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Automatic Data Collection – Bar Coding

Glossary of Basic Terms and Definitions

Information Sheet 9, June 11, 2006

2D Bar Code: 2D bar codes are made of a series of elements. Elements can be round or square and are assembled into a matrix. 2D bar codes allow for additional data to be encoded in a very small area.

Other advantages are additional data redundancy so that if part of a bar code is damaged or missing the bar code can still be decoded correctly. Examples are DataMatrix, Maxicode, and QR Code.

Accuracy: Accuracy is a bar code verification term used to describe whether any element width, or intercharacter gap width, differs from its nominal width by more than the printing tolerance.

AI: Application Identifiers

AIDC: Automatic Identification and Data Capture

Alphanumeric: The character set which contains letters, numbers and may contain other characters such as punctuation marks or control characters.

ANSI X3.182: The United States standard that defines the quality tests and measurement processes for linear bar codes. This standard is older than the ISO 15416 standard.

ANSI: The American National Standards Institute is a non-governmental organization responsible for the development of voluntary industry standards.

Aperture: The size of the light source a verifier uses to capture a bar code image. Bar code standards determine the size of the aperture based on the size of the narrow bar width. However, for UPC and EAN bar codes it is always 6 mil.

ASCII: The character set and code described in American National Standard Code for Information Interchange, ANSI X3.4-1977. Each ASCII character is encoded with 7-bits (8 bits including parity check). The ASCII character set is used for information interchange between data processing systems, communication systems, and associated equipment. The ASCII set consists of both control and printing characters.

Aspect ratio: A bar code verification term. In a bar code symbol, the ratio of bar code symbol height to symbol length.

Aspect Ratio: The ratio of bar height to symbol length of a bar code

Auto-discriminate: Auto-discriminate is the ability of a bar code scanner or verifier to recognize and correctly decode more than one symbology.

Average Background Reflectance: Expressed as a percent, it is the average of the background reflectance from at least five different points on a sheet.

Aztec Code: Aztec Code is a 2D symbology that was created to encode the complete ASCII character set in a high-density format. It has the ability to encode 3750 characters. The symbology is designed with a square 'bulls eye' pattern in the center. Each additional layer wraps around the previous layer. The more data encoded the larger the bar code becomes. There are multiple levels of error correction. Aztec Codes are good for encoding both large and small amounts of data and can be scanned from any direction.

Background: The area around a barcode that includes open space, quiet zones, and other printing.

Bar: The dark element of a bar code symbol

Bar Code Character: A single group of bars and spaces that represents an individual number, letter, punctuation mark, or other symbol.

Bar Code Reader: See "Bar Code Scanner"

Bar Code Scanner: A device (light pen, laser gun, fixed scanner, etc.) used to read a bar code

Bar code: An automatic identification technology that encodes information into a machine-readable

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Automatic Data Collection – Bar Coding Glossary of Basic Terms and Definitions (continued)

pattern. A linear bar code is composed of a series of parallel vertical bars and spaces. A 2D bar code is composed of a series of modules arranged in a matrix pattern.

Bar Width Reduction: Reduction of the nominal bar width dimension on film masters or printing plates to adjust for errors in some printing processes

Bi-Directional: A linear bar code symbol capable of being read successfully from both scanning directions

Bookland: See ISBN

CCD image array: CCD is short for Charge Coupled Device. A CCD image array is used to capture an entire image of a bar code at one time.

Character Set: Those characters available for encodation in a particular bar code symbology.

Character: Linear bar codes: A single group of bars and spaces that represents an individual number, letter, punctuation mark, or other symbol. 2D bar codes: A graphic shape representing a letter, numeral, or symbol. General: A letter, digit, or other symbol that is used as part of the organization, control, or representation of data.

Check Character: See "Check Digit"

Check Digit: A character included within a bar code whose value is used for the purpose of performing a mathematical check to ensure the accuracy of that message. This calculation results in an encoded character as the last digit of the bar code.

CMOS image array: A CMOS is short for Complimentary Metal Oxide Semiconductor. A CMOS image array is used to capture an entire image of a bar code at one time.

Codabar: Codabar is a linear symbology that was created to encode a character set of 16 (numeric plus (- \$ / : , .)). Codabar bar codes are commonly used in libraries, blood banks, and by FedEx.

Code 128: Code 128 is a linear symbology that was created to allow for the full ASCII subset of character. It is very popular in industrial, inventory, and manufacturing applications. Code 128 can be encoded in three subsets (A, B, or C). Each subset has different characters and multiple subsets can be used in the same bar code. Subsets are used to reduce the amount of space required. Code 128 has built-in error correction and an additional check digit is rarely used.

Code 39: Code 39 is a linear symbology that was created to allow for letters (upper case only), numbers plus additional characters such as (+, -, %, \$). It is very popular in medical, government, and inventory applications. Code39 uses a large amount of space for the number of digits encoded. The standard Code 39 does not have a check digit but often users will use a Mod43 for added data integrity.

Code 49: Code 49 is a stacked symbology that was created to encode the complete ASCII character set in a high-density format. It has the ability to encode 170 characters in one square inch. Each row consists of 18 bars and 17 spaces. There are between 2 and 8 rows with each row separated by a horizontal bar.

Code 93: Code 93 is a linear symbology that was created to improve upon the popular Code 39 symbology. It has a 47 character set compared to 43 in a Code39. It is a higher density symbology than Code 39.

Data Identifier: A Data Identifier is a predefined message prefix in a bar code that defines the general category or intended use of the data that follows.

DataMatrix: DataMatrix is a 2D symbology that was created to be extremely efficient. It has a full ASCII character set. 50 characters can be stored in a 1 square inch area and can be increased to a size of 14 inches square. Multiple levels of error correction are available. Symbol consists of an "L" shaped finder pattern on two outside edges and a 'clock' pattern on the remaining two outside edges.

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Automatic Data Collection – Bar Coding Glossary of Basic Terms and Definitions (continued)

Decoder: As part of a bar code reading device, the electronics that process the signals from the scanner, interpret the data captured to determine if a valid bar code is present and if so it determines what characters were encoded.

Depth of Field: Depth of Field is the distance between the maximum and minimum surface in which a scanner is capable of reading bar codes of a specified X dimension.

DI: See "Data Identifier"

Direct Thermal: A printing method where dots are selectively heated and cooled and dragged upon heat-sensitive paper. The paper turns dark in the heated areas. This printing method is susceptible to fading.

EAN: See EAN-13 and EAN-8

EAN-13: European Article Numbering (EAN) system is a linear symbology that is a European version of UPC-A with an additional digit. EAN-13 was developed for retail applications and is found on consumer products. The first and second digits are used to identify the country where the product was manufactured. The next five digits identify the manufacturer. The following five digits identify the specific product and the last digit is a check digit.

EAN-8: European Article Numbering (EAN) system is a linear symbology that is a European version of UPC-E. The EAN-8 is a 'suppressed' version of the EAN-13. EAN-8 bar codes are used on very small products where there is not enough room for an EAN-13.

Element: A single bar or space in a bar code

Film Master: A Film master is a photographic film representation of a specific bar code or OCR symbol from which a printing plate is produced.

Fixed Beam Scanner: Either a light emitting diode (LED) or laser scanner reading in a fixed plane. It requires more exact positioning of bar code than with a moving beam scanner.

Flexographic: Flexographic (Flexo) is a method of printing that utilizes a printing plate that is attached to a round cylinder. An anilox roll picks up a metered amount of ink and applies it to the printing plate cylinder and the printing cylinder applies the ink to the substrate. Flexographic printing is the most common printing method for consumer packaging.

Guard Bars: The bars that are at both ends and center of a U.P.C. and EAN symbol. They provide reference points for scanning.

Imager: An imager is a device that is used to read both linear and 2D bar codes. It works by flooding the barcode with light and uses a CCD or CMOS image array to read what is reflected back. It captures a 'picture' of the entire area at one time then processes the image to find and decode the bar code.

Impact Printing: Impact printing is a system where a microprocessor controlled hammer impacts against a ribbon and a substrate to print characters.

Ink Jet: Ink Jet printing is a method of using liquid ink deposited a drop at a time against a substrate.

Intercharacter Gap: An Intercharacter Gap is the space between two adjacent bar code characters.

Interleaved 2 of 5: I-2 of 5 or Interleaved 2 of 5 is a linear symbology that was created to encode numeric data in a smaller space than Code 39. An I-2 of 5 bar code must contain an even number of digits. The odd digits are encoded in the bars and the even digits are encoded in the spaces and are interleaved together. Similarly, to the Standard 2 of 5, each digit consists of 5 elements, 2 of which are always wide.

Ion Deposition: A method of printing that utilizes a special electrostatic paper or a charged drum, which attracts toner to the charged area. Also called "Electro-Static"

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Automatic Data Collection – Bar Coding Glossary of Basic Terms and Definitions (continued)

ISBN: Bookland or International Standard Book Number (ISBN) is a linear symbology that is used on books and other publications.

ISO 15416: The ISO standard that defines the quality tests and measurement processes for bar codes. ISO15416-1 covers linear bar code verifiers and ISO15416-2 covers 2D bar code verifiers. This is newer than the ANSI X3.182 standard.

ISO15426: ISO standard that defines the testing criteria for bar code verification devices. ISO15426-1 covers linear bar code verifiers and ISO15426-2 covers 2D bar code verifiers.

Ladder: See Orientation

Laser Scanner: Laser scanners are the most common and aggressive method of scanning barcodes.

They consist of a rotating mechanism and a laser beam to create scan line or lines. The light reflected back to the device is measured and the scan is decoded to determine if a bar code was read.

LED: Light emitting diode. A semiconductor that produces light at a wavelength determined by its chemical composition and is often used in bar code scanners.

Light Pen: See "Wand"

Linear Bar Code: Linear bar codes are made up of a series of vertical lines and spaces. The height of the bar code provides vertical redundancy, so if part of the bar code is damaged it still can be decoded correctly by scanning a different area. Different symbologies use varying bar/space widths to encode specific character sets. Linear bar codes require a quiet zone to ensure valid decoding. Examples are UPC, Interleave 2 of 5, Code 128.

MaxiCode: MaxiCode is a 2D symbology that was created to encode the complete ASCII character set in a higher density format than was possible with other 2D symbologies. This was accomplished by using hexagonal modules instead of square modules. The symbology is designed with a round 'bull's eye' pattern in the center. MaxiCode symbols actually encode two separate messages - a Primary message and a Secondary message. The Primary message normally encodes a postal code, a 3-digit country code, and a 3-digit class of service number. The Secondary message normally encodes address data and any other required information. Portions of the bar code can be damaged or removed and the bar code can still be successfully decoded.

MicroPDF417: MicroPDF417 is a stacked symbology that was created to encode the complete ASCII character set in a higher density format than the standard PDF417. It has the ability to encode 1800 characters and many standard application standards exist for applications such as driver's license and shipping labels. Each symbol has between 3 and 90 rows. Each row contains a start pattern, a left row indicator, from 1 to 30 data characters, a right row indicator, and a stop pattern. Several levels of error correction can be selected. Portions of the bar code can be damaged or removed and the bar code can still be successfully decoded.

Misread: A Misread is a condition, which occurs when the data output of a reader does not agree with the data encoded in the bar code symbol.

Module: A Module is the narrowest nominal width unit of measure in a bar code.

Modulo Check Digit or Character: See "Check Character"

Moving Beam Scanner: A moving beam scanner is a device where the scanning motion is achieved by physically moving the bar code through the light beam of the scanning device.

Nanometer: A unit of measure used to define the wavelength of light. Many standards require scanning in the 660nm (visible red) or 940 (invisible infrared).

Narrow Bar Width: The Narrow Bar Width (NBW) is the optimum width of the narrowest bar element in a

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Automatic Data Collection – Bar Coding Glossary of Basic Terms and Definitions (continued)

bar code. The entire bar code is built around a multiple of the NBW. By changing the NBW, the overall size of the bar code is directly proportional increased. Also referred to as the 'X' dimension

NIST: National Institute of Standardized Testing (NIST) maintains the calibration standards for bar codes, bar code scanners, and bar code verifiers.

No Read: A No Read is the absence of data at the scanner output after an attempted scan due to no code, defective code, scanner failure, or operator error.

Nominal: The exact or ideal intended value for a specified parameter. Tolerances are specified as positive and negative deviations from this value.

Non-Read: See "No Read"

Number System: A method of identifying individual or groups of objects. Number systems are of two types: Significant digit where each item is uniquely identified or Non-significant digit where sequential numbers are assigned regardless of product or item description.

Numeric: A character set that includes only numbers

Opacity: Ink opacity is the property of an ink that prevents the substrate from showing through. The ratio of the amount of reflectance with a black backing compared to the amount of reflectance with a white backing.

Orientation: The alignment of a bar code symbol with respect to the direction of movement on a printing press or conveyor line. Two possible orientations are Picket Fence, where the bars are in the same movement direction and Ladder where the bars are perpendicular to the movement direction.

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. In this example to encode three characters, seven characters are required to be printed.

PCS: See "Print Contrast Signal"

PDF417: PDF417 is a stacked symbology that was created to encode the complete ASCII character set in a high-density format. It has the ability to encode 1800 characters and many standard application standards exist for applications such as driver's license and shipping labels. Each symbol has between 3 and 90 rows. Each row contains a start pattern, a left row indicator, from 1 to 30 data characters, a right row indicator, and a stop pattern. Several levels of error correction can be selected. Portions of the bar code can be damaged or removed and the bar code can still be successfully decoded.

Pen Scanner: See "Wand"

Picket Fence: See "Orientation"

Postal codes: Postal Codes are height-modulated symbologies. All bars and spaces are the same width. Bars are either tall or short. Depending on the combination of tall and short bars, address information is encoded into the bar code.

Print Contrast Signal: Print Contrast Signal (PCS) is a measurement of the ratio of the reflectance between the bars and spaces of a symbol, commonly expressed as a percent.

PCS is calculated as:

$$PCS = R1 - R_d \text{ divided by } R1, \text{ where } R1 \text{ is the reflectance of the light background and } R_d \text{ is the reflectance of the dark bars.}$$

Print Contrast: See "Print Contrast Signal"

Print Quality: Print Quality is the term to describe the measure of compliance of a bar code symbol to the requirements of dimensional tolerance, edge roughness, spots, voids, reflectance, PCS, quiet zone,

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Automatic Data Collection – Bar Coding Glossary of Basic Terms and Definitions (continued)

and encodation.

Quiet zone: A clear space that is void of any graphics or text around a bar code. On linear symbologies, it is the area before the first vertical and after the last vertical bar. The standard size is typically 10 times the narrow bar width.

Reflectance: Reflectance is the amount of light of a specified wavelength or series of wavelengths measured from a test surface as compared to the amount of light measured from a barium oxide or magnesium oxide standard under similar illumination conditions.

Resolution: Resolution is the narrowest element dimension that can be distinguished by a particular bar code reading device or printed with a particular device/method.

Ribbon: A cloth or plastic tape with several layers of material, one of which is ink-like, that produces the visible marks on a substrate. Used on dot matrix and thermal transfer printers

RSS-14 Composite: RSS-14 Composite consists on a linear component, which encodes the item's primary data, and a 2D composite component, which will encode supplementary data to the linear component.

RSS-14 Stacked Omni directional: RSS-14 Stacked Omni directional is a full-height two-row format. It has the same application as the full-height RSS-14 but is used where a narrower symbol is needed. The separator pattern between the two rows is designed to eliminate cross-row scanning errors.

RSS-14 Stacked: RSS-14 Stacked is a truncated two-row format. The first two segments are in the top row and segments three and four in the bottom row. It has the same application as RSS-14 Truncated but is used where a narrower symbol is needed.

RSS-14 Truncated: RSS-14 Truncated has a reduced height to fit on small items that will be read by hand held scanners.

RSS-14: RSS-14 enables the full 14-digit UCC/EAN numbering of items. Some formats have omni directional scanning capabilities. RSS-14 can be scanned and decoded in four segments and then reconstructed. This facilitates omni directional scanning. Each segment consists of a data character and its adjacent finder pattern. The finder patterns encode a Mod 79 check value. The full height version of RSS-14 has omni directional scanning capability so that it can be scanned at retail point-of-sale. RSS-14 is smaller than UPC-A.

Scanner: A scanner is an electro/optical device that converts the bars and spaces of a bar code field into electrical signals.

Space: The lighter element of a bar code usually formed by the background between bars

Stacked Bar code: Stacked bar codes are linear bar codes that have been broken into pieces and stacked on top of each other. Stacked bar codes are in between a 2D bar code and a linear bar code in terms of size. However because the vertical bar height is not as large as a linear bar code it is more susceptible to damage causing a bar code to not be decodable. Examples are: Code 49, PDF417, microPDF417.

Standard 2 of 5: Standard 2 of 5 is a linear symbology that was created to encode numeric data and is a low-density symbology. Standard 2 of 5 bar codes are often used in airline tickets, photofinishing, and warehouse application. It is a very simple symbology where the width of the bars determines what number is encoded. It consists of 5 bars, 2 of which are always wide.

Standard: A set of rules, specifications, instructions, and directions to use a bar code or other automatic identification system. Usually issued by an industry organization, examples are: Logmars, HIBCC, U.C.C.

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Automatic Data Collection – Bar Coding Glossary of Basic Terms and Definitions (continued)

Start/Stop Character or Pattern: A special bar code character that provides the scanner with start and stop reading instructions as well as a scanning direction indicator. The start character is normally at the left-end of a horizontally oriented symbol. The stop character is normally at the right-end of a horizontally oriented symbol.

Substrate: Substrate is the surface on which a bar code symbol is printed.

Symbol Density: Symbol Density is the number of data characters per length or area of a bar code.

Symbol Length: The distance between the outside edges of the quiet zones

Symbol: A combination of bar code characters including start/stop characters, quiet zones/data characters, and check characters required by a particular symbology.

Symbology: A predefined method of encoding data into a machine-readable pattern. Different symbologies use various methods to encode the data and different levels of built in data integrity.

Thermal Transfer: A printing system like direct thermal except a one-time ribbon is used and common paper is used as a substrate. Thermal transfer eliminates the problems of fading or changing color inherent in direct thermal printing.

UPC: See UPC-A and UPC-E

UPC-A: Universal Product Code (UPC) A is a linear symbology that was developed for retail applications and is found on consumer products. The first character is the System Digit and is used to identify the associated industry for the product. The next five digits identify the manufacturer. The following five digits identify the specific product and the last digit is a check digit.

UPC-E: Universal Product Code (UPC) E is a linear symbology that is a 'suppressed' version of the UPC A. UPC-E bar codes are used on very small products where there is not enough room for a UPC-A.

Verifier: A Verifier is a device that makes measurements of the bars, spaces, quiet zones, and optical characteristics of a symbol to determine if the symbol meets the requirements of a specification or standard.

Wand Scanner: See "Wand"

Wand: A hand held scanning/verifying wand for linear bar codes, which is used in direct contact with the bar code. Also called "Wand Scanner" or "Light Pen" or "Pen Scanner"

X-dimension: The X-dimension is an approximate measure of the average width of the narrow element. In a linear bar code symbol, it is a measurement of the smallest bar size. In a 2D bar code symbol, it is the smallest element or module size. Also referred to as Narrow Bar Width (NBW)