Bar Code Basics

Bar Code and Scanning Basics

A bar code is a group of rectangular bars and spaces arranged in a preset pattern. The pattern is organized to represent elements of data referred to as characters. All codes can represent several numeric and/or alphanumeric characters.

There are many different types of bar codes. Each type uses its own symbology, which defines how the bars and spaces represent letters and/or numbers. Common bar code symbologies include Interleaved 2 of 5, Code 3 of 9, Code 28, UPC, EAN and Codabar.

The figure below shows each part of a bar code. The labels for each part remain the same even in the position, orientation or type of bar code changes.

Bar height – The height of the shortest bar in a bar code. This measurement determines how fast the bar code can pass through the scanner.

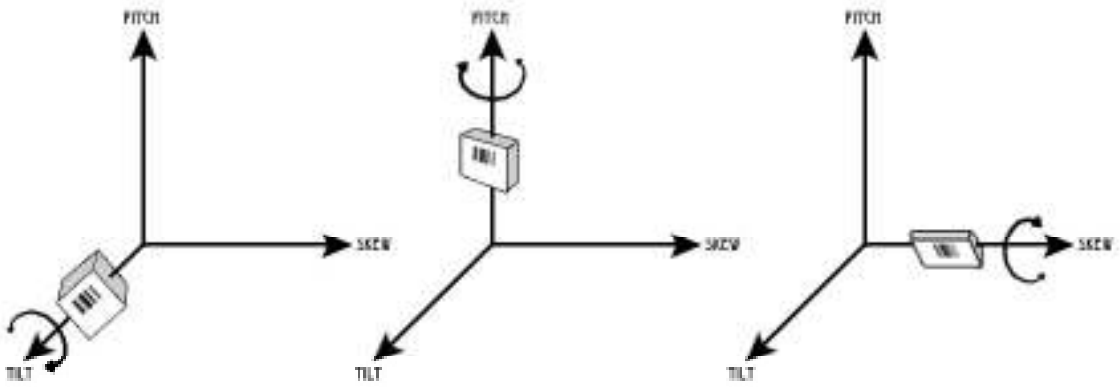
Bar width – The thickness of a bar measured from the edge of the previous space to the beginning of the next space.

Space width – The thickness of a space measured from the edge of the previous bar to the beginning of the next bar. The narrow bar and space width determine the depth of field (See the following section, Scanning Terminology, for the definition of depth of field).

Quiet zone – The required distance before the first bar and after the last bar of the code that must be free of marks or printing. A valid quiet zone is defined as 10 times the width of the narrowest bar in the code.

Scanning Terminology: Tilt, Pitch and Skew

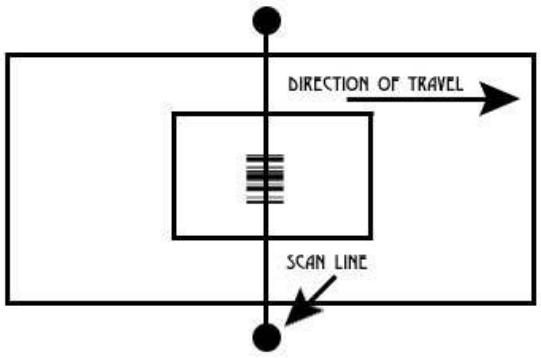
Variation in code placement affects the ability of a scanner to read a code. The terms tilt, pitch and skew deal with the angular variations of code placement in the X, Y and Z axes. The diagram below illustrates these variations.



Tilt – Rotation of a car code symbol about an axis perpendicular to the substrate. Tilt affects the appearance of the bar height to the scanner and can affect the speed at which the bar code can pass the scanner.

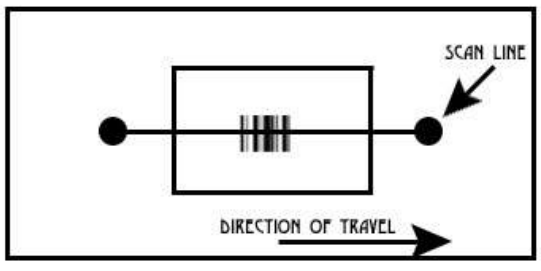
Pitch – Rotation of a bar code symbol about an axis parallel to the direction of the bars. Pitch affects the appearance of the narrow bar and space width and may reduce the depth of field.

Skew – Rotation of a bar code symbol about an axis parallel to the symbol's length. Skew reduces the bard height, reducing the speed at which the bar code can pass the scanner.



Ladder Orientation

When all bars in a code cross the scan line simultaneously, the code is in the ladder orientation. The time the bar code is scanned is proportional to the bar height. Increasing the bar height increases the time that the bar code is being scanned. See the ladder orientation diagram.



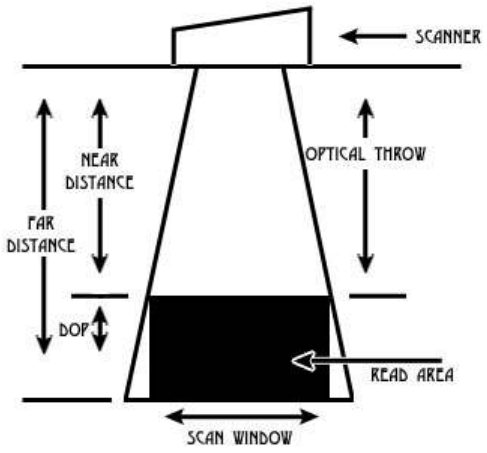
Picket Fence Orientation

When the bars of a code cross the scan line in succession, the code is in the picket fence orientation. The time the bar code is scanned is proportional to the scan window. Increasing the size of the scan window increases the time that the bar code is being

scanned. See the picket fence orientation diagram.

Omni-directional

A bar code is an omni-directional orientation when the bars may face any direction in the relation to the bar code's direction of travel.



Measures

When installing a scanner some important parameters must be set. These parameters determine the distance from which bar codes can successfully be scanned. Some of these parameters are shown in the diagram below.

Near Distance - The distance (in inches) from the face of the scanner to the closest point at which a code can be successfully scanned.

Far Distance - The distance (in inches) from the face of the scanner to the farthest point at which a code can successfully be scanned.

Depth of Field - The distance (in inches) between the near and far distance. This is the area in which a scanner can successfully scan a code.

Scan Window - The usable length of the scan line emitted from the scanner. Codes outside of the scan window will not be decoded.

Optical Throw - Same as near distance.

Maintaining Quality Bar Codes

The bar code is one of the most important components of a data collection system. If the bar code does not scan, if it contains incorrect data, or if it falls off the package, the whole system will not function as designed, and your read rates will be lower than expected. Here are some suggestions to maintain quality in your bar codes.

- Train operators well
  - Operators should recognize visible label defects. They should keep samples of good and bad labels on hand as a reference tool
- Perform basic printer maintenance regularly
  - If you are using thermal print heads, keep them clean. If you are using a dot matrix unit, be sure to chance the print ribbon regularly because a faded code might not be readable by a fixed position scanner. Put one person in charge of all printer maintenance tasks.
- Do not change a component without testing
  - Stick to quality supplies, such as ribbon or label stock, that vendor recommends. Also run the acceptable print speeds for your ribbon and media combination.

- ❖ Check bar code print quality at print time and after it has been placed
    - It is important to know the life of a label when applied to a package, as well as the effect of shrink wrap over the bar code. A matte laminate is better to use than a glossy wrap. You also need to know if your scanner is capable of reading the bar code type you are using. Accu-Sort recommends that all labels are rated Grade A or B according to the ANSI Bar Code Print Quality Standard. (ANSI X3.182 – 1990)

Glossary

Alignment
The position of a scanning or detection device in relation to the target scanning area or receiving element. Bother the reader and the photoeye require proper alignment to assure optimal performance.

Ambient Light
The lighting conditions in the scanning area. Ambient light can interfere with successful scanning of bar codes.

ANSI (American National Standards Institute)
The principle standards development group in the US. A non-profit, non-governmental group supported by over 1000 trade organizations, professional societies and companies. Member body to the ISO (International Standards Organization).

Bar
The dark elements of a printed bar code symbol. Referred to as elements in 2D symbologies.

Bar Code
An array of rectangular bars/elements and spaces arranges in a predefined pattern to represent elements of data referred to as characters.

Bar Code Character
A single group of bars and spaces that represent an individual number, letter, or any other symbol.

Bar Code Density
The number of characters that can be represented in a linear unit of measure. Bar code density is often referred to in characters per inch (CPI).

Bar Code Label
A label that carries a bar code and can be affixed to an article.

Bar Code Reader, Reader
A single device that performs two functions: 1. examines a printed special pattern (bar code) and then, 2. decodes the encoded data.

Bar Code Symbol
A group of bars that represent a character or group of characters whose width and spacing is determined by a set of rules. In most cases, human readable characters are printed below the bars.

Bar Height
The height of the shortest bar in the bar code.

Bar Length
The bar dimension perpendicular to the bar width.

Bar Width
The thickness of a bar measured from the edge closest to the symbol start character to the trailing edge of the same bar.

Baud Rate
A unit used to measure communications speed or data transfer rate; represents the number of discrete conditions or events per second.

Bed Width
The width of the conveyor bed measured in inches.

Belt Width
The width of the conveyor belt measured in inches.

Bi-directional
A bar code symbol capable of being read successfully independent of scanning direction.

Bottom Read
When the scanner is mounted under the conveyor to read codes on the bottom of the boxes or on the front or back of the boxes. If used there is not enough clearance for a standard front or back read.

BPS (Bits Per Second)
Unit of data transmission rate. *See baud rate*.

Bridge
An interface between links in a communication network that routes messages from one link to another when a station on one link addresses a message to a station on another link.

CART
See Trigger

Character
A single group of bars and spaces in a code that represent an individual number, letter, punctuation mark or other graphic element. Used as part of the organization, control, or representation of data.

Character Set
Those characters available for encodation in a particular automatic identification technology.

Codabar
For details, *see Symbologies*.

Code 128
For details, *see Symbologies*.

Code 39
For details, *see Symbologies*.

Code 93
For details, *see Symbologies*.

Code Length
The length of the bar code measured from the start of the first bar to the end of the last bar.

Code Orientation
The relationship of the bar code with reference to the scan head's reading zone. Typical code orientations are Ladder and Picket Fence.

Code Placement
Variation in code placement affects the ability of a scanner to read a code. The terms Tilt, Pitch and Skew deal with the angular variations of code placement in the X, Y and Z axis. Variations in code placement affect the pulse width and therefore the deciding of the code. Pulse width is defined as a change from the leading edge of a bar or space to the trailing edge of a bar or space over time. Pulse width is also referred to as a transition. Tilt, Pitch and Skew impact the pulse width of the code.

Code Quality
The number of scans successfully decoded during a read cycle.

Code Set
The specific assignment of data characters to symbol characters.

Continuous Code
A bar code symbology where all the spaces within the symbol are parts of the characters (Interleaved 2 of 5). There is no interactive gap in a continuous bar code symbology.

Continuous Trigger
This form of trigger requires no input signal. The reader is continuously attempting to decode bar codes. When a reader is in "continuous trigger", there is no way of determining if there is a package present or a NO-READ.

Conveyor Speed
The speed that the conveyors is moving in feet per minute. Conveyor speed directly impacts the time that the code is in front of the reader; therefore, it affects the number of reads that are possible. Scanning systems require consistent conveyor speeds to assure accuracy.

CPI
Characters per inch. *See density*.

Decoded
The process of translating a bar code into data characters using a specific set of rules for each symbology.

Decoder
As part of a bar code reading system, the electronic package that receives the signals from the reader, performs the algorithm to interpret the signals into meaningful data and provides the interface to other devices.

Decoder Logic
The electronic package that receives signals from the scan head, interprets the signals into useful data and provides the interface to other devices.

Depth of Field (DOP)
The distance between the maximum and minimum plane in which a symbol can be read. The range is from the specified optical throw to the far reading distance.

Density
The number of data characters that can be represented in a linear unit of measure. Bar code density is often expressed in characters per inch.

Discrete Code
A bar code or symbol where the space between characters, inter-character gap, are not part of the code, as with Code 39. *See continuous code*.

Far distance
The distance (in inches) from the face of the scanner to the farthest point at which a code can be successfully scanned.

Feet Per Minute (FPM)
Typically used to define the speed of a conveyor. Conveyor speed may also be defined in meters per second.

Front Read
The scanner is mounted to read bar codes on the leading edge of a box as it passes the scanner. In a front read application, the scanner can be mounted above or on the side of the conveyor.

Front/Top Read
The camera is mounted to read the front and top of packages as they pass through the scanning area. In a front/top read application, the camera is usually mounted above the conveyor positioned at a 45 degree angle to enable it to scan both the front and top of packages.

Gateway
A device used to connect networks using different protocols so that information can be passed from one system or network to the other(s).

Hardware Trigger
This is an electrical signal from a relay, photoeye, or proximity switch indicating that an object is passing by the reader.

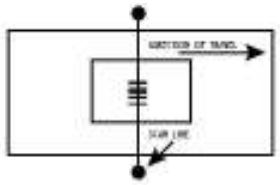
Height of Scan
The maximum vertical scanning dimension of a moving beam scanner at a specific distance from the face of the scanner.

Host
1) A central controlling computer in a network system. 2) Any device on a network system that provides a controlling function to another device on the network. 3) Any intelligent device for which another device is providing a communication interface to a network.

Inter-character Gap
The space between two adjacent bar code characters in a discrete code.

Interleaved Bar Code
A bar code in which characters are paired together using bars to represent the first character and spaces to represent the second.

IP Address (Internet Protocol Address)
IP Address is the numeric address given to a network card which enables other devices on a network to find it. For readability, this number is displayed in "dotted-decimal" format (e.g.: 127.0.0.1) as opposed to the binary equivalent (e.g.: 01111111000000000000000000000001).



Ladder Orientation
When the bar code's bars are positioned horizontally on the product, causing them to appear as a ladder. The ends of all bars will enter the scan window first.

LAN
The acronym for local area network. A LAN system is usually confined to the same building or a few nearby buildings, with all equipment linked by wiring dedicated specifically to the LAN.

Laser Scanner
An optical bar code scanning device using a low energy laser light beam as its source of illumination. A laser scanner or scan head sends the information it collects to the decoder.

LED (Light Emitting Diode)
A semiconductor generally made from gallium arsenide, that can serve as a visible or near infrared light source when voltage is applied continuously or in pulses. LEDs have extremely long lifetimes when properly operated.

Linear Bar Codes
Also referred to as 1D or 1-dimensional symbologies. Examples: Code 39, I2of5, UPC.

Mil
One thousandth of an inch (.001 inch). Bars and spaces of codes are commonly referred to as being certain number of mils wide.

Misread
The scanner incorrectly decodes a bar code as it passes through the scan zone.

Moving-Beam
Rather than using a stationary laser beam and relying on product movement for a single scan, a multi-facet mirror wheel and motor is used to 'move' the beam across the code several times while in motion itself.

Moving-Beam Bar Code Scanner
A device that dynamically searches for a bar code symbol by sweeping a moving optical beam through a field of view called the scanning zone. Automatic bar code reader that reads codes by sweeping a moving optical beam through a field of view. Moving-beam scanners are usually mounted in a fixed position and read codes as they pass by.

Narrow Bar (NB)/Narrow Space (NS)
Smallest code element, bar or space, in the bar code symbol. Also known as the X dimension.

Near Distance
The distance (in inches) from the face of the scanner to the closest point at which a code can be successfully scanned.

No-Read
When the scanner is unable to decode a bar code as it passes through the scan zone.

Omni-Directional
Orientation is unpredictable and can be ladder, picket fence, or any angle in between. A single scan line is not sufficient to scan bar codes oriented omni-directionally.

One-Dimensional Symbologies
Also referred to as linear codes. Examples: Code 39, I2of5, and UPC are all 1D or linear bar codes.

Operating Range
The sum of the scanner's optical throw and depth-of-field. Also referred to as the read zone or read range.

Optical Throw
Measured distance from the scanner's window to the near reading distance of the depth of field. Typically, this is the closest a bar code can be to the scanner's window and still be properly decoded.

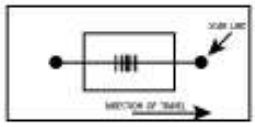
Optimum Reading Distance
Typically, the center of the depth of field.

Orientation
The alignment of the code's bars and spaces to the scan head. Often referred to as vertical (picket fence) and horizontal (ladder).

Percent Good Reads
The number of successful reads per refresh period. This is valid only when the refresh period is set to 0.

Performance Indicator
A bar code decoder function that counts the number of decodes during a trigger period. When the period = 0, the performance indicator provides the number of decodes (up to 100 attempts).

Photoeye
Used as a presence detector (trigger) to identify objects in the bar code reading zone. The photoeye emits a beam and is used with a reflector to create a photoelectric circuit. When an object blocks the beam, breaking the circuit, a signal called TRIGGER is sent to the reader.



Picket Fence Orientation
When the bar code's bars are positioned vertically on the product, causing them to appear as a picket fence. The first bar will enter the scan window first.

Pitch
Rotation of a code pattern about the X-axis. The normal distance between center line or adjacent characters.

Quiet Zone
Required distance before the first bar and after the last bar of the code that must be free of marks or printing.

Reflectance
The amount of light returned from an illuminated surface.

Relative Reader Angle
The mounting angle of the reader as it relates to the conveyor surface and direction of travel.

Resolution
The narrowest element dimension which can be distinguished by a particular reading device or printed with a particular device or method.

Scan
A single pass of a laser beam over the code or a portion of the code. Search for a symbology that is to be optically recognized.

Scan Area
The area intended to contain a symbol, or the location of the conveyor that is being scanned by the reader for bar codes.

Scan Window
The usable length of the scanning beam that may detect the bar codes. Scan window is perpendicular to the depth of field (DOF).

Scanner
An electronic device that optically converts printed information into electrical signals. The signals are sent to the decoder logic.

Scanner Orientation
Relationship of the scan head with reference to the bar code's location on products. The scan head must be set up to insure that all code bars and spaces are bisected at the same time. Typically, either side read or top read is used for picket fence or ladder code orientations.

Side Read
The scanner is mounted to read the side of a box as it passes by the head

Skew
Rotation about the Y-axis. Rotational deviation from correct horizontal and vertical orientation; may apply to single character, line or entire encoded item.

Start and End of Trigger Photoeyes
The trigger cycle begins when the start of trigger photoeye is blocked and continues until the end of trigger photoeye is unblocked. Relay decisions and data communication take place after the end of trigger photoeye is unbroken.

Symbologies
Codabar
Self-checking numeric bar code encoding numbers and several characters (e.g.: $, -, +, ?) with a slightly higher density than Code 39. Includes two bar/space sizes.

Code 39
A bar code with a full alphanumeric character set, a unique start and stop character, and three other characters. The name is derived from its code structure, which is three wide elements out of a total of nine elements. The nine elements consist of five bars and four spaces.

Code 93
Similar to Code 39 but requires two check characters. Code 93 was designed to provide a higher density symbology with higher security than Code 39. Although code 93 is a higher density, it is not self0checking and therefore requires two checksums.

Code 128
A symbology capable of encoding the full ASCII 128 character set. It encodes these characters using fewer code elements per character resulting in a more compact code. It features a unique star and stop character for bidirectional and variable length decoding, both bar and space character parity for character integrity, a check character for symbol integrity, a check character for symbol integrity, a function character for symbol linking, and spare function characters for unique application definition and/or future expansion.

EAN
European Article Numbering System used in retail industry (a superset of UPC) used on product packaging to uniquely identify a product and manufacturer.

Interleaved 2 of 5 (I 2of5)
A bar code with a numeric character set with different start and stop characters. The name is derived from the method used to encode two characters. In the symbol, two characters are paired together using bars to represent the first character and the spaces to represent the second. This interleaved structure allows information to be encoded in both the bars and the spaces. A Start character, bar and space arrangement, at one end, and a different stop character bar and space arrangement at the other end, provide for bidirectional decoding of this symbol.

UPC
Acronym for Universal Product Code. The standard bar code type for retail packaging in the United States and Canada.

Syntax
The rules dictating how you must type a command or instruction to the computer will understand it.

TCP/IP
An industry standard suite of protocols providing communication s in a heterogeneous network environment. TCP/IP stands for Transport Control Protocol/Internet Protocol.

Two-Width Symbology
A bar code symbology whose bar and spaces are characterized simply as wide or narrow. Codabar, Code 39, and Interleaved 2 of 5 are examples of two-width symbologies.

Tilt
Rotation around the Z-axis. Used to describe the position of the bar code with respect to the laser scan line.

Tracking
Process of keeping track of packages as they travel through the scanning area. Tracking can be done based on the leading edge or trailing edge of packages. Belt speed (as monitored via the TACH signal) and reader mounting also figure into the tracking process. Several methods of tracking are available.

Trigger
A signal, typically provided by a photoeye or proximity switch, that informs the scan head of the presence of an object within its reading zone. Sometimes referred to as CART signal.

Trigger cycle
The time during which reader is attempting to read the bar code.

Two-Dimensional Symbologies
More complex bar code capable of containing much larger amounts of data in a smaller image size because of using either a stacked or matrixed construction when compared to the 1D codes. Example 2D codes: DataMatrix, MaxiCode, and PDF417. AXIOM does not read 2D codes.

UPC
Acronym for Universal Product Code. The standard bar code type for retail food packaging in the United States.

UPS
The abbreviation for uninterruptible power supply. A battery-powered united that automatically supplies power to your computer in the event of an electrical failure.

Visible Laser Diode
A light source used in scanners to illuminate the bar code symbol. Generates visible red light at wavelengths between 660 and 700 nM. Replaced Helium-Neon tubes in most scanners because diodes are small and consume less power.

Wide Bar (WB)/Wise Space (WS)
Widest code element, bar or space, in the bar code symbol.

Wide to Narrow Ratio
Dividing the size of the wide elements by the size of the narrow elements of a bar code yields the bar and space ratios. Bar and space ratios can differ. NOTE: If the narrow bar and narrow spaces are equal and the wide bar and wide spaces are equal then you calculate only one ratio.

Window (scan head, reader, or graphical user interface)
1) The physical location on the scan head where the sensor receives reflected laser light from the surface of products. 2) The physical location on a scan head from which the lser light exits the device. Often referred to as the exit window. 3) A software graphical user interface that appears on a monitor with which the users interacts (via keyboard and/or mouse) to operate various user-definable functions. In AXCESS, there are several buttons and drop-down menus available from the Main Window.

“X” Dimension
The dimension of the narrowest bar and narrowest space in a bar code.