

6.1.3.2 Direct thermal printing. Direct thermal printing utilizes heat sensitive paper and therefore the heated print head contacts the printing media (labels) directly. Only thermal label stock that has the capability of being scanned in both the B633 and B600 bands shall be used. This stock is more durable and resistant to heat and industrial solvents than the white-colored organic label stock is. The material shall have the capability of being scanned by laser-diode and visible red scanners. In any case thermal labels shall not be used on material that will be directly exposed to sunlight for a period of time exceeding 3 weeks.

6.1.3.3 Indirect thermal printing. When indirect thermal printing methods are used the heated printing heads are applied to an ink ribbon and the ink is then transferred to the label material. Care should be taken to use the correct combination of ink ribbon and label material when using this printing method.

6.1.4 Permanent marking methods. Some applications will require that permanently marked bar codes be used. This usually implies that the bar code is to remain readable for the lifetime of the material to which it is affixed or the lifetime of the material in which the bar code is marked. For these applications the bar codes may be laser-etched, photo-imaged, or utilize some other permanent marking technology. A variety of permanent marking methods are shown in MIL-STD-130, Identification Marking of U.S. Military Property. Permanent marking requirements shall be used when specified by the procuring activity. Whether or not a specific permanent marking technology has to be used will also be specified.

6.2 Optional requirements.

6.2.1 Use of optional check character for additional data security. Code 3 of 9 is strongly self-checked and most situations do not require a check character. If a specific application requires exceptional data security, a check character can be added to the encoded message. When this option is to be exercised the data shall be followed by the encoded check character. The check character is the modulus 43 sum of all the character values (see Table V) in a given message, and is printed as the last character. Check character generation is illustrated by the following example:

Data Message: 12345/ABCDE

Sum of Values: 1+2+3+4+5+40+10+11+12+13+14 = 115. Divide 115 by 43. The quotient is 2 with the remainder 29. The check character is the character corresponding to the value of the remainder, which in this example is 29 or "T". The complete message, including the check character would therefore be 12345/ABCDET.

TABLE V. Character Values for Determining the Optional Check Character

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		

6.2.2 Use of encoded leading space for breaking long data messages. It is sometimes advantageous or even necessary to break up long bar code messages into two or more shorter messages. The break may be needed due to space constraints or bar code scanner capability. If the first data character of a Code 3 of 9 message is a space, the bar coded reader appends the information contained within the message (excluding the leading space) to its buffer. This operation continues for all Code 3 of 9 messages that contain a leading space. When a Code 3 of 9 message that does not contain a leading space is read, the message is added to the reader's buffer, completing the data entry event. See example of a broken message in Figure 3. It is recommended that the individual messages do not exceed 22 characters each and that the combined data does not exceed 50 characters.

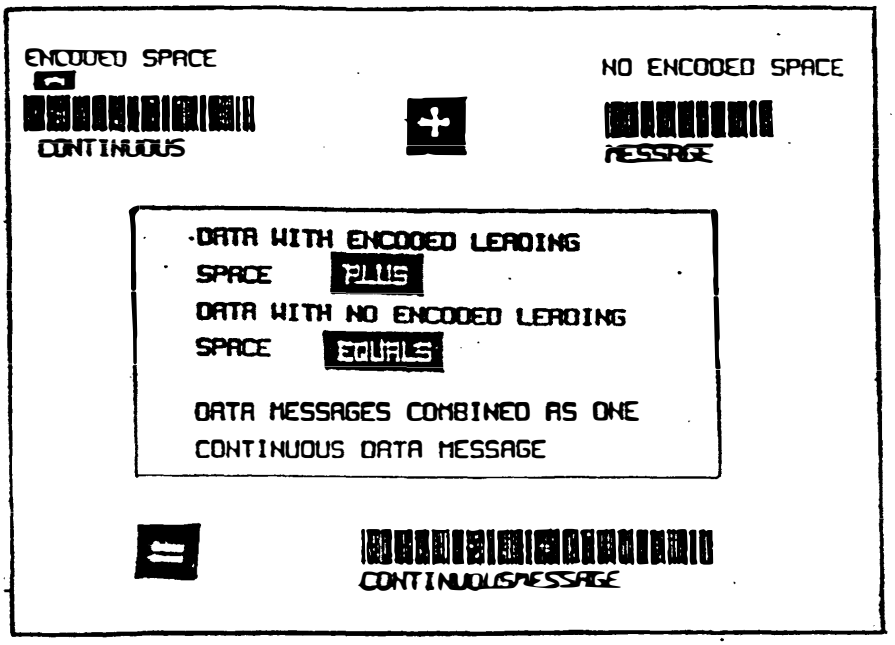


Figure 3. Example for Use of Broken Messages

6.2.3 Conversion to full ASCII. (Limited to internal close-looped operations only). There may be applications that require the encodation of the entire ASCII character set. The full ASCII set of 128 characters may be encoded by using the Code 3 of 9 symbols $, /, %, and + as precedence codes with the 26 letters, as shown in Table VI. While in the "Full ASCII" mode, the Code 3 of 9 characters $, /, %, and + represent their corresponding ASCII characters if they are followed by a digit, space, symbol, or stop code. If one of these special characters is followed by a letter, the pair of characters is decoded as shown in Table VI. Note that the lower case letters of the alphabet are represented by a plus sign followed by the corresponding letter (a is +A etc.) Certain ASCII control codes are alternately named as control letters. For example, carriage return (CR) is also known as Control M and is represented in Code 3 of 9 as $M. Many Code 3 of 9 readers are internally programmed to respond in unique ways to specific two-character labels in which both characters are symbols (+, -, ., /. %, $). For example, *—* denotes CLEAR BUFFER. Traditionally, the 36 possible two-character labels in which both characters are symbols are reserved for use as control labels. For example, the ASCII data ab/DP would be converted to code 3 of 9 by encoding the characters +A+B/ODP or the reverse is true, i.e., the encoded characters +A+B/ODP would be decoded as ab/DP. If the reader is not in the ASCII mode, this would decode exactly as it appears, i.e., +A+B/ODP.

6.2.4 Use of ultra-high densities. Ultra-high densities greater than 9.4 CPI may be used in closed-loop and special applications when specified by the procuring activity, NOT the provider of the bar code markings. Scanners that will read ultra-high density bar codes will not usually be able to read the lower-density bar codes and the scanners generally used will not usually read ultra-high density bar codes.

TABLE VI

Code 3 of 9 Conversion to Full ASCII

ASCII	CODE 39	ASCII	CODE 39	ASCII	CODE 39	ASCII	CODE 39
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 %X %Y %Z

NOTE: Character pairs /M, /N, and /P through /Y are reserved for future control character pairs.

6.3 Changes from previous issues. Vertical lines or asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

APPENDIX A

READABILITY REQUIREMENTS

10. GENERAL

10.1 Scope. This appendix establishes the criteria for determining the acceptability of bar coded data based on readability of the bar code. The requirements and information contained herein are a mandatory part of this standard.

11.2 Application. The requirements in this appendix apply to all SDS and are not dependent on the type of material marked or on the marking technology utilized. Inspection of the SDS shall be performed after any process that may affect the readability of the bar code. It will be acceptable if the bar code can be successfully scanned as described in section 40.

20. REFERENCED DOCUMENTS

20.1 Government Documents. The following document forms a part of the appendix to the extent specified.

Military Specifications

MIL-STD-105, Procedures and Tables for Inspection by Attributes

30. DEFINITIONS
Not applicable.

40. SPECIFIC REQUIREMENTS. SDS will be acceptable if the bar code can be successfully scanned. A successful scan is achieved when a bar code is read with three or fewer attempts with a wand-type scanner or two or fewer attempts with a laser scanner. These requirements apply when the scanners are being used in accordance with correct operating procedures as specified by the scanner manufacturer. A minimum of 97 percent of the bar codes in a shipment shall be successfully read within the above parameters, and 100 percent of the labels must meet the format requirements. Random sampling shall be in accordance with MIL-STD-105.

Custodians:

Army - SM
Navy - SA
Air Force - 43
Marine Corps - MC (LLP-2)
DLA - DH (DLA-CWP)

Preparing activity:

Army - SM

(Project PACK 0836)

Review activities:
Army - CR, AL, AR, AT ME, AV, MD EA, ER, MI, GL, LM, AM, MR, MT, TM, AM
Navy - YD, MC, SH, AS, OS, MS, EC, CG, TD, JH
Air Force - 11, 99, 01, 69, 70, 71, 80, 82, 84
DLA - CT, SC, DM, ES, GS, IS, PS, CS, IP, SS
Federal - GSA
DOD - PO, DLSSO

User activities:
DLA - IP, SS
Army - MT