

# A Guide to Basic Barcoding

## **WHY USE BAR CODES?**

Studies have shown that bar code solutions are implemented in over 70% of installed Auto ID applications. Bar codes provide virtually error free data collection. Studies have shown that a proficient data operator will make one error for every 300 characters manually entered. Compare this to 1 in 3 million utilising bar code technology.

Almost everybody has seen bar codes on products in the supermarket and experienced the benefit of bar code scanning at the checkout. Imagine the time it would take the operator to manually enter the SKU (stock keeping unit) and price for every item.

Historically the early adopters of bar code technology were the industrial sector followed by retail. Nowadays bar code technology has extended to many sectors of industry and commerce. Example applications include:

**Automotive, books, courier services, defence, electronics, food, government, health, insurance, mail order, packaging, postal, printing, rental, transport, and wholesaling.**

Bar coding is used in so many areas because it has proved to be an adaptable and successful technology. Virtually all types of industry are using bar codes to replace keyboard data input.

## **WHY SHOULD YOU USE BAR CODING?**

Many companies perceive bar coding to be an additional cost of doing business. In reality bar code investments usually pay for themselves in less than a year. Benefits can include increased productivity, increased invoicing accuracy, faster reaction to problems and a reduction in inventory levels.

Whatever the business system, a bar code solution can be added to:

- Improve service levels
- Improve working environment reducing the frustrations of a manual environment.
- Improve margin.

When considering bar code solutions, they should generally be used to improve the efficiency of an existing paper based system. Do not try to design a bar code solution from scratch. There may be too many problems to solve at once. Think about the following issues:

- What is the problem?
- How could you resolve it?
- Consider a few procedures that can be made more efficient.
- Decide how and where to read bar codes.
- Decide how to print bar codes.

## THE TECHNOLOGY UNCOVERED.



Many people misunderstand the technology that is behind the bar codes printed on food labels, packaging labels, documents, envelopes, product serial number labels etc. They all seem to look the same, but they are not. Many industries may have their own bar code standard. By reading through this guide you will learn about:

- Industries and Applications
- Bar code basics
- Bar code symbologies
- Bar code printing
- Bar code quality
- Bar code scanners – fixed
- Bar code scanners – portable

*Now lets take the first step and look at some of the common applications that are ideally suited to bar code technology.*

## APPLICATION EXAMPLES

There are many uses for bar coding solutions. The common applications are associated with the industrial and retail sectors. However, there are many more applications for bar codes. Nearly all industries use keyboard input for data entry. It is conceivable that all these industries have a potential requirement for a bar code solution. Listed below are a few applications that are common in our industry.

- Inventory control
- Receiving (Goods Inward)
- Work in progress
- Despatch
- Point of Sale
- Time and attendance
- Marketing (data collected on portable terminals)
- Package delivery
- Quality control
- Retail Demand (bar code verification)
- Ticketing
- Healthcare

## INVENTORY CONTROL



Inventory and warehousing is one of the most common applications for bar code solutions. A warehouse must have the ability to receive products, despatch products and keep accurate inventory. If a mistake is made in the warehouse, it is often compounded. The wrong product is sent to a customer, the inventory is inaccurate, the product can not be sold and the customer is dissatisfied, increased delivery costs are incurred and additional man-hours are needed to fix the problem.

Most companies already have a warehousing system in place. Whilst these are tried and tested paper based systems the accuracy can be improved with the implementation of a bar code solution.

When the stock is received, each item should be labelled with a bar code. The label could be produced using a PC based label design package such as LabelView, or generated direct from the host system. The label could be on any material though paper is the most common. For many applications, a Code 39 bar code symbology is adequate. The part number is usually bar coded and the product description becomes part of the label.

In some industries, raw materials and components arrive at the receiving bay already bar coded. Increasingly these codes conform to an industry standard. These can be scanned to confirm that the correct items have been received.

If the warehouse is relatively small these codes can be scanned with a scanner having either a keyboard wedge or RS232 interface. The items must be physically brought to the scanner. This is the least expensive approach. For larger or busy warehouses, it is not always practical to bring the item to the scanner. Portable Data Terminals act as portable computers and with built in scanning capabilities, record the item at point of receipt. The collected information will be downloaded to the host either in a batch or by radio frequency communication method.

The use of bar codes significantly reduces the effort required to perform a physical inventory whilst at the same time dramatically improves the accuracy.

During the actual inventory process a program on the PDT prompts the operator to scan the bar code label on the product and if appropriate the bar code location label. Usually the operator is prompted for the quantity. The quantity would normally be entered via the keyboard of the terminal. Throughout the process, the program builds a data file of location, part number and quantity. Other information such as operator identification and date/time may also be stored. Suitable validation built into the software ensures the accuracy of collected data.

When the stock take is complete or at regular intervals depending upon the size of the warehouse, the data will be downloaded to the host computer for processing.

The inventory process can be extended to cycle counting. The main difference is that a data file can be downloaded to the portable terminal before the process begins. This data file could contain the location, product number and expected quantity. The display on the terminal will guide the operator to the correct location and prompt which part to check. Once the objects

have been counted the actual quantity can be recorded. If there is a mismatch between actual and expected quantity, the error can be recorded.

## RECEIVING (Goods Inward)



Many products received into a warehouse now already contain a bar code supplied by the vendor. The label could contain details such as product code, serial number, build date, revision identification, purchase order number etc. These pre-marked products can be useful if your computer system maintains a list of expected deliveries. Scanning the serial numbers at the receiving bay can quickly update the host computer with completed orders. Even if the host does not have a list of what is expected, bar code reading will still speed the receiving process.

Not all packages received contain bar coded labels. If this is true it is still possible to implement a bar code tracking system. As products are received the details from the despatch note could be entered onto a computer. The computer could assign a unique serial number to each product. Connected to the computer would be a thermal transfer printer which would print a label containing description, product code and serial number. Each label could be manually applied to the product before it is put away.

Equipped with a portable terminal the operator would store the product and the warehouse. The terminal would prompt the operator for location, product code and serial number. When the put-away is complete or at regular intervals depending upon the size of the warehouse, the data will be downloaded to the host computer for processing.

## WORK IN PROGRESS

In a manufacturing environment, the company's stock will constitute three components: raw materials, work in progress (WIP) and finished goods. WIP is the hardest to measure. With a suitable WIP system it is possible to monitor the stock values of WIP, which could be 30% of total inventory.

The simplest form of WIP system would be a host computer linked to a network of bar code readers and one bar code printer. At each workstation, an operator would record products as they pass through. The operation could involve scanning the work station identifier, product code and activity performed. The product itself could be bar coded though in many cases a 'build document' follows the actual product. In this instance, the 'build document' would contain a bar coded works order number and a detailed list of operations. As the operator completes the task the bar code reader is used to enter the works order number, operation code and employee number. On the 'build document' each operation description would have a bar code associated. The data collected would also be time/date stamped. It could be used to provide reports on:

- 1) Work order status
- 2) WIP levels
- 3) Product tracability
- 4) Product/batch recalls
- 5) Identify manufacturing bottle-necks

## **DESPATCH**

This area of business can be a complex process. Orders must be sorted, picked, and made ready to be loaded on to delivery vehicles. The correct process used in conjunction with bar coding can provide an accurate and up to date picture of the overall despatch process.

A primary use of bar coding in despatch applications is to meet customers' demands on label requirements. Customers may demand that all products received must contain a bar code label that matches a predefined specification. Industries where this is required include automotive, retail and defence.

A second use is creating an accurate list of items picked. A picking list can be downloaded to a portable terminal. This will prompt the operator for the location, part number and serial number. Verification on the portable terminal ensures that only the required items are picked. The collected data will be uploaded to the host computer. Products would be physically picked and moved to the despatch area.

## **POINT OF SALE**

Bar code POS systems are installed in small gift shops through to large supermarket chain stores. Virtually all supermarkets use counter mounted projection scanners that allow bar code reading regardless of orientation. Smaller stores find that bar coding is practical because of the increased speed at the checkout, timely and accurate stock checking and sound price assurance. These smaller convenience stores tend to use CCD or hand held laser bar code readers.

The POS terminal is usually connected to a network containing a central database. This database is usually on-line so that stock levels are adjusted automatically. When an item is scanned the data from the EAN bar code is used to lookup the price and description. These details are sent back to the POS terminal to record each transaction.

In most supermarkets bar code shelf edge labels are also used. These are often used to provide pricing information to the customer. These labels can be used as part of a random price checking process. The operator would scan the shelf edge label with a Portable Data Terminal and bar code reader. The terminal would have either part or the full database in its memory. When the shelf edge label is scanned the display would show the product description and price. If the price on the shelf edge label does not match that on the terminal display the error can be rectified.

## **TIME AND ATTENDANCE**



With the introduction of government's 48-hour working directive, time & attendance packages are becoming more popular. They provide an easy method of tracking employee's hours.

Most time & attendance systems comprise of a network of wall mount terminals connected to a PC. Software on the terminals record the employee in or out as they swipe an identification card through a reader. The information can be sorted by department and provide detailed attendance records including sick leave and holidays.

## **MARKETING (Data collected from portable terminals)**

Manufacturers are able to record purchasing trends by providing shoppers with a bar code reader. As products are placed in the shopping trolley the purchaser can scan the product bar code using a portable data terminal. When they return home, these details can be downloaded through a modem to the information collation centre.

## **PACKAGE DELIVERY**

Many private delivery companies now benefit from bar coding solutions. Many of them offer a guaranteed overnight delivery service by a fixed time the next day and need the ability to provide accurate information on the whereabouts of a parcel. This is achieved by scanning the parcel code onto the vehicle. The drivers take with them a portable data terminal pre-loaded with a data file containing all delivery details for the route. These details will include delivery address, customer account code and parcels to be delivered. The terminal will prompt the driver through the shortest and most economical route. Upon arrival all products to be delivered will be scanned. If an item is missed the driver will be warned, if an incorrect parcel code is scanned it will not be unloaded. After completing the delivery the driver will insert the terminal into a vehicle cradle and transmit the data through a suitable media such as GSM. This method allows head office real time information that can help them answer any customer queries.

## **QUALITY CONTROL**

Just as bar code implementation is possible for production systems it can be used in quality control applications. Bar codes can be used as part of an inspection procedure; a different code can be used to identify a fault or rejection.

## **RETAIL DEMAND (Bar code Verification)**

Requirements for the checking and verification of bar codes vary depending on how the barcodes you have printed are going to be used. If you are printing bar codes purely for your own internal use there will not be any requirement for anybody outside the company to read the code.

However if you are producing bar codes that will be used by third parties, possibly with a variety of bar code readers there may be a requirement to verify that bar code has been printed within the specification of the symbology in use. Verification is particularly important if you are supplying bar coded products to the retail sector. Here it is critical that the bar code can be read first time at the checkout. Any failure to read the bar code first time will result in a delay at the checkout as the operator manually key enters the bar code number. If this happens (however remote it may seem) there is the possibility that the retailer may say "we cannot read your bar codes with our reader and therefore are returning all your products and imposing a large fine".

Verification allows you to check the quality of your bar code and to guarantee they have been printed within the specification determined for the symbology. It is a little more complex than simply scanning the bar code to check it reads on your scanner. A special bar code verifier is required that is capable of analyzing the compliance of the code in line with the specifications of the symbology. A bar code verifier will provide lots of technical information about a bar code (e.g. measured reflectance density (MRD) contrast rating, wide/narrow bar ratio etc.) Usually the verifier will summarize all these details to inform the user if the bar code is within or outside the acceptable tolerances of the bar code symbology.

## **TICKETING**

The need for computerised ticketing to automate the admissions process is now expanding to medium and small applications. These emerging markets include small office/home office and e-commerce but typically the industry is comprised of niche markets. These focus on tracking customers and the purchase of admittance to a specific attraction. Typical niche markets include:

- Theatre box office
- Cinemas
- Concert events
- Amusement parks
- Ski Areas
- Transportation tickets etc.

## **HEALTHCARE**

The healthcare industry uses bar codes to capture data and help manage critical patient and drug information. From the laboratory to the hospital ward, bar code data can enable real time access to clinical documentation, patient details, drug recognition, insurance data and much more.

## **OTHER APPLICATIONS**

No matter what industry your customer is in, bar code technology can be applied to help automate and improve the efficiency of your data processing requirements.

## **WHAT IS A BAR CODE?**

A bar code is a method of encoding data (numbers and/or letters) in a form that can be read and understood by a machine. The data is encoded in an array of parallel bars and spaces of varying widths. Reading the bar code employs an optical technique because information is scanned using light that reflects from the bars and spaces within the symbol. There are different types of bar codes. These various types are known as symbologies.

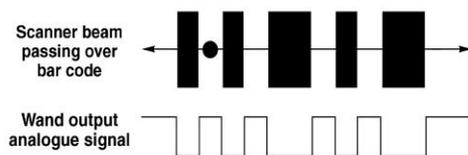
The definition of a symbology is "Any of the standard systems representing data in a bar code form, each having its particular characteristics and rules of composition. The symbology specifies the character set, start and stop codes, length etc". An easy definition is to consider a symbology as a language in bar code technology. Just as we have different languages in different countries, we have different symbologies for different industries. Many of us are familiar with the bar code found on products in our local shops, but there are many standards used in various industries. Retail, healthcare, manufacturing, postal, automotive etc. all have a symbology unique to the industry. Why? Simply because symbologies have evolved to solve different problems.

## BETWEEN THE LINES (AND SPACES)

A bar code does not normally contain descriptive data. A bar code normally contains a reference number that is used by a computer to lookup an associated record that contains descriptive data and other important information. *FOR EXAMPLE:*

A bar code found on a tin of beans does not contain the description and price. It contains a 13-digit number. When the cashier scans this bar code, the computer (till) uses the number to look up the associated record. The computer instantly does a "price lookup" and displays the price and product description on the till.

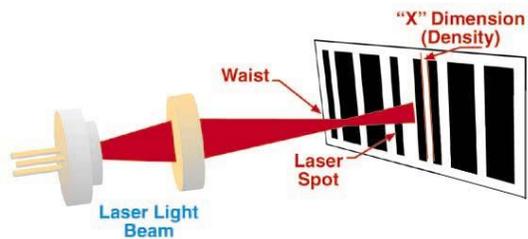
## HOW ARE BAR CODES READ



When the bar code is scanned the optical elements in the reader convert the light reflected back into an analogue (i.e. not digital) signal. More light is reflected from the spaces than from the bars. The electrical pattern seen by the reader is interpreted as a series of high / low voltages. A decoder either internal to or external to the reader will convert this

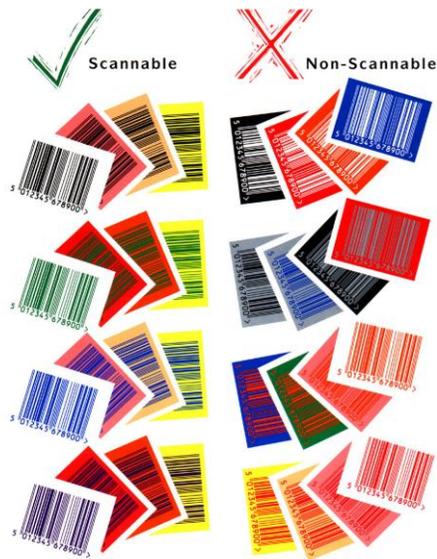
analogue signal into its digital representation i.e. data.

The scanner starts to read the bar code at a white space (quiet zone) before the first bar. The scanner continues past the last bar and the white space that follows it. As a general rule the longer the bar code, the higher the bars will be. This is because the bar code reader cannot read the bar code if the light source (scanner) moves out side of the top and bottom of the bars. The longer the information is to be encoded the longer the bar code. It is useful to remember that the size (magnification) is dependent upon printing conditions. Bar codes will need to be enlarged for poorer quality printing processes.



## BAR CODE COLOURS

There are a number of colour combinations that can be used to represent the dark bars and light background of a bar code symbol. The most common colour combination is black bars and white spaces. The picture illustrated shows some other acceptable colour combinations.



The structure of bar codes varies from symbology to symbology but the diagram below represents some of the components in a bar code.

