

# Explore the Different Print Technologies

*and Learn Which Printing Technology is Right for You*

Have you been outsourcing your labels only to have them expire or become obsolete while sitting in storage? Or, have you missed timely shipments because you didn't receive product labels on time? Or, perhaps you have a monochrome thermal transfer printer like a Zebra or a Brother, but you've discovered that a splash of color is what your product really needs to grab consumer attention on the shelves? Either way you'll find that color label printers are a maze of different brands, printer models, price points and printing technologies.

Understanding the key differences in the variety of available printing technologies is essential in discovering which technology is best suited your application needs. While no single printing technology is perfect for all applications, it's important to understand your specific application and the unique challenges it presents.

A vibrant, abstract background featuring a large splash of multi-colored ink (red, orange, yellow, green, blue, purple) on a white surface. The ink is in motion, creating a dynamic, cloud-like shape. To the right, several thin, vertical lines of color (yellow, red, green, blue) extend from the top to the bottom of the frame, resembling a rainbow or a series of colored ribbons.

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# ***The Different Fundamental Printing Technologies Used in Desktop Color Label Printers:***



Electrophotographic (EP)



Pigment-Based Inkjet



Water-Based Inkjet (WBIJ)



Thermal Transfer



# Water Based Inkjet (WBIJ)

While this technology has been powering small home and office printers for quite some time, it has since matured and become robust enough for the desktop label printing segment in just the last decade. It has revolutionized the segment by allowing people to rethink how they can best fulfill their needs for short-run prime labels without the constraints of a third party that impose long lead times and high minimum order quantity or outrageous label costs. As the range of inkjet coated stocks has grown, and as this technology continues to improve and advance, its appeal continues to attract new customers in different segments.

## How does it work?

An inkjet printer creates an image by firing tiny droplets of ink onto the paper. The complete image is comprised of many small dots. The quality of an image is determined by the number of dots per inch (DPI) and the range of colors possible. A few different colors of ink can be combined to produce virtually any color (except for white). **Cyan (C), Magenta (M), Yellow (Y) & Black (K)** are commonly used colors, referred to in the industry as CMYK. The liquid portion of the inks used in these printers is predominantly water, hence “water-based inkjet.”







These water-based inks have color components that can be either **dye-based** or **pigment-based**; the ink chemistry and properties differ accordingly. In dye-based inkjet inks, the colored dyes are chemically bonded to the liquid portion of the ink, forming a “solution.” In contrast, pigmented inks are “suspensions.” That is, particles of coloration are suspended within a liquid and held between water molecules. Dyes seep into the paper substrate more easily than pigments, which primarily sit up on the surface of the paper. Dye-based inks are brighter and have a wider color range than pigmented inks, as well as having the ability to print on a wider variety of label substrates. These days, WBIJ desktop label printers are available from 600 x 600 dpi resolution and higher, though, for prime label applications, you should consider going for printers with at least 1200 x 1200 dpi capability. All WBIJ printers require the substrate or label facestock to be coated with an inkjet receptive layer (IRL). This coating is essential to enable the bonding of ink with the label material (paper or synthetic) to produce optimal, smudge-proof output. While this coating makes WBIJ label material slightly more expensive, its benefits include almost no waste, and the on-demand flexibility, at little upfront investment costs, far outweighs the higher substrate costs. Initially, its appeal was limited to very short runs, e.g., run sizes ranging from tens to a few hundred, but as technology has matured and operating and maintenance costs have reduced over time, brands find it increasingly viable to run job sizes of a few thousand(s) labels on these desktop machines.



# Pigment-Based Inkjet

Pigmented inks have a longer life span and are more color-fast than dyes. If prolonged exposure to sunlight or other elements of nature is expected, dye-based inks will need some protection like lamination or varnish to prevent color fading over time, while pigmented inks can withstand the elements for longer without fading. There are important niches like chemicals or even other consumer labels or packaging applications for which printed labels must withstand exposure to sunlight or moisture for extended periods of time. However, protection may still be required for pigment inks if continuous outdoor exposure over several weeks or months without any color shift is expected.







# Electrophotographic (EP)

Initially, a photocopying technique, EP technology (also called laser or LED printing), provided a way to do higher volume document printing at faster speeds and lower maintenance frequency. Instead of using light reflected from an original document as in older photocopiers, a laser (sometimes an LED) was used to translate computer data into light pulses that would expose a light-sensitive, photo-conducting drum or belt. By the 1980s, laser printing had been downscaled enough to be manufactured within a desktop-sized printer.

## How does it work?

The coloring agents used in electrophotographic systems are called toners. They come in two forms – **dry** and **liquid**. Dry toners are used in all desktop and office printer/copier systems. Both dry and liquid toner systems are used in electrophotographic digital presses. Dry toners consist of pigments or dyes embedded inside polymer beads. The fusing process melts the polymer beads to the surface of the paper. In addition to the colorants within the polymer beads are “charge agents” that allow the toner to be charged opposite to that of the photo conducting drum. Without this charge, the toner would not stick to the drum (or belt) or be transferable to the paper. Toners also contain small “lubricating” particles between them to keep them from sticking together. The materials used for electrophotographic printing can either be uncoated or coated. Since the toner image is “fused” onto the substrate by applying heat and pressure, a coating is not essential for proper adherence. However, coatings may still be applied for other reasons, for instance, providing a glossy or distinctive textural look and feel or preventing easy bending or tearing.



First-generation EP/toner-based label printers appeared around 2005. With print quality at 600 dpi and substantial print durability, they were revolutionary at the time and offered flexibility to customers for whom in-house label printing capability was an essential requirement. These first-generation EP printers were complicated to build and maintain though, so when WBIJ technologies arrived at the scene, those fell by the wayside. However, EP technology provides unique capabilities. EP allows you to print with White ink (toner) along with CMYK, so the printers are offered in a 5-color format – **CMYK + White**. With WBIJ printers, you're largely limited to printing on white substrates, but with the availability of printing white toner with EP printers, a vast world of label printing capabilities is now possible, especially on colored and transparent substrates. The white toner's opacity allows the colors to stay separated from the base substrate and pop out to produce attractive, beautiful designs. Premium product segments like high-end liquor, cosmetics, etc. typically prefer their label design and art to reflect their unique positioning. The availability of laying down white toner allows printing on clear material or specialty substrates like foils or craft materials.



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# Thermal Transfer

Thermal Transfer printing is the oldest digital print technology around; the printers based on this technology are ubiquitous in the space of monochrome or one-color printing. These printers are fast, economical, easy to maintain, and are consistent when the objective is to print basic information like product manufacturing/expiry dates or barcodes near the point of sale. At resolutions of 300 or 600 dpi, the labels produced from thermal transfer printers are generally not suitable for most prime label applications.

## How does it work?

Thermal Transfer printing is a digital printing method where the material is applied to paper or another material by melting a coating of ribbon so that it adheres to the material on which the print is applied. It produces consistent, reliable images on every label with durable, long-lasting images. However, there are a few niche labeling applications that still favor thermal transfer technology over competing technologies, which is why you'll still find manufacturers making four-color thermal transfer printing systems.





# Advantages of Thermal Transfer Printing Include:

1. Availability of CMYK process AND spot color ribbons such as metallic gold, silver, white, signal red or blue, and many more
2. Ability to print on low-cost substrates of varying thicknesses with a very high level of durability and resistance to solvents, moisture and UV exposure
3. Low maintenance requirements & can easily handle dusty, dirty, manufacturing environments

There are several unique applications in which labels printed with thermal transfer technology still find their usage. For example, many electronic applications require that the labels applied are UL approved. These labels are required to meet stringent criteria via testing mandated by UL 969. Similarly, if the labels must be printed and applied in a manufacturing environment that is corrosive and dirty, thermal transfer printers may be a better fit than inkjet or EP technologies. If you want to print a large quantity of non-prime color labels on cheaper substrates for which lower print resolutions would be suitable, the end-product is reasonably durable when printing with Thermal Transfer technology. Another common application for thermal transfer printers is overprinting on pre-printed colored labels to add barcode and variable data closer to the packaging point. It's also worth noting that these printers are easily integrated with automatic in-line label applicators.



# Next Steps

Now that you're aware of the three key technologies available in a desktop format for printing color labels, you can start identifying the right printer and label materials that fit your needs. When buying a label printer for the first time, it's advised to consider professional installation and a training package. This is not only to ensure the label printer is installed and works properly but to also ensure that you or any employees who will be using the printer are trained to use it properly and perform essential maintenance on a periodic or as-needed basis.

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