Standard Terminology Relating to
Automatic Identification Hard Copy Printing Systems [1]

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1. Scope

1.1 The definitions in this terminology are those that relate directly or indirectly to business imaging hard copy printing used in automatic data-capture systems and the measurement of the quality thereof.

2. Referenced Documents

2.1 *ANSI Standard:*
ANSI X3.182 Guideline for Bar Code Print Quality

3. Terminology

3.1 *Definitions:*

2D matrix symbols—see **matrix symbols.**

2D stacked symbols—see **multi-row symbols.**

2D (two-dimensional) symbol, *n*—a machine-readable symbol that must be examined both vertically and horizontally to read the entire message. Two-dimensional symbols may be of two types: matrix symbols and multi-row symbols.

achieved width, *n*—the calculated bar or other element width based on measurements.

AIAG, *n*—an abbreviation for the Automotive Industry Action Group; a standards body composed of representatives from the U.S. automobile industry responsible for the development of a common automotive industry standard relating to symbol technologies and Electronic Data Interchange (EDI).

AIM, *n*—an acronym for the Automatic Identification Manufacturers; a trade association of automatic identification suppliers.

angle of incidence, *n*—the angle between an incident ray and the normal to a surface at the point of contact. When referring to a scanner reading a printed symbol, the angle between the light source scanner beam and the symbol position.

aspect ratio, *n*—*in a bar code symbol*, the ratio of bar height to symbol length.

autodiscrimination, *n*—the ability of a symbol reader to automatically recognize and decode multiple symbologies.

bar, *n*—one of two types of elements comprising a bar code symbol. An element of a bar code symbol whose reflectance is less than the Global Threshold.

bar code, *n*—an array of parallel rectangular marks and spaces in a predetermined pattern.

bar code density, *n*—the number of characters that can be represented in a lineal inch. (See **symbol density**).

bar code label, *n*—an adhesive-backed carrier bearing printed bar code information suitable for a affixing to an apparatus, equipment, or container surface.

bar code reader—see **bar code scanner.**

bar code scanner, *n*—a device used to identify and decode a bar code symbol.

bar code symbol, *n*—an array of rectangular bars and spaces, arranged in a predetermined pattern, following specific rules that represent elements of data referred to as characters.

DISCUSSION—Typical bar code symbols contain a leading quiet zone, start character, data characters, check characters (if any), stop character and a trailing quiet zone. Examples are: UPC code, Code 11, Code 39, Code 128, 2 of 5 code and Codabar.

bar height, *n*—the dimension of a symbol element perpendicular to its width.

bar reflectance (Rb)**,** *n*—the smallest reflectance value in a bar.

bar width, *n*—the thickness of a bar measured from the edge closest to the symbol start character to the trailing edge of the same bar.

bar width ratio, *n*—*in symbologies having two widths*, the ratio of the widest to the narrowest width within the bar code symbol. (See also **wide to narrow ratio**.)

bar width reduction, *n*—a diminution of the nominal bar width dimension on film masters or printing plates to compensate for systematic errors in some printing processes.

base side, *adj*—*when referring to a film master*, the nonimage bearing side (See also the reverse, **emulsion side**.)

bearer bars, *n*—solid lines that are located at the perimeter of some bar code symbols whose purpose is to reduce partial, incorrect scans and support the printing plate. Bearer bars do not contain information.

bi-directional, *adj*—*in reference to bar codes*, symbologies that may be decoded whether scanned in one direction or the reverse direction.

charge coupled device, CCD, *n*—an array (linear or matrix) of transductive elements wherein packets of electrons are set in each element as a result of the quantity of light received

during an exposure interval, and where these packets are recovered from the array in the form of a pulse height-modulated electric signal.

characters, *n—in bar code symbols*, the smallest group of elements that represent one or more numbers, letters, punctuation marks or other information.

character set, *n*—those characters available for encodation in a particular automatic identification technology.

check character, *n*—a calculated character included within a symbol whose value is used to perform a mathematical check of the accuracy of the decoded data.

clear area, *n*—a space containing no dark marks, which precedes the start character of a symbol and which follows the stop character. Also, the region of a document reserved for OCR characters and the required unmarked space around these characters. (See also **quiet zone**.)

code density, *n*—the number of characters that can appear per unit of length, usually expressed as characters per inch (cpi).

code medium, *n*—the material used to construct a machine-readable code; such materials may be retroreflective, luminescent, magnetic, opaque, transponder or conductive.

code set, *n*—the specific assignment of data characters to symbol characters.

code word, *n—in reference to bar codes*, an arrangement of bars and spaces used to communicate one or more data characters.

concatenation, *n*—the linking or chaining together of either separate items of data in a bar code symbol, or of the data contained in two or more separate bar code symbols (also referred to as "message append").

compliance indicator, *n*—a specified string of three characters indicating that the message which follows conforms to the requirements of a particular standard.

contact scanner, *n*—a bar code reader that requires physical contact between the code medium and the scanner.

continuous bar code, *n*—a bar code symbology where all spaces within the symbol are parts of characters and no inter-character spaces are present.

contrast, *n*—the difference in reflectance between dark bars and light spaces of a bar code symbol.

data element, *n*—a single, atomic piece of data that cannot be subdivided and still retain any meaning.

data identifier, DI, *n*—a specified character, or string of characters, that define the intended use of the data elements that follow.

decoder, *n—as part of the two-dimensional symbol and linear bar code reading systems*, the electronic package that receives the signals from the scanner, executes the algorithm to interpret the signals into meaningful data, and acts as the interface to other devices.

delta code, *n—in encoding information in a one-dimensional medium*, intervals that are subdivided into modules that are assigned values of "1" or "0" where "1s" are bars and "0s" are spaces. Examples are UPC, Code 128, Code 93 and Code 49.

density, *n—in printed symbologies*, the number of data characters that can be contained in a given unit of measure.

Linear bar code density is expressed in characters per inch (CPI) and two-dimensional symbol density is expressed in characters per square inch (CPSI).

depth of field, *n—in bar code reading*, the difference between the minimum and maximum distance from the aperture of the reader to the symbol throughout which the bar code can be accurately interpreted.

diagnostic verifier, *n*—a device that automatically evaluates the quality of a film master or a printed code by comparing the observed information to a standard for the printed symbol.

diffuse reflection, *n*—the component of reflected light that emanates uniformly in all directions from the reflecting surface.

dirt, *n—when referenced for scanning purposes*, the presence of non-reflective foreign particles embedded in a substrate.

discrete bar code, *n*—a bar code symbol in which the intercharacter space is not part of the code and is allowed to vary dimensionally within wider tolerances than those specified for bars and spaces. An example would be Code 39.

EAN International, *n*—abbreviation for the (European) International Article Numbering Association.

EAN symbology, *n*—symbologies specified by the International Article Numbering Association, EAN International.

edge contrast, EC, *n*—the difference between the space reflectance (*Rs*) and the adjoining bar reflectance (*Rb*) as calculated by the equation: $EC = Rs - Rb$.

edge-to-edge symbologies, *n*—a bar code scheme that 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. Examples are Code 93, Code 128, Code 49 and Code 16K.

Electronic Industries Association, EIA, *n*—an abbreviation for a standards organization in the United States specializing in the electrical and functional characteristics of interface equipment.

electronic data interchange, EDI, *n*—the communication of data between business trading partners accomplished in a standard format and syntax.

element, *n—in coded symbologies*, a single bar or space in linear or stacked configurations or a single cell in matrix (2-D) configurations.

element edge, *n*—the location where the scan reflectance profile intersects the midpoint between the space reflectance (Rs) and bar reflectance (Rb) of adjoining elements.

element width, *n*—the thickness of an element measured from the leading edge of an element to the trailing edge of the same element. (See **X dimension**.)

emulsion side, *n*—the image-bearing side of a film master. (See also the opposite **base side**.)

erasure correction, *n*—a use of error correction characters to correct data errors that have unknown locations.

    DISCUSSION—Only one error correction character is required to correct each erasure.

error correction, *n*—use of error correction characters to locate and correct data errors that have unknown locations.

DISCUSSION—Two error correction characters are required to correct each error (one to locate the error and the second to correct the character's data).

error correction characters, *n*—special symbol characters that are calculated mathematically from other symbol characters for the purpose of error correction, error detection or erasure correction.

error detection, *n*—use of error correction characters to determine that the number of errors in the symbol exceeds the error correction capacity.

DISCUSSION—Error detection prevents the symbol from being decoded as erroneous data.

error correction level, *n*—an indicator of the number of error correction characters in a symbol.

field of view, *n*—the lineal dimension defining the length of a bar code that can be read in one scan, particularly significant in moving beam and array technologies.

filler character, *n*—a character inserted to extend an item of data to achieve a desired length. (See also **pad character**.)

film master, *n*—a master negative or positive film transparency of a specific bar code symbol from which a printing plate is made.

finder patterns, *n*—a unique pattern, containing no data, that is specific to each symbology, whose purpose is to locate the symbol within the reader's field of view.

fixed beam scanner, *n*—either a visible light or laser scanner reading in a set plane.

fixed mount reader, *n*—a bar code reader that is mounted in a stationary fashion to intersect the plane of a bar code symbol passing before the reader. Often employed in conveyor and transport systems.

flux, *n*—the combining of photons of light energy to create radiant power.

DISCUSSION—Luminous flux or visible light energy, ranges from 390 to 770 nm. Radiant flux encompasses all light energy in the optical spectrum—ultraviolet, visible, and infrared wavelengths.

global threshold, GT, *n*—the reflectance level that discriminates bars from spaces in a scan reflectance profile.

DISCUSSION—The global threshold is established through the middle of a profile at a constant reflectance value. The reflectance value is determined by dividing the symbol contrast (SC) by 2 and adding the minimum reflectance, Rmin according to the equation:

$$GT = R\text{min} + (SC/2) \qquad (1)$$

haloing, *n*—a shadow effect around the entire printed segment or around the leading edge of a printed segment caused by excessive pressure between the printing plate and the printed surface.

hand-held scanner, *n*—a scanner held and operated by a human, thus enabling the scanner to be brought to the symbol.

highlighting lines, *n*—*in label printing*, horizontal, thick, divider lines placed above and below the package identification building block.

horizontal bar code, *n*—a bar code symbol presented in such a manner that its overall length dimension is parallel to the horizon; also called, **picket fence.**

human-readable interpretation, *n*—the letters, digits or other characters associated with specific symbol characters and printed along with the linear bar code or two-dimensional symbol.

image processing, *n*—techniques for filtering, storing and retrieving images, and for processing pictorial information by computer.

incident irradiation, *n*—the amount of flux per unit area that is normal (perpendicular) to a surface or detector.

DISCUSSION—If the flux is not normal (not perpendicular), then the component of the angular flux is the incidence. In radiometric terms, incidence is called radiant incidence or irradiance. Irradiance (Ee) is measured in watts per square metre using the formula Ee = W/m2.

ink fill-in, *n*—expansion of a mark beyond specified tolerances.

inspection band, *n*—an area of the bar code symbol where measurements are taken spanning from 10 to 90 % of the average bar height.

intensity, *n*—the amount of radiant or luminous flux per unit solid angle that diverges from a light source.

intercharacter space, *n*—the space between the last bar of one character and the first bar of the next that separates two adjacent characters. Also called intercharacter gap.

label, *n*—a piece of paper, cloth, polymer, metal, or other material affixed to something and indicating its contents, destination, or other information.

ladder code—See **vertical bar code.**

laser marking, *n*—etching of data by lasers that directly mark a surface such as metal, wood, and fiberboard.

laser scanner, *n*—an optical bar code reading device using a low energy laser light beam as its source of illumination.

light pen, *n*—*in a bar code system*, a handheld scanning wand that is used as a contact bar code reader where the operator traverses the reader across the bar code symbol.

light source, *n*—*for symbology readers*, light energy can be emitted in straight lines from a point source or from several points as an extended source.

DISCUSSION—Light sources for bar code reading equipment are typically infrared (900 nm peak), visible red (630 to 720 nm), and incandescent (400 to 900 nm).

linear symbol, *n*—a one-dimensional, linear sequence of rectangular bars and spaces that are arranged in a predetermined pattern following specific rules to represent elements of data that are defined as characters.

DISCUSSION—A typical bar code symbol contains a leading quiet zone, start character, data character(s) including a check character (if any), stop character, and a trailing quiet zone.

machine-readable, *n*—that characteristic of printed information that permits direct transfer of information from a printed surface to a data-processing system without operator intervention.

DISCUSSION—Examples are linear bar codes, 2-D symbologies and optical characters whereby machine reading produces an accurate data stream rendition of information that can be interpreted by a computer program.

magnification factor, *n*—the constant multiplier applied to the nominal dimensions of a bar code symbol to obtain the actual dimensions at which it must be produced.

matrix array, *n*—a set of rows and columns of transductive elements able to convert the quantity of light received to a relatively-sized modulated electrical signal. Distinguished from a linear array. (See **photodiode array (matrix)**.)

matrix symbols, *n*—an arrangement of regular polygon shaped cells where the center-to-center distance of adjacent elements is uniform and the arrangement of cells represents data or symbology functions, or both.

minimum edge contrast, ECmin, *n*—the smallest edge contrast in a scan reflectance profile.

minimum reflectance, Rmin, *n*—the smallest reflectance value in a scan reflectance profile.

minimum reflectivity difference, *n*—the difference between the smallest minimum space reflectance value and the largest maximum bar reflectance value as measured across the entire symbol. According to the equation:

$$MAD = Min\ (As\ min) - Max\ (Ab\ max) \qquad (2)$$

where:
As = Minimum Space Reflectance, and
Ab = Maximum Bar Reflectance.

DISCUSSION—Bar, space, and MAD reflectances can be expressed as percentages or in decimal form. If the reflectance of the bars is determined to be 2 %, and the reflectance of the spaces is determined to be 90 %, then the MAD equals 88 %. MAD = 90 % – 2 % = 88 %.

misread, *n*—a disparity between the data encoded in a symbol and the data output from a code reader. Also known as bad read or mis-scan. Such errors will not be detected by test routines in the decode algorithm. (See also, **non-read**.)

modulation, MOD, *n*—the ratio of minimum edge contrast (ECmin) to symbol contrast (SC) expressed as:

$$MOD = ECmin/SC \qquad (3)$$

module, *n*—the narrowest nominal width of bar or space in a symbol.

DISCUSSION—Wider bars and spaces are often specified as multiples of one module. One or more modules construct an element. Also known as **X dimension.**

modulo, *n*—an arithmetic operation in which the result is the remainder after division. The type of algorithm used to calculate the check digit for certain bar code symbols.

moving beam scanner, *n*—a scanning device where scanning motion is achieved by mechanically moving the light beam through the bars and spaces of a bar code symbol.

multi-row symbology, *n*—symbologies where a long symbol is broken into sections and "stacked" one upon another similar to sentences in a paragraph. Examples are: Code 16K, Code 49 and PDF417.

(n, k) symbology, *n*—a class of bar code symbologies in which each symbol character is *n* modules in width and is composed of *k* bar and space pairs. A subset of these is the *n, k,*
m, class of symbologies, where *m* represents the maximum width of an element in modules. (See **module**.)

N (Wide to Narrow Ratio), *n*—*in symbologies with two element widths*, the wide to narrow ratio of elements is calculated by summing the average wide bar width and average wide space width and dividing the sum by 2 times *Z*. Intercharacter gaps, if applicable, are not included.

$$N = (\text{average wide bar} + \text{average wide space})\ (2 * Z) \qquad (4)$$

nominal width, *n*—*in reference to bar codes*, the intended width of an element.

non-contact, *n*—a method of bar code reading typified by fixed or moving beam scanners having a greater optical throw and depth of field than contact, or wand scanners.

non-read, *n*—the failure of a bar code scanner to recognize or decode a bar code symbol after a scanning attempt. Such a non-read may be caused by bar code symbol defects, scanner defects, or operator error.

normative, *n*—information that is part of the standard.

number system character, *n*—the first, or left-hand, digit in a UPC number that identifies a particular numbering system. Similar to AI or DI numbers, but used specifically for retail applications according to UCC rules

omnidirectional, *adj*—refers to a code format that can be read, regardless of orientation, from a multiplicity of angles.

DISCUSSION—Many omnidirectional scanners employ multiple *x*-axis and *y*-axis scan patterns to achieve the omnidirectional capability when scanning linear bar codes.

opacity value, *n*—the calculated value of a material by means of two reflectance measurements, *R*1 and *R*2. The first measurement, *R*1, is taken on a sample of a blank material using an infinite pad backing. The second measurement, *R*2, is taken of the same blank material with black backing. The reflectance value of the black backing should not exceed 5 %. The opacity value is calculated according to the following equation:

$$\text{Opacity value} = 1.00 - (R1 - R2/R1) = R2/R1 \qquad (5)$$

optical throw, *n*—the distance from the aperture of a bar code reader to the leading vertical plane of the depth of field. Also, the minimum distance a bar code symbol can be away from a scanner and still be successfully read.

oscillating mirror scanner, *n*—a single beam scanner with a mirror that oscillates in a plane at right angles to the scanner beam which causes the field of view to be swept by the beam.

overall profile grade, *n*—*as defined in ANSI X3.182*, the lowest grade received by measurement of the following parameters: edge determination, overall profile reflectance grade, decode and decodability; grades may be denoted by letters (*A* to *F*) or numbers (4.0 to 0).

overhead, *n*—*in a bar code system*, the fixed number of symbol characters required for start, stop, and checking in addition to data carrying characters. As an example, a symbol requiring a start, stop and single check character contains three characters of overhead.

over-laminate, *n*—*in reference to code printing*, a coating or material added to protect a printed symbol.

pad character, *n*—See **filler character.**

paper bleed, *n*—an optical phenomenon that causes bars to appear larger and spaces to appear narrower than actually printed because of the scattering of incident light rays within the media.

parity, *n*—a system for encoding characters as 'odd' (having an odd number of binary ones in their structure) or 'even' (having an even number of binary ones in their structure), used as a self-checking mechanism in bar codes.

DISCUSSION—A parity bit (parity bar or module) can be incorporated into an encoded character to make the sum of all the bits always odd or always even, which then becomes a fundamental check.

photocell/photoelectric cell/photo-sensor, *n*—a solid-state, photosensitive, electronic device in which use is made of the variation of current-voltage characteristics as a function of incident radiation (light).

DISCUSSION—In conveyor and transport systems, a photocell may serve as a presence sensor to identify that an item is in view and ready to be scanned.

photodiode array (linear) (PDA), *n*—a group of very small photodiodes, arranged in a line, that detects photon energy (light) from the radiation that strikes a surface and measures the amount of reflected light as electrical pulses.

DISCUSSION—When used in a bar code reading device, photodiode arrays detect saturation (high reflection indicates a light space) and black (minimal reflection indicates a dark bar). Each photodiode in the array is sampled by a microprocessor, and the image of the bar code is decoded by the microprocessor.

photodiode array (matrix) (PDA), *n*—an area photodiode array, having a two-dimensional configuration.

DISCUSSION—Matrix arrays permit the viewing of more vertical areas of a bar code symbol permitting vertical redundancy to average out printing defects. Common configurations are a 64 by 64 array or a 128 by 128 array.

photometer, *n*—a device that measures the intensity and brightness of a light beam.

picket fence code, *n*—a bar code printed so that individual bars are vertical (perpendicular to the horizon); the bars look like pickets in a fence. See the reverse, **vertical bar code** or **ladder code.**

preprinted symbol, *n*—a symbol printed in advance of application either on a label or on the article to be identified.

print contrast signal (PCS), *n*—a comparison between the reflectance of printed bars and intervening spaces. PCS, under a given set of illumination conditions, is defined by the following equation:

$$PCS = \frac{Rs - Rb}{Rs} \qquad (6)$$

where:
Rs = Space relectance, and
Rb = Bar reflectance.

print gain, *n*—gain in bar width of the printed bar code symbol, compared to the original precision film master; caused in the plate-making process by ink spread during printing.

DISCUSSION—Film masters are made with a predetermined amount of bar width reduction (BWR) to compensate for print gain.

print quality, *n*—as described in ANSI X3.182, the grade of a printed bar code symbol as rated by measurements and calculations of various parameters.

printability gage, *n*—a printer's tool used to determine the amount of print gain under given printing conditions.

printability range, *n*—the range of print gain found under actual working conditions, based on press sheets selected at random during a press run.

quiet zones, *n*—areas of high reflectance (spaces) immediately preceding the start character and following the stop character of a machine-readable symbol as defined for a particular symbology. (See also **clear area.**)

radiation pattern, *n*—the optical pattern of light that leaves the media surface, as described by the radiated light intensity at various angles.

random errors, *n*—errors introduced by the printer, reader, operator, or other system element; errors that are encountered during one scan that may not be encountered during the next scan.

read area, *n*—area covered by a scanner. Bar codes must reliably pass through the read area with the length of the symbol parallel to the scan plane.

reader, *n*—a device used for machine reading of bar codes that usually consists of a scanner, a decoder, and a data communications interface.

reflectance, absolute, *n*—the ratio of the total reflectance from a document to the total light incident on that document.

reflectance, diffuse, *n*—reflected light whose angle of reflection varies from the angle of incidence of the illuminating light, such as in reflection from a rough surface.

reflectance, specular, *n*—reflected light whose angle of reflection is equal, or nearly equal, to the angle of incidence of the illuminating light, such as in reflection from a mirror.

resolution, *n*—*in a bar code system*, the narrowest element dimension that can be distinguished by a particular reading device or method.

retro-reflective, *adj*—a characteristic of material that reflects light back to its source regardless of the angle of incidence.

reverse image, *n*—a symbol in which the dark areas are represented by the material substrate (background) and the light areas are represented by the printed portion of the symbol.

scan, *n*—the search for a symbol which is to be optically recognized; also, a search for marks to be recognized by the interpretation unit of an optical scanner.

scanner, *n*—a device that examines a spatial pattern, part by part, and generates analog or digital signals corresponding to the pattern.

DISCUSSION—Examples are scanners used in mark sensing, pattern recognition, character recognition, and bar code recognition. In bar code reading applications, the scanner converts bar code symbols to electrical signals for input to a reader for decoding and subsequent transfer to a data communications interface.

scanning/reading range (also called Operating Range (OR)**,** *n*—the combined distance of optical ability of a lens, a photographic material, or a photographic system to distinguish detail under specific conditions. Also, the narrowest

element dimension that can be distinguished by a particular reading device.

scan reflectance profile, *n—according to ANSI X3.182,* a record of the reflectance measured using the reference reflectivity method across the entire bar code symbol.

self-checking bar code, *n*—a bar code that will not permit a single printing defect to be interpreted as a valid character within the symbology algorithm.

self-clocking, *n*—a bar code symbol designed to be read with a single aperture reader over a range of velocities, with allowances included for change in velocity after reading has commenced.

skew, *n*—rotation of a bar code symbol about an axis parallel to the symbol's length.

slot scanner, *n*—the scanning portion of a point-of-sale system embedded within a retail checkout counter.

DISCUSSION—Traditionally, a helium-neon laser is employed, reflecting the light beam by a series of mirrors to create a pattern that reads the UPC symbol. The symbol is drawn across the scanner window so that at least one beam of light intersects the entire UPC symbol. Also called desk scanner or checkout scanner.

source marking, *n*—the bar code marking of a specific item at the point of initial production of the item.

space, *n*—the element of a bar code symbol whose reflectance is greater than the global threshold (equivalent to a binary 0) as opposed to the bar or dark element.

space reflectance (Rs), *n*—in reference to bar codes, the highest reflectance value in a space or quiet zone.

spectral, *adj*—of or relating to, or made by an array of components of an emission or wave separated and arranged in the order of some varying characteristic, such as wavelength, mass, or energy.

spectral band, *n*—an arrangement of a specific set of adjacent wavelengths.

spectral response, *n*—the variation in sensitivity of a reading device to light of different wavelengths.

specular reflection, *n*—the mirror-like reflection of light from a surface. Also, reflection of light from a surface at an angle equal, but opposite to, the angle of incidence.

spot size, *n*—the diameter of the focused image of the emitter in scanners that use apertured optical systems.

spots, *n*—in reference to bar code, unwanted dark areas in the spaces, quiet zones and intercharacter gaps (if applicable) of a symbol that may be caused by presence of extraneous ink, printing errors, or dirt.

start/stop characters or patterns, *n*—distinct characters or patterns used at the beginning and end of bar code symbols that provide timing references and direction-of-read information to the decoding logic.

stepladder code, *n*—see **vertical bar code.**

structure, *n*—the order of data elements in a message.

substitution error, *n*—the replacement of a bar code marked character(s), by an erroneous character(s) usually traceable to poor quality printing, decoding logic error, human input error, or any combination thereof.

substitution error rate, SER, *n*—the ratio of the number of invalid or incorrect characters entered into the data base to the number of valid characters entered.

substrate, *n*—the material (usually paper, plastic or metal) upon which a bar code symbol is printed or reproduced.

symbol, *n*—a combination of linear bar code or two-dimensional symbol characters including start/stop characters, quiet zones, data characters, special function characters and error detection or correction characters, or both, required by a particular symbology to form a complete, scannable entity.

symbol character, *n*—a unique bar or space pattern, or both, which is defined for a particular symbology.

symbol check character, *n*—a symbol character calculated from other characters in a bar code symbol determined by an algorithm defined in the symbology specification and used to verify that the bar code has been correctly composed and read. The symbol check character does not include data encoded in the symbol.

symbol contrast, SC, *n*—in reference to bar codes, the difference between the largest and smallest reflectances in a scan reflectance profile.

$$SC = R\text{max} - R\text{min} \tag{7}$$

symbol density, *n—in reference to bar codes,* the number of characters per lineal inch, limited by the width of the narrowest bar or space.

symbol grade, *n—in reference to ANSI X3.182,* the simple average of all profile grades using the standard weighting 4.0 = A, 3.0 = B, 2.0 = C, 1.0 = D, and 0.0 = F.

DISCUSSION—The symbol grade may be stated as a decimal or converted to a letter grade. A meaningful symbol grade must include aperture diameter. The format for denoting the symbol grade is: "Symbol Grade" followed by "Measuring Aperture Number" followed by a forward slash (/) followed by the wavelength(s) in nanometers.

symbol length, *n*—the physical length of a bar code symbol, including quiet zones.

DISCUSSION—As an example, for Code 39:

$$L = (C+2)(6X + 3NX) + I(C+1) + 2Q \tag{8}$$

where:
L = length of symbol,
C = number of data characters (including data identifiers and check characters),
X = nominal width of narrow element (X dimension),
N = ratio of wide element to narrow element,
I = width of intercharacter gap, and
Q = width of quiet zone.

symbology, *n—in reference to readable codes,* a discrete set of characters used to represent and transmit information by use of a set of rules for encoding information in the symbol by an arrangement of parallel, rectangular, bars and spaces arranged in a predetermined pattern or by two dimensional cells arranged according to unambiguous rules.

DISCUSSION—Examples of bar code symbologies include: Code 39, UPC/EAN, Interleaved 2 of 5, Code 128, Code 49, Code 16K, and PDF417.

symbology identifier (SI), *n*—an optional three character code that may prefix transmitted data from a bar code reader identifying the symbology read and any options enabled in the reader or special features of a symbology encountered.

symbology reference decode algorithm, *n*—a decoding algorithm that may be found in a particular application or symbology specification, or both.

syntax, *n*—in reference to codes, the rules governing the use of appropriate identifiers, delimiters, separator character(s), and other non-data characters as well as data positioning within the message.

systematic error, *n*—errors introduced by the printer, reader, or other system elements that are consistent for all bars or all spaces.

tilt, *n*—rotation of a bar code symbol about an axis perpendicular to the substrate. Compare **pitch, skew**.

toner, *n*—a dispersion of concentrated pigment or dye used to manufacture, strengthen or modify the color of an ink.

topology, *n—in a computer network*, the physical layout including the method of connection between nodes.

transition point, *n—in bar code reading*, the edge of a space or bar where continued movement to an adjacent and complementary module causes a photodetector to reverse its bias from dark current to saturation and vice versa.

truncation, *n—in bar code printing*, decreasing the length of bars to reduce the height of the symbol below normal specifications.

two-dimensional symbology—see **2D symbol**.

Uniform Code Council, Inc., U.C.C., *n*—a standard setting organization originally chartered by the National Grocer's Association; it supervises the standards for the Universal Product Code, UPC.

UCC/EAN, *n*—a consortium of UCC and EAN that promulgates international standards.

UN/EDIFACT—abbreviation for United Nations, Electronic Data Interchange for Administration, Commerce and Transport, an international group dedicated to standards for electronic interchange.

Universal Product Code, UPC, *n*—a bar code symbology specified by the Uniform Code Council.

verification, *n*—a technical process used to evaluate whether or not a specific symbol meets a standard specification.

verifier, *n*—a device that measures bars, images, spaces, quiet zones, locator points and optical characters of a symbol to determine whether or not a standard specification is met.

version A, *n—when applied to UPC codes*, the standard 12-digit symbol.

version E, *n—when applied to UPC codes*, a 6-digit symbol formed by zero suppression.

vertical bar code, *n*—a symbol oriented so that the bars are parallel to the horizon; also termed ladder or step ladder bar code.

vertical redundancy, *n*—the availability of more than a single scan path through the elements of a bar code symbol.

visible laser diode, VLD, *n*—a light source operating in the human visible light spectrum.

void(s), *n*—in bar code standards, unwanted light areas contained within the dark elements of a positive bar.

wand scanner, *n*—a hand-held device used as a contact bar code or OCR reader.

wide-to-narrow-ratio, *n*—a calculated proportion comparing the width of wide elements to narrow elements in a bar code having two widths

width code, *n—in bar code symbology*, a binary code that assigns a value of one to the wide element (bar or space) and a value of zero to the narrow element.

X dimension, *n—in bar code symbology*, the intended width of the narrow elements as set by the application or specification, or both.

Y dimension, *n—in a bar code symbology*, the specified height of elements.

Z-Axis, *n—in bar code reading*, a coordinate related to the orientation and movement of a symbol on a transport system.

Z dimension, *n—in bar code reading*, a calculation of element width achieved by adding the average element width of bar and space and dividing by two.

DISCUSSION—Example: Z_d = average narrow bar + average narrow space divided by 2.

zero suppression, *n—in bar code reading*, the technique used to shorten UPC codes by omitting zeros from the symbol.

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