The Common Sense Case: Why Thermal Trumps Laser for Label Printing ●●●

W hen you're finished changing, you're finished," said Benjamin Franklin, a printer and purveyor of common sense. This paper, makes the common-sense case for using thermal printers in label applications. In fact, the advantages of thermal over laser are so compelling that the only reason to continue using laser printers for labeling must be habit. Before enumerating the advantages of thermal printing technology over laser, it will be useful to consider the use of laser printers for labeling.

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Thermal Printing: The Common-Sense Advantages

Overcoming Imaginary Barriers

E-Class *Mark III:* Ideal Solution

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Laser Printing Labeling: History and Concerns ■ ■ ■

Laser printers have long been used in label printing applications, chiefly because a base of laser printers are usually already installed—primarily for forms, letters, and other narrative communications and documentation. Their multi-function capability made it relatively easy to adopt the laser printer hardware for printing labels. Since adoption was easy, a thorough examination of the technology's appropriateness was rarely undertaken. Parameters such as operating costs, total cost of ownership, materials and energy usage, ergonomics, and other relevant factors were simply not considered in the label printing context.

After laser label printing applications became the de facto standard, users began to see the shortcomings of using laser printers for this function. While many are now demanding better label printing solutions, they are challenged by inertia in the form of a huge installed base of laser printers.

Laser printers can be used to print a large variety of media, from plain paper to specialty papers to films and transparencies. However, when printing on anything other than plain paper, special precautions must be taken, such as the use of laser-specific media, custom printer components, and special maintenance procedures. These special precautions must also be taken to print labels reliably because of the way the laser printer is designed.

Laser Printing Labeling: Design Issues ■ ■ ■

Laser printers have multiple moving parts, a number of path changes in the printing process, and require the heated fusion of ink (i.e., toner) to paper. When printing on labels many problems can occur, from backing separation to adhesive seepage. A typical laser printer may have a media path changing directions three or four times, along the way passing by a photoreceptor drum, where compression, heat, and toner are applied, then further passing by a fuser where high compression and heat are applied. Each component adds risk to the process, increasing the likelihood that the printing process could fail.

Every time a label changes its path direction, it separates from its silicon-coated backing. Separation is detrimental to any printer mechanism, particularly when dealing with labels. A label that separates from the backing while in the printer will adhere to the first surface in which it comes in contact. Recovery requires access to the point of failure, removal of the label, and cleaning of the components. The end result: significant downtime.

In the laser printing process, heat and compression are applied twice: first in the photoreceptor drum, and then (with even higher heat and compression) in the fuser.

Heat across the complete page is necessary in laser printing. However, the application of heat increases the temperature of the label adhesive and decreases its viscosity. This may cause the adhesive to seep from the label's edges.

Compression is also applied each time the sheet changes paths, first by the photoreceptor drum, and then, with greater pressure, by the fuser. Compression squeezes the adhesive between the label and the silicon backing, again potentially forcing it out through the edges of the label.

Failures due to heat and compression require cleaning of the components, which contributes to downtime and drives down productivity. Importantly, printers that perform label printing require more service than those that only perform bond paper printing.

Special Precautions for Laser Label Printing ■ ■ ■

Laser supply and manufacturing companies have addressed label printing problems with a variety of products and services. One can think of these as "special precautions," because they only exist to counter the risks inherent in laser printing labels and increase label printing reliability.

While it is true that laser printers will typically process and print on label sheets without these special precautions, they will not do so without sacrificing volume or reliability. All these techniques increase operational costs. Examples of special precautions implemented to improve laser label printing reliability include:

■ Special Toner Cartridges

Some manufacturers offer oil-fused wipers for customers printing a high volume of labels. Details on the technology and positive effects on reliability have not been publicized.

■ More Frequent Maintenance

Certified service partners of laser printer manufacturers offer special preventive maintenance contracts for customers who print at high volumes.

■ Spot Adhesives

Spot adhesives (i.e. patterned adhesives, zoned adhesives) keep the adhesive at a distance from the label edge to minimize the likelihood of seepage. This is not a common practice, as it increases the cost of labels.

■ Special Adhesives

Some label manufacturers offer labels with special non-oozing adhesive, designed to prevent jams. The problem with these adhesives is that they fail to provide a permanent bond.

Thermal Versus Laser: The Common-Sense Advantages ■ ■ ■

More than two million thermal printers are installed in the United States. The technology is quiet, very simple, and highly reliable. Both direct thermal and thermal transfer printing technologies use heat to create an image. The printers employed in both technologies use the same type of printhead, with the media used determining the process employed. In fact, most thermal transfer printers can be converted to direct thermal printers by simply not using a ribbon. The printhead is stationary and the media advances past it in one motion the printing takes place.

In direct thermal printing, the printhead comes in direct contact with the face of the media. Thermal media has a heat sensitive coating that reacts to the heated elements in the printhead, resulting in an image.

Thermal transfer technology uses a ribbon image transfer process. The ribbon is coated on one side with a black or colored heat sensitive coating. This side of the ribbon is against the surface of the print media. The other side of the ribbon is flush against the printhead. The heated elements of the printhead come in contact with the uncoated side of the ribbon, melting the coating off the other side of the ribbon onto the surface of the media.

■ Advantage #1: No Toner

In both thermal processes, the imaging is embedded in the media. Any time you print with laser, you have to have a toner. There is no option to use some other printing method.

With thermal, if you have a low price point—a low-cost target—you can go with direct thermal technology that has the imaging solution in the media. On the other hand, if you need a higher end solution, you can go with thermal transfer. That ribbon gives you the option of high-quality printed images, but you don't have to burden every solution with it. So there is flexibility in terms of cost and quality. With laser, there is no similar flexibility.

Common-Sense Advantages ■ ■ ■

Beyond the issues raised by laser printer design, there are many advantages that together make a persuasive case for any organization using laser printers for labels to change to thermal printers. Areas impacted include the following:

- Material technology
- Material utilization
- Energy efficiency
- Space considerations
- Functionality and durability
- Mobility
- Price

● Advantage #2: Print Only What You Need

Thermal technology enables you to print single, one off labels versus sheets of labels. This is one of the essential label printing efficiencies of the technology.   In many stores (e.g., groceries, pharmacies), item and shelf labels are preprinted on laser printers as pricing updates and changes are made. Employees put the labels on a cart, roll it out on the floor, then go up and down the aisles taking off the old labels and affixing the newly printed ones.

Watch the process: every cart carries a trash bag behind it, not only for the labels being replaced, but for the newly printed labels as well. Employees take a laser sheet, pull three or four labels off, and then throw away the balance of the sheet, often more than half of the printed labels. The waste is tremendous.

With a thermal printer, you can put the printer on the cart and print right there and then. There's no need to preprint—just roll it out with a terminal, scan, and print.

● Advantage #3: Energy Efficiency

Further, the handling of toner and toner cartridges can be messy, problematic, or just plain frustrating. They demand special disposal because they represent a material hazard. Recent studies indicate that this hazard may be more than environmental—it may be personal. According to a recent study conducted in Queensland, Australia, some printers emit sub-micrometer toner particles that may be associated with respiratory disease.[1] The study says that health effects from inhaling ultrafine particles depend on particle composition, but the results can range from respiratory irritation to more severe illness such as cardiovascular problems or cancer.[2] Another study in Japan found that laser printers increase concentrations of styrene, xylenes, and ozone.[3]

If you compare the two technologies, a thermal printer such as Datamax-O'Neil's E-Class *Mark III* uses about 3 amps of current, while a small laser printer uses about 7. That's an energy savings of over 50 percent, and a green, sustainable advantage for thermal over laser.

The energy savings are directly related to design and technology. More parts (and actions) are involved in a laser printer: a heating drum, a laser, and a fuser. Conversely, a thermal printer has a heating element in the printhead and a motor that moves the paper. That's it. It's another example of simplicity paying off, in this case with improved energy efficiency.

● Advantage #4: Smaller Is Better

A small desktop thermal printer is about a third of the size of a laser printer. Desktop models fit conveniently in small places such as nursing stations, retail counters, laboratories, etc., where space is at a premium.

● Advantage #5: Do More

Thermal printers can print long, continuous banners; laser printers cannot. For example, the E-Class Mark can print 99 inches on a 4-inch-wide material. Other thermals can print wider. With a laser, there is no possibility of loading 99 inches of material into the back of the printer. With the thermal printer, there's no need to load from the back; simply have a source of continuous stock to feed to the printer.

In difficult applications—any application where a label might be exposed to weather, chemicals, or some other external element—the thermal unit will generate a label that won't be damaged by sunlight, rain, heat, cold, or exposure. None of these affect the image quality or the label itself.

Conversely, with a laser, the elements are going to get into the label. That's an essential difference. Thermal runs a synthetic label with synthetic imaging—the resin on the ribbon—and it embeds the image into the label. It's not just laying it on top; it's literally burning it into the synthetic. The image therefore becomes part of that label. A laser is just laying toner on top of the paper—and fails to generate a truly fused solution.

So there are applications where the label is exposed to the elements, but there are other applications where the native durability of thermal labels is just as important. Consider healthcare, where laboratory processing is an important part of the work. Here labels will go on slides and test tubes; specimens are being processed. In this application, chemicals are used to clean off different tools, but the application requires that the cleaning doesn't remove or distort the bar codes or the text—otherwise the label becomes useless.

Thermal printing is one of the only technologies that enables the printing of on demand bar codes for collected specimens. In laboratories, labels have to be chemical-resistant, and on demand printing is necessary because each specimen label is unique, with a unique bar code.

● Advantage #6: Get a Move on

Until recently, many thermal printing solutions didn't have features such as wireless connectivity, LAN capability, or Bluetooth; but now these technologies are available with thermal solutions and contribute to mobility.

In more and more solutions, the printer is attached to a cart and married to a terminal, whether in a hospital, retailer, or shipping facility. The whole solution moves on regular rounds with the employee. They get the full benefit of printing on demand in real time.

A completely mobile solution such as this needs a power supply, and until recently required a higher level cart. Datamax-O'Neil is introducing a battery pack for this application that will minimize or eliminate the requirement for a powered cart for the printer. This will enable using completely mobile solutions in more environments in a cost effective manner.

Laser printers could be applied in mobile applications as well, but would require more than twice the energy as a thermal solution. An E-Class *Mark III* on a cart can print all day on a single battery charge. With a laser printer, a high-end cart with a large power supply would be required, as well as more space.

● Advantage #7: Save Now, Save Later

The misperception may exist that thermal printers have a higher up-front cost than lasers when used for label printing. Not true. Most stores and organizations using laser printers for labeling purposes use models that have a price point around $1,000. The price for a basic E-Class *Mark III* is about half that cost.

Yet the real savings of the thermal printing solution comes over time. Less maintenance, more productivity, less energy consumption, and less wasted materials—it's the lower total cost of ownership that puts the real financial distance between thermals and lasers.

Overcoming Imaginary Barriers ▪ ▪ ▪

Considering the benefits of thermal label printing, one would expect an exodus of laser users to the promised land; but several barriers have appreciably slowed the pace of change.

The first is, simply, ignorance of the technology. The lack of awareness of thermal printing technology—or the existence of a blurred or antiquated perception of it—has dampened the impetus to examine the alternatives available for label printing, and to see what benefits might be there.

The second hurdle is fear of changing systems. You have to make an IT switch to move from laser to thermal; for those with no printer expertise, it's a barrier because of the different printer languages. The two types of printers are driven differently. If you don't have a driver on a Windows system, it may mean programming changes.

In reality, the language is simple. It's not like programming a software interface; it's a couple of lines of code to tell the printer to print. And it's very easy to develop and understand the code. In an hour, we can show anyone who has done any kind of coding before, or any kind of application development, so that they would fully understand how to do this. Once an organization makes the decision to change from laser to thermal printing labels, it's absolutely simple to implement. They tell us what they want to print, and we show them the code, which we've already developed. Just put it in, send the data—and you're working.

And you're working more efficiently, more reliably, and more economically than you were before.

The E-Class *Mark III*: Ideal Thermal Printing Solution for Labels ▪ ▪ ▪

Value is more than just the purchase price of a product. It is a balance between cost, features, and sustainability. We call this "The Three Dimensions of Value." The E-Class *Mark III* is affordable to own, easy to use, and economical to operate. For those printing labels, it's an ideal solution.

Affordable to Own
The E-Class *Mark III* offers a competitive purchase price, durable construction, reliable performance, and a low maintenance design that makes it affordable to own now and over a lifetime of use.

Easy to Use
The E-Class *Mark III* has a fully accessible print mechanism for easy media loading, a large graphic display, user controls for easy interaction, plus a full suite of communication options, language emulation software, and Windows drivers that simplify the transition from laser to thermal printing.

Economical to Operate
The E-Class *Mark III* uses thermal printing for increased power efficiency, and larger standardized media and ribbon rolls for lower material costs. Unlike laser printers, the E-Class *Mark III* significantly reduces material cost by printing the exact quantity of labels needed and eliminates the need to throw away partially printed label sheets commonly found in laser applications.

NOTES
1. He, Congrove; Morawska, Lidia; and Taplin, Len (2007) "Particle Emission Characteristics of Office Printers," Environmental Science & Technology, 2007, 41 (17), pp 6039-6045.
2. "Study Reveals the Dangers of Printer Pollution," Queensland University of Technology, August 2, 2007, http://www.news.qut.edu.au/cgi-bin/WebObjects/News.woa/wa/goNewsPage?newsEventID=13495.
3. Levine, Barry, "Are Laser Printers Hazardous to Your Health?" August 1, 2007, newsfactor.com, http://www.newsfactor.com/story.xhtml?story_id=020000F8E2PG&full_skip=1.

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