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PRINTtips



**Graphics
Printing
Mailing
Under One Roof**

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How Digital Printers Work

Glance around your desk. Chances are you've got a desktop laser printer or inkjet printer nearby your computer for making prints from the document files you or others create. These printers, so ubiquitous today, revolutionized the printing industry twenty years ago by giving us other ways besides offset printing to reproduce documents.

In the early days it was relatively easy to determine whether a document had been printed using an offset press or a copier. But as digital printing technology improved and quality reached offset level, it became clear that digital printing augmented and expanded the demand for printing in general.

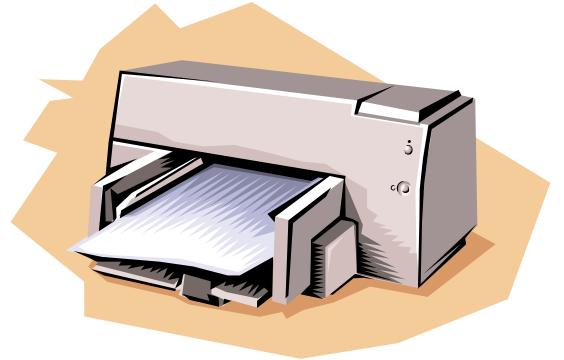
Today the major difference between offset and digital printing lies in what each can be used for, and the specific situations when one technology offers an advantage over the other.

What is digital printing?

The term *digital printing* can be broadly defined to include any reproduction method that uses electronic files and dots to produce an image using ink, toner, inkjet, or other dye- or pigment-based imaging system. Because a digital printer re-draws the page image for each print rather than relying on a press plate to carry the image, a digital print requires no setup sheets and each sheet can contain a different image.

The advantage of digital printing

The characteristic of re-drawing the image for each page means that digital printers can do two things very efficiently: print sets of multi-page documents one set at a time; and personalize the image on a page to a single person or company.



This feature facilitates the use of personalization in marketing, on-demand printing for books and manuals, and just-in-time inventory management based on short run lengths.

How does digital printing work?

Digital printing begins with creation of the document file – the words and images that will print on the page. Regardless of what program is used to create the file or any of its components, the file is converted into a *raster graphics image*. A *raster* is a grid of x and y coordinates on a display space; a *raster image file* identifies which of those coordinates to illuminate.

A raster image file is sometimes referred to as a *bit map* because it contains information that is directly mapped to the display grid. BMP, TIFF, GIF and JPEG are all examples of raster image file types. The action of converting a file to a raster image file is known as *raster image processing* or *RIPping*. To prepare for digital printing, all files must be RIPped to create the bit map that will guide the imaging device (usually laser or inkjet) to print the dots in the right place.

As we mentioned before, digital printing devices use a variety of technologies to create the image: wet or dry toner, inkjet, and dye- or pigment-based

How Digital Printers Work (continued)

systems. The most frequently used are dry toner-based printers and inkjet printers.

Laser printers use the pulses of light from a laser beam to create images on a light-sensitive surface. The images are formed from dot matrix patterns, typically 240 x 240 dots per inch, 300 x 300 dots per inch or 600 x 600 dots per inch.

The laser printer uses technology similar to a copier, based on the principle of the attraction of opposite electrical charges. Using the bit map information from the RIPped file, the laser beam exposes an electrically charged photoreceptor, changing the charge to the opposite of the rest of the photoreceptor. Toner particles are attracted to the photoreceptor, then transferred to paper. The toner is fused to the paper by passing the paper through hot rollers (approximately 400 degrees).

The heat required to fuse the toner to the paper introduces some limitations to the type of stock that can be used in a laser printer.

Toner

Toner is a fine, negatively charged, plastic-based powder. The plastic particles ensure that the toner will “melt” when heated by the fuser. Toner is manufactured by mixing pigment (either black or colored) with molten polymer, then cooling the mixture and crushing it in a milling process. This creates toner particles of between 7 and 10 microns.

The size of a toner particle is relevant to the resolution of a printed image. Because the toner must adhere to the dots of a bit map, it is important to maintaining the resolution of the image that the toner particles be no bigger than the dots. High speed digital production printers such as we have use microfine toner; this is why we can hold a finer resolution than is possible with a desktop laser printer.

How does an inkjet printer work?

An inkjet printer uses extremely small droplets of ink to create the image on the paper. The ink droplets are controlled by digital signals that use one of three methods (continuous

flow, thermal drop-on-demand, or piezoelectric drop-on-demand) to force the liquid ink out of its cartridge, spraying it onto the paper. Inkjet droplets are usually between 50 and 60 microns – smaller than a human hair (70 microns) but larger than a toner particle.

When printing photographs, an inkjet printer using specially formulated paper can achieve near-photographic quality. Some inkjet printers print on paper or other substrates dispensed from rolls; this enables printing high resolution images in large format for products such as posters, signs, and displays.

Digital printing and paper

Papers designed for digital printing have different properties than paper used for offset printing. In particular, the paper must be formulated to react appropriately to heat, pressure, and the chemistry of toners or inkjet inks.

You may have had the experience of using an inkjet printer to print on a sheet of paper that has always worked well in your laser printer, but having the image not reproduce clearly or having the ink seep through the sheet. Or paper may eject with a bad curl from your desktop laser printer, the result of moisture on the surface of the paper rapidly evaporating during the toner fusing process. Yet other papers are not able to withstand the high heat in a laser printer and react by cracking, curling, or improper fusing of the toner.

Why explain how things work?

You may be wondering why we would devote an entire issue of Printips to a discussion of equipment. Part of the reason is that we want you to know something about the way our imaging technologies work, since we believe the knowledge will help you evaluate our recommendations when we advise offset vs. digital printing.

It will also help you understand why we may change our recommendation based on the actual image you need to reproduce. We want you to be fully informed so that you will always understand your options and make the best, most informed decision.

“Toner particles are attracted to the photoreceptor, then transferred to paper.”

“... the toner must adhere to the dots of a bit map...”

Digital Printing Tips

When designing a document that will be printed on a toner-based digital printer, keep these tips in mind:

- For screens, blends and gradients, use tint values with a wide range. Narrow tint ranges mean wider bands of tint value will be used at output, which leads to banding. We recommend a range of 15% to 85%.
- Don't create black type from CMYK. If printing in full color, be sure that black type is set to print as K rather than as a blend of CMYK. Black type created as

CMYK appears muddy and grayish and may appear fuzzy due to mis-registration of the CMY.

- Keep print coverage low on fold lines. Cracking at the fold line is a common problem with toner-based digital printing. Scoring on the fold line helps prevent cracking; so does designing so that there is lower toner coverage at the fold.

Also remember that the range of papers that can be used in digital printing is not as wide as offset printing. The greatest limitations are the thickness of the paper and the kind of coating on the paper.



“Scoring on the fold line helps prevent cracking...”

Q. Why are the paper choices for digital printing so limited?

A. There are two primary challenges to developing paper for digital printing. The first is formulating a paper that will run well regardless of the paper path (straight or curved), toner chemistry and developing system, and fuser

heat and pressure. The second is to produce a paper with the right surface and brightness to keep the image sharp, and the right opacity to prevent image show-through. Finally, the digital color printing puts different demands on the sheet than digital black and white printing.

Coated stock in digital printing has been an issue. The coating on papers produced for offset printing can't withstand the high heat environment of digital printing. This once represented a true limitation to digital printing; however, as customers have requested coated stocks, paper manufacturers have risen to the demand and begun to develop coated stock for digital printing, and equipment manufacturers have found ways to lessen the effect of the heat.



“...produce a paper with the right surface and brightness to keep the image sharp...”

Variable Data Printing



One of the principal advantages of digital printing is that it can economically be used for *variable data printing*, a term that describes various levels of document personalization. The levels are:

- *Personalized printing* where the document includes some information specific to an individual. A simple example is *mail merge*, where an individual's name and address appears as an inside address of a letter. Personalized printing may also include personal information throughout the text of a letter.

- *Versioned printing* refers to printed materials that share much of the same information and design, but introduce some variation based on specific criteria. An example of versioned printing is a membership brochure where

the photographs and featured services change depending on the age range of the individual.

- *One-to-one printing* refers to printed materials that are completely customized to a single individual, with changes in graphs, charts, images, and text depending on the characteristics or demographic information of the individual. The changes are dictated by data collected in databases. An example of one-to-one printing is an insurance benefits booklet or a post card inviting the recipient to use a Personalized URL (PURL).

We provide variable data printing services at TechneGraphics. If you are interested in learning more about how variable data printing can benefit your sales and marketing or human resources departments, please contact us.

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