

White paper

How to Select the Right Label Printer

*Understanding the Convenience,
Cost and Quality Considerations for
Laser, Inkjet and Thermal Printers*

There are numerous factors for selecting the right label printing solution to meet specific needs. Printing frequency, print quality, bar coding requirements, ease of use and of course total cost of ownership (TCO) all come into play.

Many offices, retail stores, hospitals, labs, factories and other facilities have inefficient, overly expensive labeling processes because their needs changed over time but their printers did not. Inkjet and laser document printers simply aren't cost effective for many labeling scenarios because of TCO and quality drawbacks that develop when they are regularly used to print adhesive labels. Purpose-built thermal label printers are more cost effective, even at modest label printing volumes. They provide the added benefits of greater convenience, many more media options, more consistent print quality, and superior performance for bar code printing.

This white paper provides a brief overview of laser, inkjet and thermal technologies as they relate to label printing, explains the usage scenarios when each type of printer is most appropriate, and highlights hidden cost and performance considerations for each print technology. The paper also provides data and guidance to help you determine which printer type is most cost-effective for your labeling operations, and explains the cost, convenience and quality benefits that thermal printers provide.

Print Technology Profiles

Laser, inkjet and thermal printers can all create labels. The following sections highlight the label printing advantages and shortcomings for each technology.

Laser

Laser printers are designed for document printing and excel at it. They are fast, provide good print quality, can create color output, and are widely available and supported. Despite their speed, laser printers are not a good option for high-volume label printing because the cost-per-label is relatively expensive, and over time the adhesive material on sheet-fed labels builds up inside the printer and degrades its performance. The buildup can block the photoreceptor drum or fuser, leading to premature failure.

Media is the primary drawback for using lasers for label printing. The laser labels that are widely available in office supply stores often aren't durable enough for many enterprise and specialty labeling needs. Durable laser label media is available, but it does not always have high-performance adhesive, and thus is unsuitable for long-term or harsh-environment applications.

Because lasers are page printers, they cannot conveniently create single labels. An entire sheet of media needs to be loaded into the printer, even if only a single label is needed. The rest of the sheet will either be wasted, or can be reloaded, which then requires extra steps – one to reload, another to direct the printer (using the word processing or labeling software on a PC) to print on the remaining labels instead of on the backing where labels already have been peeled off. Laser printers do not provide a straight paper path, which increases the chances of jams and wasted media.

Bar code label printing can drive up the cost of using lasers. Producing quality, readable bar codes requires approximately 50 percent ink coverage, which is considerably more coverage than is required for printing quality text. Therefore bar code printing consumes more toner (and ink in inkjet printers) than text printing, which increases the supply cost.

For these reasons, laser printers are best used when entire sheets of non-durable, low-quality labels are needed, but are not needed often – because of the lifecycle limitation from adhesive buildup. Laser printers cost more to purchase than inkjet or thermal models, so their replacement cycle is an important TCO consideration when assessing whether a laser document printer should also be used for label printing.

Inkjet

Inkjet printers have many of the same advantages and limitations as lasers, and have a lower purchase price. The low initial cost does not translate into low TCO because of the high recurring cost of replacing or refilling ink cartridges. Inkjet printers generally do not match the quality of lasers. More importantly for labeling operations, inkjet quality is not consistent. When inkjet cartridges are running low, printed images appear faded and may include streaks or blank spots; new cartridges and low-cost inks are prone to smudging. These print quality problems can make bar codes unreadable to a scanner, which is a fatal flaw for a bar code printer. Quality concerns are not limited to bar code labels. Weak logos and graphics do not communicate a strong brand image, while hard-to-read text can cause a host of problems.

Inkjet printers have most of the same media limitations as lasers, including the need for sheet-fed labels and limited varieties of label stock. Their printheads are more prone to premature failure from label adhesive buildup. Inkjet printers are best used by organizations that need basic, low-quality labels and do not need to print more than a few sheets of labels at a time.

Thermal

Thermal printers work by essentially using controlled heat to create an image onto the media. For direct thermal printing, the most widely used thermal printer technology, the printhead applies heat to coated thermal media, which turns dark where the heat was applied. There is no ink or toner – the only supply needed for direct thermal printers is the label or paper stock itself. In contrast, for thermal-transfer printing, the printhead heats a ribbon, which transfers ink to the media. Thermal-transfer printers are usually used for creating permanent identification and other long-term labels. Direct thermal technology is suitable for mailing, shipping and many other labeling needs.

Media provides advantages for thermal printers. First, since labels come in rolls or fanfold stacks, they can conveniently be printed on demand in the exact quantity needed (including single labels) without having to use an entire sheet of label stock. Secondly, thermal printers support a wide range of media, from basic receipt papers and label stocks to durable plastic or film and composite materials. This includes labels suitable for use in sterilization, frozen storage, clean room and other environments that would degrade or destroy general-purpose label stock. The limitation to thermal media is that it is generally not available at office supply stores, though many suppliers will ship thermal media within 24 hours of receiving the order.

Thermal printers are not well suited for page printing and other general office uses. Most models are optimized for printing labels that range from 2 to 8 inches wide, and thus aren't suitable for general-purpose document, sign or large-format label printing.

Thermal printers are favored for their quality and consistency. Some thermal printer manufacturers warranty the printhead for 1 million inches, which is more than 15½ miles of output. Because there is no ink or toner, direct thermal print quality doesn't depend on the ink supply (although ribbons are a consideration for thermal transfer printers). Thermal printing techniques can also produce very precise images, which is why thermal is the most commonly used technology for bar code printing.

Matching the Technology to the Task

Each technology is effective for some label printing tasks and inefficient for others. Finding the most cost-effective printer to meet your needs requires an understanding of your label volumes, quality requirements and work processes. The following questions will help you determine your requirements and differentiate among the printers available to meet them:

- Is label printing a temporary or ongoing requirement?
- How often will labels need to be printed?
- How many labels will be needed at a time?
- How important is the print time to first label?
- How easy is it to load label media?
- Does the printer need to be told where to print on a sheet?
If yes, is this easy for users to do?
- What usage and storage conditions will the labels be exposed to?
- How long do labels need to last?
- What label sizes are needed?
- What kind of material will you need to print on?
- Is the suitable media readily available for the printer, or is additional treatment necessary (e.g. applying laminate, or taping or stapling labels in place because the adhesive may fail)?
- Can the printer support all the needed label sizes and media?
- What are the consequences if a label is unreadable?
- Are bar codes needed? Does the printer have to connect to a computer?
- Who is responsible for maintaining and troubleshooting the printer?
- How much down time is acceptable?
- What are the supply and labor costs associated with the printer?

The more factors that are considered beyond initial purchase price and the perceived convenience of using an existing printer, the more thermal printers tend to be selected for label printing. Since thermal printers are purpose-built for labeling, they are advantageous for most label printing uses, regardless of the type or volume of labels produced. The following sections provide more insight and examples of how thermal printers provide value for a variety of labeling use cases.

Thermal Convenience Benefits

Organizations do not need to print a lot of labels to appreciate the convenience and productivity benefits that thermal label printers provide. Purpose-built thermal label printers are designed to make labeling easy and keep unnecessary labor costs out of printing processes.

Understanding work processes is essential for determining which print technology is best for your operations. For example, can a laser printer really be considered fast if users need to remove the paper tray and load label stock each time they need labels, then switch the label stock and paper

again when they're done? Can inkjet printers be considered convenient if labels periodically need to be reprinted because the first batch was smudged or faded? Thermal printers prevent these problems, and provide other advantages.

A dedicated thermal label printer with roll-fed media is ready to print labels on demand, in the exact quantity needed, whenever users need them. With easy-loading roll-fed media, there is also no need to remember whether label sheets need to be loaded face up or face down (and no rework if the sheets were loaded the wrong way). Optional, built-in cutters and peelers are available so the label comes out of the printer ready to be applied, with no extra steps. There are linerless versions of thermal media that solve the problem of having to discard backing material, a feature that is especially valued by mobile printer users. These characteristics of thermal printers save time every time labels are printed, and keep unnecessary productivity losses and labor costs out of work processes.

Thermal printers often provide superior throughput for label printing. The common printer speed metrics of pages-per-minute (ppm) and inches-per-second (ips) do not provide a good measure of label printing speed. When comparing label printers, it is important to measure the time to first label (also referred to as first label out), which is measured as the elapsed time between when a user hits <print> and when the label is presented for use. Time to first label is essentially a measure of how long a worker will have to wait for materials before he or she can complete the task at hand. Fast first label out performance is important for customer-facing applications so customers aren't kept waiting, and for high-volume operations such as item labeling. Another metric, total print time, should be evaluated if operations call for workers to produce multiple labels simultaneously. Some printers require a pause between each label produced to process the next print job, while others can print nearly continuously after output begins. The time spent during pauses can be a strong impediment to efficiency. Purpose-built thermal printers generally excel at first label out and total print time performance.

Thermal printers also save time for label printing because users do not need to switch plain paper for label material. While the act of removing paper, loading labels then switching the media back again when label printing is finished may not seem too time consuming, the labor and costs add up the more this simple task is repeated, as the following example shows.

Assume an office only needs to print labels twice a day, and it takes about a minute each time to switch the media. In a year, media loading requires more than a day and a half of labor, which is an unnecessary productivity loss that can easily go unnoticed. The calculation below documents the time loss for the low-volume labeling process described above.

One minute to change & replace media done twice a day =
2 minutes/day
2 minutes/day x 5 days/week = 10 minutes/week
10 minutes/week x 52 weeks/year = 520 minutes/year
520 minutes/year ÷ 60 minutes/hour =
8.67 hours annually spent changing media

Note this calculation does not include the time needed to replace ink and toner, which can take longer than switching media. Multiply these time savings by the number of printers within your organization, and by your average hourly labor rates, to estimate the labor-cost component of TCO for each print technology.

Thermal Cost Benefits

No time-motion studies or formal labor cost collections are usually needed to see the cost advantages of using thermal printers to produce labels. Supply costs alone usually provide a TCO advantage for thermal printers compared to lasers and inkjets. The TCO for thermal printers is also favorable because of their long product lifecycles and minimal service requirements.

The table below shows typical prices for blank mailing label and shipping label media for laser, inkjet and thermal printers. For comparison, standard-quality label media in common mailing label and shipping label sizes were used. Prices listed for laser and inkjet printers represent the average online price listed by three national office supply retailers for the same name-brand label stock. Thermal prices are considered typical for common-quality mailing and shipping labels.

Laser mailing labels are 1.8 times more expensive than the thermal alternative, and laser shipping labels are nearly four times more expensive. Inkjet label media is not as expensive, but thermal media is still at least 40 percent less expensive than inkjet.

Figure 1: Label Media Cost Comparison

	Laser	Inkjet	Thermal
1,000 mailing labels (1 x 25/8)	\$9.06	\$9.54	\$5.11
1,000 shipping labels (3¾ x 4)	\$134.42	\$59.04	\$35.71

The media costs described above do not account for waste, which varies by printer type and media path. Roll-fed thermal media often results in less waste than sheet-fed labels, which may be discarded if only one or two blank labels remain on the sheet, or may become unusable because of creasing or peeling that occurs while loading and unloading.

While thermal media is clearly more cost effective, label stock costs do not show the full extent of thermal printing's value. When laser or inkjet printers are used, the cost of toner or ink must be added to the per-label cost calculation. There is no equivalent added cost for direct thermal printers because no additional consumables are required. Replacement ribbon cost must be factored in for thermal-transfer printing. The amount of ink, toner or ribbon used to produce each label varies according to the amount of text and graphics, so it is difficult to calculate and present typical costs. As noted, printing bar codes consumes more toner and ink than printing text. You can get a general idea of your own imaging material costs by comparing how many labels are printed to how often the toner, ink or ribbon is replaced, and dividing the label volume by the imaging material cost. Use the worksheet below to calculate and compare per-label costs for different types of printers.

Thermal printers can accommodate a wider range of media than laser or inkjet models, which makes it easier to find the most cost-effective media required for the labeling environment. Read the Belden sidebar to learn how the manufacturer reduced its laminated media costs by 57 percent by switching from laser to thermal printers.

Reliability Reduces TCO

Thermal printers are known for their reliability and long lifecycles, which reduce TCO. Thermal label printers should be expected to last numerous years, which creates a favorable amortization period for the initial investment. Because label printing doesn't degrade a thermal printer's performance like it can for lasers and inkjets, moderate- or high-volume label printing will not hasten the replacement cycle.

Factories and distribution centers that can't afford downtime because of high throughput or just-in-time shipping requirements use thermal more than any other print technology. Thermal printers are very reliable, even in high volume, harsh environment conditions. Thermal is also the leading print technology used at retail point-of-sale stations, where reliability is paramount because breakdowns will keep customers waiting and can result in lost sales. See Intermec's [white paper Printing Productivity from Start to Finish](#) for documentation and examples of the reliability, uptime and service cost advantages of thermal label printers.

Label Cost Worksheet

Print Technology	Media cost per 1,000 labels	+ Ink/toner/ribbon cost per 1,000 labels	= Total consumable cost per 1,000 labels
Laser			
Inkjet			
Direct thermal		N/A	
Thermal transfer			

Printheads are the most important part of thermal printers, and are also very reliable. As noted, some thermal printheads have a warranty to perform for 1 million inches, which is more than 15 miles of output. Plus, users can easily clean thermal printheads, which extends their life. Thermal printheads are replaceable, so the entire printer doesn't need to be replaced when the printhead reaches the end of its duty cycle.

There are obvious savings and TCO advantages if printers do not need to be serviced or replaced. However, high uptime is not the only way thermal printers contribute to low operating costs. As the Belden profile showed, the efficient printing processes that thermal label printers support lead to productivity gains that effectively lower TCO.

After switching from laser to thermal printers Belden reported \$800 in monthly media savings, and \$7,500 in total monthly savings, with the balance of money saved coming primarily from not having to apply additional adhesive and laminate to the thermal label stock. In Belden's case, the labor savings were more than eight times higher than the media savings. Thermal printers are also available in mobile versions, which can provide even greater labor productivity improvements by eliminating time spent retrieving labels. See Intermec's [white paper *Time is Money: How to Save Both with Mobile Printers*](#) for examples.

Thermal printers are extremely cost effective for all types of labeling operations because of their low supplies costs, long life cycles and their ability to improve productivity by minimizing downtime. Organizations do not need to sacrifice quality to get the low-cost labeling benefits that thermal printing provides, as the following section shows.

Thermal Quality Benefits

Thermal label printers provide immediate and long-term label quality advantages over laser and inkjet. These advantages include print quality consistency and the precision needed to produce high-quality logos and graphics. Plus thermal printers are compatible with a wide range of media that helps ensure durability and performance in challenging environments, including sterilization, frozen storage and long-term outdoor use.

Besides print quality, thermal labels can also have a durability advantage over those produced on laser and inkjet printers because thermal printers can support more than paper-based label media. Thermal label printers are designed to accommodate tag stock and composite materials that would cause jams in general-purpose document printers. Stock media available for thermal printers includes:

- Heat- and moisture-resistant materials suitable for washing, sterilization and frozen storage;
- Labels with aggressive adhesives for rough surfaces;
- UL labels;
- Card, tag and ticket stock;
- UV-resistant material;
- Clean room-compatible labels;
- Polyester, Kapton and other synthetics that provide extreme durability and environmental resistance;
- RFID smart labels.

Technology Switch Success Story: Manufacturer Cuts Shipping Label Costs 57% with Thermal Printers and Media

Communications products manufacturer Belden uses durable shipping labels on the coils of wire it sends to customers throughout the U.S. Label quality and environmental resistance are very important, because products are stored outside and each label includes a bar code for automatic identification.

Belden previously printed its labels on desktop HP laser printers, then manually applied a coat of laminate and a separate adhesive to the label to protect against exposure to heat, sunlight, wind rain and snow. Belden went to the effort and expense of laminating its labels because its laser printers were not compatible with any media that was durable enough for the label usage conditions.

Belden later learned that many types of thermal label media are available to satisfy its shipping label needs. The company then replaced its laser printers with two Intermec thermal printers and different durable label stocks that were selected for the specific products being labeled.

"The new shipping label printers eliminated the need to double laminate the packing labels. The shipping group used to spend an average of 60 hours a month double laminating the old shipping labels, time that can now be utilized for other duties," said Pam Shim, system services manager of Belden. "The cost of materials for packing labels was \$1,400 per month, but after implementing the Intermec label material, costs have been reduced to \$600 per month. Overall, we save \$7,500 a month by using the Intermec printers."

See the complete Belden case study at www.intermec.com.

As the Belden example showed, it took two extra manual steps (applying adhesive and laminate) to make the shipping labels produced on a laser printer durable enough to withstand outdoor storage. Thermal media was readily available to provide the needed protection and durability, enabling the shipping labels to be produced in a single pass through the printer with no extra, manual steps.

The label adhesive buildup that occurs in laser and inkjet printers not only reduces the equipment lifespan, but frequently causes print quality problems. Paper scraps, dust and other particles from the environment can also build up inside the printer and interfere with printing. Office printers and other non-ruggedized models are susceptible to buildup because they aren't sealed against the environment. When buildup occurs, blank areas will appear on the label because the blockage prevents the inkjet printhead or laser fuser and photoreceptor drum from creating the image. If the blank area occurs on a bar code it will probably render it unreadable. Smearing, which often results from using low-quality, low-cost laser or inkjet media, can also ruin bar codes.

Thermal printers tend to produce crisper, more precise images, which is why they are the leading choice for bar code printing. For bar codes to be readable, the bars and spaces must be produced to very exact width specifications and must provide

sufficient contrast between dark and light elements. Thermal is the dominant technology used for bar code printing because it is capable of producing very crisp lines and images, and because many thermal printers have native support for bar code symbols and do not treat them as fonts or bitmap images, which reduces quality.

It is worth noting most companies that must comply with strict shipping label bar code quality standards imposed by their customers, shipping or logistics companies use purpose-built thermal label printers. Thermal printers are also widely used for other labeling applications where quality is critical, such as blood bag and laboratory sample identification, work-in-process and component identification, file management and asset tracking.

Conclusion

For label printing, thermal printers provide convenience, cost and quality advantages over laser and inkjet models. These advantages are apparent even at low labeling volumes, and grow as label production scales. Unlike lasers and inkjets, thermal print quality does not go down as the number of labels printed goes up. What does go up with thermal printers is the TCO advantage as more labels are printed, because of lower media and supplies costs.

Thermal printers have long been the leading choice for bar code labeling. Now organizations with all types of labeling needs are increasingly adopting thermal printers because of their value. The ability to easily support multiple label materials and sizes, avoid the work and waste associated with sheet-fed media, and freedom from toners and inkjet cartridges all make thermal printers easy to use. Their excellent, consistent print quality make them suitable for all types of labeling tasks. Users do not need to pay a premium for these advantages, and in fact many thermal printers pay for themselves simply because of their supply savings.

Intermec invented the first on-demand bar code label printer in 1971. Today Intermec label, ticket and tag printers cover every type of application, from economical low-volume needs to rugged, industrial-strength printing and applicators. Recognized for quality, durability and reliability, Intermec printers offer a wide range of features including multiple protocol support, programmability, Internet printing and management, wireless, internal Ethernet support, RFID, and liner-less technology. Our connectivity support and software resources make it easy to set up and use Intermec printers right out of the box in office, healthcare, retail, industrial and other environments. To learn more about the complete Intermec printer product line, complementary software and accessories, and to review case studies and white papers about successful printing programs visit http://www.intermec.com/products/printers_media/index.aspx.

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