



# CodeFacts

AIDC (Automated Identification and Data Collection) Technical & Informational Documents  
Written for Everyone

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## Printing Bar Codes

### *A Comparison of On-Site Printing Technologies for Generating Bar Code Labels*

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There are many different ways to create bar code symbols. The strategy you use to do so will depend on many factors. This CodeFacts document will explain the different ways to produce bar codes and should provide you with some direction on the best methodology to suit your needs.

A bar code symbol is often defined as “an array of bars and spaces which, when assembled, represent data.” It can also be described as “a machine readable symbol.” In basic computer parlance, a bar code symbol is considered more “graphic” than “textual.” So, how do we turn those numbers and letters into the patterns of vertical stripes that make up a bar code symbol?

Fortunately, all bar code creation software accomplishes the translation or encoding of a group of text characters into bars and spaces to form a bar code symbol and a bar code scanner decodes those bars back into text. Knowing these simple facts makes the system much simpler to understand and implement. But what is the best way to create those bar code symbols?

### **Software -Stand-alone or Integrated?**

There are many bar code label design and production software programs available these days. These programs are best suited to “stand-alone” applications where bar code labels are made outside of any other application software program and labels are produced in batches. Alternately, there are also applications where the printing of the bar code symbols needs to be integrated into another software application and not run stand-alone. An example of this would be having product labels automatically printed for the items received during an inventory receiving function in an accounting program. The result of this fact is that you have to decide, at the outset, whether bar code printing will be a stand-alone function, or one integrated into a running application.

## **Stand-alone Label Design and Printing Software**

AURORA provides a number of different types of stand-alone label design and production software programs. Basically speaking, some are designed for use with standard office printers (dot-matrix and laser) and the rest are for use with dedicated label printers that use direct thermal or thermal transfer print technologies. (These uncommon thermal printing technologies are explained later and in even greater detail in the CodeFacts document Detailed Information Regarding Direct Thermal and Thermal Transfer Printing Technologies.) All of the stand-alone software programs are the same in one fundamental aspect—they allow the label designer to create dozens of label “templates” that can be stored as computer files. Each label template consists of one or more “fields” that basically relate to the different areas (or fields) on the labels. A field can be text, bar code or graphic. The information contained in a field can be static or variable. When variable, it can be the date or time, a consecutive number, the result of a formula or a field in a merged or related database, or any one of a number of other things. Those people familiar with report generator or mail-merge software programs would find these bar code label printing programs to be very similar.

## **Integrating Bar Code Printing Into Other Software**

When integrating bar code symbol creation into existing software programs or routines, a number of strategies are available. One of the easiest, at least in theory, is to use a bar code font or typestyle. Because, like Morse Code, a bar code character is just a specific array of bars that represent that character, it would seem quite simple to produce bar code symbols this way. However, because most all bar code symbologies have “overhead” characters, in addition to the literal encoded data text characters, this is more involved than it seems. At the least, overhead characters such as “start of symbol” and “end of symbol” are required. Other overhead characters such as modulus check digits and “shift” characters (explanations of both are beyond the scope of this document) may also be required, adding complexity to the creation of the symbol.

The other more common strategy for creating bar code symbols from within existing software is to use a printer that directly supports bar code printing through printer firmware. This could be already built into the printer, or be added in the form of a cartridge or SIMM. What this basically indicates is a printer that has the ability to print bar codes built into its off-the-shelf capabilities. Virtually all direct thermal and thermal transfer printers have this capability, few dot-matrix or laser do. In programming terms, when accessing these built-in bar code characters, “escape code strings” need to be sent to the printer to turn the bar code characters on and

off. Fortunately, the addition of those pesky “overhead characters” and modulus checksum characters are handled automatically by the printer firmware.

A final method for integrating bar code symbol generation into existing software is to utilize a software library. Such libraries are available for purchase from AURORA that are ‘C’ programming routines or Windows DLLs, that are integrated into other programming software code. These can obviously only be used when the application’s software source code is accessible and a knowledgeable programmer is at one’s disposal.

## **Bar Code Symbol Printing Technologies**

### **Batch or Demand?**

Before going into descriptions of the five printing technologies that can be used for printing labels on-site, one overriding thought must be taken into consideration—will the labels be printed in batches or on demand? That is, will they be printed by the dozens or hundreds, or will they be generated one or a few at a time? Answering this fundamental question will help you determine the best printing strategy.

### **Dot-Matrix**

Yes, it is possible to print scannable bar code symbols from even the most lowly dot-matrix printer. However, seldom is this a reliable or recommended strategy! The many potential problems inherent in dot-matrix printing outweigh the only viable benefit—low cost. The disadvantages can be summed up in the following points:

**Resolution** - Even a 24-pin dot-matrix printer doesn’t provide much of a range of print resolution. Simply speaking, the width of the smallest bar of the bar code symbol (known as the “X Dimension”) can never be smaller than the diameter of the round dot-matrix pin.

**Round Pins** - Speaking of round pins, by using a dot-matrix printer to create bar code bars, you are vainly attempting to create long, narrow, smooth-edged rectangles constructed with round dots! Not easy.

**Speed** - Because of the number of “hits” needed to be made by dot-matrix pins to create a bar code symbol, the speed of the printer is normally about 10-20% of what it runs at when printing text.

**New Ribbon** - A new ribbon provides nice black bars—something necessary when scanning the bar code symbol—but “bleeds” excessively into the adjacent spaces, often obliterating them.

**Old Ribbon** - An old ribbon gives nice and consistent edge definition to the black bars—but may not be black enough to present enough contrast to the bar code scanner compared to the spaces.

The conclusion is—only use dot-matrix printers to print bar codes if you really, really have to and there’s an overriding need to print your bar codes as economically as possible.

## **Laser**

Laser printers make very good quality bar codes because of their relatively-high print resolution, consistently black image quality and fast speed. However, laser printers make lousy demand printers. Question: If there are 30 labels on a laser label sheet, what happens when you only want to print 3? Answer: You waste 27 labels. Laser label sheets cannot be run through a laser printer more than once without risking squeezing the label adhesive onto the fuser roller and other internal mechanisms in the laser printer. This can be expensive and is generally impractical in most applications.

Other disadvantages with laser printers are that the label stock is relatively expensive and the image is not particularly durable. The laser toner is quite prone to flaking off—especially when using contact (wand/pen) bar code readers. However, if all you want to do is print a batch of labels or incorporate a bar code symbol into the printing of a document (e.g., cheque, remittance form, etc.), laser printing is a viable strategy.

## **Desktop Inkjet**

The prospect of using such lightweight printers to print batches of bar code symbols hardly merits discussion. Suffice it to say that while the bar code image created by these economical printers is of decent quality, the high cost and low speed of such printers makes them workable in few applications.

## **Dot-Matrix, Laser and Ink Jet**

One last comment about these printing technologies: Many companies insist on making bar codes with dot-matrix, laser and ink jet printers because they can justify using them for other purposes, like producing documents and business forms. This strategy, however, means that the stock in the printer needs to be changed every

time a job is changed from document printing to label printing and vice versa. This is not very practical and leads to even greater waste when someone forgets to change the print stock! It gets even worse if the printer is a shared (networked) printer.

## **Direct Thermal**

Note that this print technology's name is often shortened to just "thermal." Thermal printing utilizes a special stationary print head. It is made up of thousands of electronic resistors. These resistors are controlled by the printer electronics, which heat them up, and cool them off, very quickly. As thermal-sensitive paper or label stock passes beneath and touches the resistors, a black image is left on the surface. Most business people are familiar with this technology as it is the same as that used in most low-end or older model fax machines.

It should be noted that the resistors in the print head are square in shape. Therefore, the bar codes (and any square or rectangular graphic, for that matter) produced by one of these printers, have exceptional edge definition. Text and round or angular graphics, however, have jagged edges.

Thermal printers typically use labels supplied in rolls, although fanfolded labels are often available. The price of the printers goes up based on a few factors: the label printing speed, wider print width capabilities, and the duty cycle of the printer. Options such as a rewinder (for rewinding large batches of printed labels), cutter (to cut each label or tag) or peeler (to automatically peel back the label liner as the label is ejected from the printer) are available.

Most light- to medium-duty thermal printers limit the width of the label stock to a bit more than four inches. However, since everything printed on a thermal printer can be rotated 90 degrees, very long (wide) labels can be produced.

Probably the biggest advantage to direct thermal printing is that there are no other supplies required other than the labels. That is, no toner or ribbon or ink is needed. The label image creation is basically "self contained." The other major advantage is that the thermal image, because it is embedded into the label, is very durable and cannot easily be scratched off.

There are a few disadvantages with thermal printing, the major one being image longevity. Just because the label has gone through the printer and been "imaged" doesn't mean that the non-imaged white areas can't still be turned black by excessive heat or exposure to sunlight. They can! Additionally, the black thermal image will continue to fade over time, no matter what conditions the label is kept

under. Even under the best conditions, don't expect a thermal label to be of decent quality beyond a year.

A couple of other issues to keep in mind with thermal printers: There are not a great number of different paper or label types available that are thermally imprintable and there is some maintenance involved with thermal printers. This minor upkeep is required because the print head is in direct contact with the face of the label, and the thermal chemicals, so there is a buildup that needs to be cleaned off regularly with alcohol pads.

### **Thermal Transfer**

Thermal transfer printing is the same as direct thermal printing in every single way, but with one major difference: Rather than having the print head directly contact the printing surface, an image is transferred from a ribbon onto the face of the label.

Thermal transfer ribbon is a special material made of micro-thin, clear Mylar. One side of the ribbon is coated with a black substance that has some interesting properties. When heated, it melts very quickly. When the heat is removed, it hardens very quickly. The "ink" can be made of a predominantly wax- or resin-based material.

Wax ribbon is used mostly for imprinting paper labels, where not a lot of durability is required. Resin ribbon is best for imprinting synthetic label materials, such as mylar, polyester, vinyl, or Teslin. As well, there are many "hybrid" ribbons available, which are combinations of wax and resin. Because the image is literally "melted out" of the ribbon, forming a negative image of what went on the label on the spent ribbon, an inch of ribbon is consumed for every inch of label that moves through the printer. Fortunately, thermal transfer ribbon costs very little. A thousand square inches—enough to cover 42 large four-by-six-inch shipping labels, or 200 small two-by-one-inch product labels, costs about 65 cents.

Virtually any very smooth material can be imprinted with a thermal transfer printer, whether it be label or tag stock. Labels used for dot-matrix printing cannot be used, as they are not smooth enough. They have relatively rough surfaces to soak up the liquid ink from a dot-matrix printer ribbon.

Thermal transfer printers can come with the same options as direct thermal printers: a rewinder (for rewinding large batches of printed labels), cutter (to cut each label or tag) or peeler (to automatically peel back the label liner as the label is ejected from the printer).

Thermal print heads used to print in thermal transfer mode will last 2-3 times longer than those used in direct thermal applications. This is because the print head is not directly in contact with the face of the label. Rather, it only touches the slick Mylar backing surface of the ribbon, which may have on it a thin film of lubricant. Thermal transfer printers also require less regular cleaning of their print head, for the same reason.

## **Conclusion**

There are literally hundreds of choices for software/hardware combinations for creating bar code labels. A reputable integrator, like AURORA bar code technologies can provide a tremendous amount of guidance in your choice of a workable solution to the on-site printing of bar codes.

