Weber®
Labels & Labeling Systems

Contents

Introduction

One of the most sustained waves of technology throughout American industry is the use of bar codes for systematic data collection. It is driven by the need for accurate and timely data gathered from the manufacturing, inspection, transportation and inventory cycles of a business operation.

Bar code symbols have gained acceptance as one of the most accurate and practical media to implement automatic collection of printed data. Bar codes are achieving this widespread popularity because they can be incorporated in the primary source marking of products from production to consumption.

In this handbook, we will introduce you to the fundamentals of bar code composition, the most popular codes, how they are printed, and the types of scanners used to read them.

Benefits of Bar Coding

Bar codes streamline identification. The black-and-white bars that you see on grocery items in your supermarket represent a unique identification for that product. This symbol, called the Universal Product Code (UPC), is the standard for the grocery industry and has been in existence since 1973.

Bar codes have received overwhelming acceptance because they offer the simplest and most accurate, cost-effective approach for identifying objects by using reading machines (scanners).

One of the primary advantages of bar codes over other technologies is its low susceptibility to errors in data input. Bar codes can have built-in safeguards (check digits) to prevent incorrect scans from being entered, minimizing the possibility of errors.

Other advantages of bar coding are speed, timeliness and cost efficiency. Scanning a bar code is faster than manually recording information or keying data into a terminal. Bar-coded information is often immediately transferred to a host computer. Real-time data collection enables timely information to be accessed almost instantly, when the data is still current.

In addition, improved efficiency can be realized by substituting bar code systems in place of manual systems, resulting in increased productivity and reduced labor costs.

In short, your benefits from the use of bar codes will be:

- Accuracy of data input.
- Speed of entering data into your computer system.
- Timeliness of information for more effective management of resources, inventories, etc.
- Labor savings realized through elimination of manual systems.

Bar Code Terminology

Aperture — A scanner's aperture is the opening through which the light exits the unit. The aperture determines the diameter of the light spot reaching the bar code. Proper aperture size selection is critical to the system. It must be matched to the nominal bar size.

Bar — The darker, non-reflective element of a bar code.

Bi-Directional — A bar code symbol that permits reading in either direction across the bars and spaces.

Check Digit — A calculated character included within the bar code for error detection. Also referred to as a Checksum Character.

Code Density — The number of data or message characters that can be represented per unit length of space.

Continuous Code — A bar code that does not have inter-character gaps as part of its structure.

Depth of Field — The difference between the minimum and maximum distance that a bar code can be read, similar to that of a photographer's lens. This does not apply to wand scanners since they require contact with the symbol surface.

First Read Rate — The percentage of correct readings that will be obtained in one pass of the scanner over the symbol.

Fixed Beam Scanner — A bar code scanner that uses a fixed (or stationary) beam of light to read bar code symbols. The symbol must be moved through the light beam to be read.

Hand-Held Scanner — A scanner held and operated by a human operator, enabling the scanner to be brought to the symbol.

Bar Code Terminology

Inter-Character Gaps	The space between the bars or spaces that represents different characters in a discrete character bar code.
Mis-Read	A message that is decoded incorrectly and transmitted to the host computer. The transmitted data does not agree with the encoded data.
Moving Beam Scanner	A bar code scanner that uses a moving light beam to dynamically scan and decode a bar code symbol.
Nominal Bar Element	The width of a narrow bar or space. Also known as the X-dimension.
No-Read	A scan attempt that does not result in a successfully decoded symbol.
Quiet Zone	An area before the start character and after the stop character that is devoid of printed material. Also be referred to as the Margin.
Space	The lighter, reflective element of a bar code.
Start Character	A special pattern of bars and spaces used to identify the beginning of a bar code symbol.
Stop Character	A special pattern of bars and spaces used to identify the end of a bar code symbol.
Voids	Light areas in the bars of a bar code symbol that are usually caused by printing errors.
Wide-To-Narrow Ratio	The ratio between the width of the wide elements and narrow elements.

Universal Product Code (UPC)

- Incorporates numeric characters only.
- Usually includes 12 digits and allows bi-directional scanning.
- Zero-suppressed version is printed using seven digits.
- Check digit is incorporated into code.
- Quiet zone is nine times the narrow bar width on both the left and the right.
- At 100 percent magnification, required size for a 12-digit UPC with the quiet zone is approximately 1.5" horizontally and 1.0" vertically.
- EAN variations are used in Europe.
- Common applications include retail, packaging, counting and data processing.

When scanned, the UPC will be decoded as a 12-digit number. These 12 digits represent the following: digit 1 is the number system character; digits 2,3,4,5 and 6 make up the manufacturer's ID number; digits 7,8,9,10 and 11 are the vendor's item number(s); digit 12 is the check digit.

When scanned, the UPC zero-suppressed will be decoded as a 12-digit number. These 12 digits represent the following: digit 1 is the number system character, which is always zero when printing zero-suppressed UPCs; digits 2,3,4,5 and 6 make up the manufacturer's ID number; digits 7,8,9,10 and 11 are the vendor's item number(s); digit 12 is the check digit. However, only seven human-readable numbers appear when printing zero-suppressed UPCs

Common Types of Bar Codes

Interleaved 2 of 5 ("I" 2 of 5)

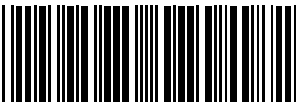
- Incorporates numeric characters only.
- Can be of variable length, but must have an even number of characters.
- Common applications include warehousing, product/container identification, general industrial and automotive.
- Often used in UPC Shipping Container Code formats.
- Quiet zone is ten times the width of the narrow bar.

The Interleaved 2-of-5 bar code is a bi-directional, continuous, self-checking numeric bar code. It uses a series of wide and narrow bars or spaces to represent each character, and each symbol employs unique Start and Stop elements.

The symbology requires an even number of characters to be interleaved together. The bars represent data characters occupying the odd positions, and the spaces represent characters in the even positions. Additionally, each data character must be composed of five elements, two wide and three narrow. Character pairing begins with the most significant digit (left most digit) and continues two at a time until all characters are used. The Start element consist of two narrow bars while the Stop element combines a wide and narrow bar.

Code 39 (3 of 9)

- Incorporates alphanumeric characters.
- Can be of variable length.
- Check digit is optional but normally not used.
- Common applications include LOGMARS (Department of Defense), GSA, AIAG (automotive), general industrial and HIBCC (health industry).



The 3 of 9 bar code is a variable-length, bi-directional, discrete, self-checking, alphanumeric bar code. Its data character set contains 43 characters: 0-9, A-Z, -, ., $, /, +, % and space. Three of the nine elements are wide and six are narrow. A common character (*) is used exclusively for both a Start and Stop character. The Start/Stop characters must be included in every bar code. It's the Start/Stop pattern that allows symbols to be scanned bi-directionally.

Code 39's flexibility to encode both text and numbers has contributed to its widespread use.

Code 128

- Employs alphanumeric characters.
- Can be of variable length.
- Common applications include general industrial, inventory control and retail container marking.
- Often used in UCC/EAN Serial Shipping Container Code formats.
- Quiet zone is ten times the width of the narrow bar.

This code has 128 characters. Like Code 39, Code 128 offers variable-length symbols. But at the same time, Code 128 is more compact. Code 128 allows the

user to encode any character found on a CRT keyboard, including the control characters. This gives the user more encoding versatility than previously possible in an industrial bar code.

PDF417

- Self-checking, two-dimensional bar code.
- Encodes up to 810,900 different character sets and/or interpretations, plus 256 international characters and binary data.
- Allows for bi-directional scanning.
- Symbology includes a Start/Stop pattern, left/right row indicators and data codewords.
- Quiet zones are two times the X-dimension.

PDF417 is a multi-row, continuous symbology capable of encoding large

quantities of information. It's just what its name suggests — a Portable Data File. Being one of the first two-dimensional bar codes, the symbology has not yet been standardized by any industry. However, it is being considered for coding shipping manifest information.

The symbology can vary in height and width because any number of rows of information (from 3-90) can be stacked vertically, plus a varying amount of data codewords (from 1-30) can make up the length. Each PDF417 bar code also incorporates two parity-check codewords, which act as the symbol's error correction code. The codewords carry out the same functions as check digits in other bar codes.

PDF417 is able to condense so much information into such a small space that it could soon prove to be one of the most flexible bar code symbologies around.

In-House Printing Advantages

The decision of whether to print bar-coded labels in-house or purchase them from an outside vendor involves reviewing several factors. The major considerations include the costs involved, your manufacturing process and any marketing concerns.

Cost Factors:

When justifying the cost of in-plant production over the outside purchase of bar code labels, consider these factors:

- *Diversity of product line*. If your application involves a large variety of products to be bar coded, the cost of investing in film masters for outside printing can be extremely high. For example, the average cost of a film master is $20-$40. So for 1,000 products, film alone could cost you as much as $40,000.
- *Inventory space*. Maintaining inventories of preprinted packages or labels from an outside vendor can be both cumbersome and costly.
- *Changes in product information*. If products or label information changes, the preprinted labels that are in inventory become obsolete and new ones have to be purchased.
- *Number of label styles*. Long runs of "generic" labels can save money over the purchase of a variety of different labels. These generic labels can be imprinted with in-house equipment.

Manufacturing Factors

When evaluating your manufacturing process to determine its compatibility with an in-house system, the following must be considered:

- *Production schedule.* Random production requires on-demand labeling. In-plant production of labels would provide this type of flexibility.
- *Diversity of product line*. A diverse product line usually requires diverse production lines. This is where the need for variable label production comes in.
- *Product depth*. If there will be long runs of just a few products it may be more beneficial to use preprinted labels. But if you have multiple short runs, it is more cost efficient to use in-house equipment.
- *Returned goods*. Using in-house equipment is valuable when handling the problem of re-marking return goods.

Marketing Factors

Another label printing factor to consider is product image. Although preprinted labels may be more appealing to the consumer, labels produced in-house can be much more flexible in the long run. Last minute changes can be made immediately, increasing label effectiveness and customer satisfaction.

Almost any type of printing method can produce bar codes. The best method will depend on the application. Speed, flexibility, volume, data density and turnaround time all must be considered. The most common printing methods are described

Non-Impact Printing

The three types of non-impact printing are thermal, laser and ink jet. Each method has its advantages and disadvantages, but what they all have in common is that no physical contact is made with the label or the product.

Thermal Printing

Zebra 105SL Thermal/Thermal-Transfer Printer

Thermal printing uses heat from a stationary printhead that contains many small resistive heating elements. These elements create dot patterns that produce the actual image on paper. There are two types of thermal print technology — *direct* and *transfer*. Direct-thermal printers require a specially-coated paper. The coating reacts to heat and changes color when heated.

The advantages of direct-thermal printing:

- Lower supply cost because ribbons are not necessary.
- Printer models can be economical.
- Excellent resolution of high-density bar codes.

The disadvantages of direct-thermal printing:

- Higher cost of label materials.
- Papers are sensitive to heat and light.
- Printed image may fade over time.

The advantages of thermal-transfer printing:

- Superb resolution of bar codes, text and graphics.
- Prints on a wide variety of label stock.
- Longer printhead life compared to direct thermal printers.
- High print speeds.
- Offers both demand and batch printing capabilities.
- Accepts label and ribbon combinations for almost any application, including harsh environments.
- Extensive options available for more flexible label handling.
- High-end models feature extremely durable industrial construction.

The disadvantage of thermal-transfer printing:

- Cost of replacing ribbons.

Zebra 140XiIIIPlus Thermal/Thermal-Transfer Printer

Laser Printing

Laser printers fall into two categories: *cut-sheet* and *continuous-form*. Cut-sheet laser printers are designed for the office environment and work best with single-ply sheets of paper. These printers combine heat with pressure-fusion, which makes them less compatible with pressure-sensitive and synthetic materials.

Continuous-form laser printers are designed for high-duty cycles and high-speed electronic data processing. Some units do not use heat and pressure to fuse the toner. Rather, light-created heat transfers the toner while all other areas of the paper stay cool. No pressure is involved in this technique, therefore, these printers work well with pressure-sensitive and synthetic materials.

The advantages of laser printers:

- High-resolution bar codes and text.
- High-speed printing.

The disadvantages of laser printers:

- Higher cost for continuous-form models and their maintenance.
- Printed image may fade with time.

Cut-Sheet Laser Printer

High-Resolution Ink Jet Printer

Ink Jet Printing

Ink jet printing is available in *carton printers* and *label printers*. Both methods spray dots of ink onto a surface to build bar codes and characters. Ink jet printers produce bar code markings directly onto the carton. The bar codes are created from dots usually five to ten times larger than in dot matrix printing.

Depending upon the printing surface, ink jet carton printers can turn out much larger bar codes than if printed on labels, which increases their potential to be unreliable. Some of the higher-end ink jet technologies, however, consistently produce reliable bar codes on both porous and nonporous surfaces. High quality scanners should always be used to read ink jet bar codes.

The advantages of ink jet printing:

- Elimination of the label and label application cost.
- Cost per mark is 10 times less than label printing.

The disadvantages of ink jet printing:

- Inconsistent bar code readability on some printing surfaces.
- Unreliable print quality if product handling is poor.
- Prints lower density bar codes than thermal-transfer technology.

Ink jet label printers produce results similar to impact dot matrix (see pg. 14). The dot size is larger, but dot pattern and placement are comparable. All the features and limitations involved with dot matrix apply.

Impact Printing

The following methods for printing bar codes involve physical contact with the label material.

Dot Matrix

Dot matrix printing involves the firing of pins or hammers against a ribbon and then onto the label material. Each pin or hammer produces a small dot of ink on the label surface. Bars in the code are built by placing a series of vertical dots in a column. Narrow bars generally are one dot wide. Wide bars are generally two or three dots wide, but can be more. Since the smallest width of a narrow bar is one dot wide, the smallest narrow bar possible is the diameter of the dot, which generally ranges from 0.008" to 0.020".

The advantages of dot matrix printing:

- Low cost of label materials and ribbons to generate high-quality bar codes.
- Very reliable in industrial environments.
- Ability to produce multi-across labels.
- High print speed rates.

The disadvantages of dot matrix printing:

- Limited bar code print density.
- Noisier than other print technologies.

Flexographic or Offset Printing

This is the method Weber uses to produce custom-printed bar code labels. It is commonly used to print UPC bar code labels for retail goods.

The process involves a large label printing press in conjunction with rubber, cyrel or metal printing plates. The primary application for offset/flexographic bar code labels involves long run labels where variables do not change.

The advantages of flexographic or offset printing:

- Low cost per label.
- Fairly high-density bar codes can be produced.

The disadvantages of flexographic or offset printing:

- Lack of flexibility for variable information changes. It is only appropriate for large production quantities of labels.

Reading devices (or scanners) fall into two categories: contact and non-contact readers. Contact readers are normally hand-held units, while non-contact readers can either be hand-held or stationary units.

Contact Readers

Contact readers must either touch or come in close proximity to the bar code symbol. Contact readers are a good choice when it is not possible to convey coded items past a scanner, or where the label cannot be placed in an easy-to-view position.

The most common type of contact reader is the pen wand, also known as a light pen. It serves as an excellent substitution for traditional clipboard and keyboard data-entry and collection methods. Many benefits come from using contact readers to scan bar codes, including a reduction in the number of clerical errors in recording data; a reduction in labor and paperwork to process the data; faster and more accurate inventory taking; and enhanced efficiency of forms and document tracking/control.

Careful attention should be given to match the wand resolution to the code density. For instance, a high-density resolution wand may be too sensitive to read a low-density symbol. It may decipher an ink spot as a bar, or an ink void as a space. Conversely, a low-resolution wand may not be able to recognize a narrow bar of a high-density code.

The angle at which the wand is positioned to the surface of the symbol (45-90 degrees), as well as the speed at which the wand is moved across the symbol (3-6 inches per second), are key parameters affecting a high first-pass read rate.

Types of Scanners

Non-Contact Readers

Non-contact scanners include hand-held and stationary scanners. The main characteristic of a non-contact scanner is that it does not have to come in contact with the bar code symbol. Non-contact scanners can read a bar code up to a distance of several feet, depending upon symbol size and scanner design.

Weber Laser Data Terminal

Non-contact scanners employ either a moving beam or a stationary beam. They are commonly referred to as laser scanners, although not all of them use laser beams for their light source. A stationary beam is one that does not oscillate across the symbol, but has to be moved across the symbol by either moving the reading device or the symbol itself. A moving beam scanner uses an oscillating light beam to scan symbols at a rate of up to 40 times a second.

A stationary scanner is usually mounted in a permanent location, frequently alongside or above a conveyor. It can scan bar-coded products passing by at speeds in excess of 1,000 feet per minute. No human operator is required to achieve a "read."

Weber Fixed Station Scanners

By incorporating these automated reading machines at strategic data collection points within your manufacturing operation, you can more closely monitor inventory levels, optimize storage utilization, deliver material when needed to appropriate work station, expedite order processing and provide accurate and prompt billing.

A hand-held scanner is one the operator picks up and brings to the bar code. The entire reader and data collection device may be movable, or only the reader is movable and connected to a permanently-mounted data collection device. Both types can be equipped with a variety of options, including keypad and display.

Weber Portable Data Terminals

Weber Hand-Held Laser Scanners

After a symbol is read, a number of options exists for handling the data. The information can be stored for later use, transmitted to a host computer, or used immediately for comparison against data already existing in "memory." These options are determined by the software program in the data collection device or the host computer.

Inventory

Portable scanning devices can streamline inventory tasks. For example, a central computer can download directives to a portable unit to facilitate order picking. By following the computer directives, an operator would proceed to the location displayed on the unit, use the bar code wand to scan the shelf tab item code, enter a quantity from a menu tablet and proceed to the next picking location. At the end of the picking cycle the gathered data is transmitted to the main computer where inventory counts are updated and purchase orders are issued to replenish stock.

Property management also presents a worthwhile application for the portable pen. Operators using portable bar code readers will periodically walk through a facility and pass the wand over labels to establish current inventory.

Shop Floor Control

Stationary scanners mounted at shop floor work stations throughout the plant can be used to monitor work-in-process. A bar code label identifying each lot of material is attached to a container. As the material is processed through each work station the code is read and the process results are transmitted to a master computer. Real-time production information insures that orders are delivered on time and that the product has undergone thorough inspection.

Production

Bar code labels located on parts being assembled can be scanned and the code numbers validated against an acceptable "build list" to insure the final product has all of its components.

Receiving/Shipping

Scanners located at receiving and shipping stations are being used to record product movement. In addition, captured information at the point of transaction permits invoices to be verified and real-time bills of lading generated. Back orders can be immediately routed to the shipping dock.

Weber Can Help!

Weber has been simplifying product identification, inventory control, material handling and other labeling problems for over 80 years. We have combined our labeling knowledge with over 40 years of bar coding experience and the latest bar code printing technology to provide you with complete labeling solutions. Weber has a worldwide sales and service organization that is trained in the latest developments in bar coding systems, and we are prepared to help you stay on top of the current industrial bar code trends and technologies.

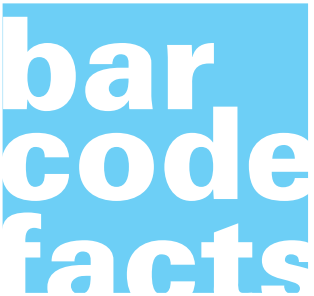
The Legitronic® family of label printing systems is unmatched in versatility. These systems are designed to handle complete bar code label printing needs. Some of the equipment and capabilities include:

- A complete line of on-site label printing equipment to meet your specific needs.
- Easy-to-use label design software that provides all popular bar codes, including UPC, UCC Case Code, HIBCC, LOGMARS, GSA and AIAG.
- High-performance label printers that produce sequentially-numbered bar codes and variable-sized, standard label characters with push-button ease.
- The ability to accept scanner, scale and computer input for automatic label generation.
- A complete line of hand-held and stationary bar code scanner products to provide a total system solution.
- Automatic label applicators and printer-applicators to reduce labor costs associated with bar code label application.
- Weber's complete line of label materials to make the most difficult applications simple.

To meet bar code requirements off-site, Weber offers its ECLIPSE Bar Code Label Service Bureau. ECLIPSE uses the latest printing technologies, including an ion deposition process that prints bar code information as labels and tags are produced on our high-speed rotary presses.

Whether you're just starting with bar codes or looking to improve the efficiency of your bar code operation, Weber can help.
Call us today at 1-800-843-4242
Or visit our web site, www.weberpackaging.com

Weber Makes Bar Codes Easy!!



- The first patent for a bar code was issued on October 7, 1952, to Bernard Silver and Norman Woodland.
- Bar codes were first used in 1967 to identify railroad cars.
- Researchers in Antarctica tag penguins with bar codes to aid in the tracking of the endangered birds' migration patterns.
- On June 26, 1974, at Marsh's Grocery in Troy, Ohio, a ten-pack of Wrigley's Doublemint Gum was the first product with a bar code ever sold in the United States. That gum is now on display at the Smithsonian Museum of American History.
- American artist Bernard Solco creates giant oil paintings of bar codes. His work has been exhibited around the world.
- The most common bar code today is the UPC, which is featured on over 100,000 different grocery items alone.

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