

# EVALUATING INKJET PRINTING FOR CORRUGATED

COLTEN FREEZE OF BENNETT PACKAGING PROVIDES AN OVERVIEW OF THE TECHNOLOGY AND WHAT TO LOOK FOR IN PRINT QUALITY.

**A**s corrugated converters continue to evaluate whether digital printing is a good fit for their mix of business, they are finding that the research on the topic can be daunting. The wide range of available solutions combined with the variation in print quality requires careful review. This article provides a basic overview and explains the types of printers available and how to evaluate printing quality.

In its simplest definition, inkjet printing is the process of applying ink to a substrate using printing heads that fire fine droplets of ink to a blanket or directly to a

substrate to create an image. It is also referred to as stochastic printing.

## A Few Definitions

Optical or theoretical resolution is the resolution that is typically stated in marketing vehicles for digital printers. Optical resolution refers to how many droplets of ink that can be, theoretically, printed in an inch. Use the following equation to calculate the optical resolution of a printer:

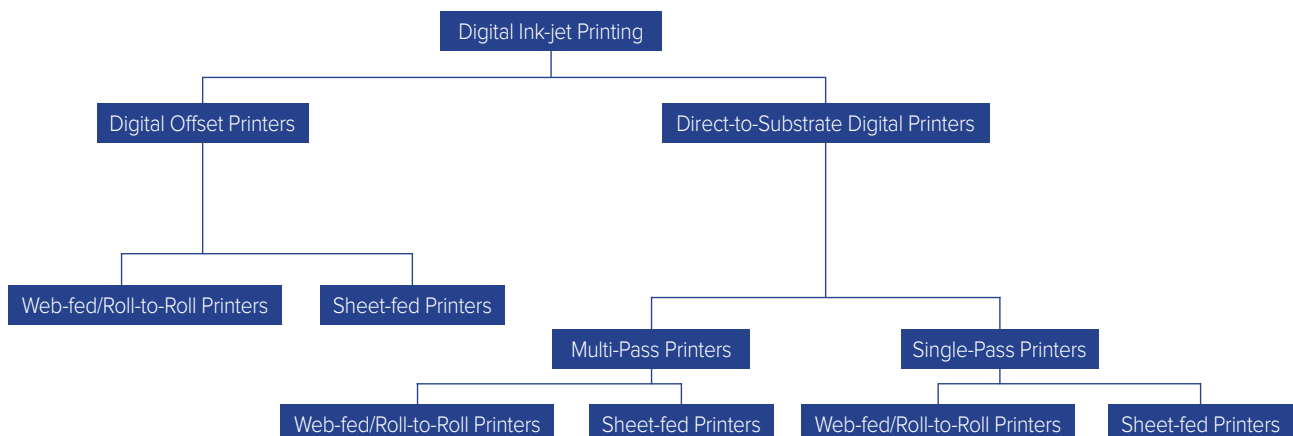
$$\text{Print nozzles per square inch} = \frac{\text{printer's available droplet sizes} \times \text{redundancy}}{\text{droplet size}^2}$$

Visual resolution is the actual amount of droplets that can be counted in a square inch on a print, or droplets per inch (DPI).

Picoliter is the unit of measurement used to describe the droplet size that a digital machine is capable of printing. Most digital printers are capable of printing multiple sizes. In picoliters, the smaller the number, the smaller the droplet of ink, the larger the number, the larger the droplet. A printer capable of printing smaller picoliter droplets will have a finer resolution print.

There are several categories of digital inkjet printers as illustrated in this chart:

## Categories of Digital Ink-jet Printers



ON A MULTI-PASS PRINTER THE FINAL IMAGE IS COMPOSED OF DROPLETS OF INK APPLIED IN MULTIPLE PASSES. THERE ARE DIFFERENT METHODS OR CONFIGURATIONS OF MULTI-PASS PRINTING ILLUSTRATED BELOW.

Offset inkjet printing is similar to offset lithography except that no aluminum plates are required. Ink droplets are distributed directly to a blanket and the blanket then distributes ink to the substrate. For direct to substrate inkjet printers no plates are required. And unlike flexography or lithography, ink droplets are distributed directly to the substrate from the print head.

Digital printers can be divided into two categories: multi-pass, and single-pass.

### Multi-Pass Printers

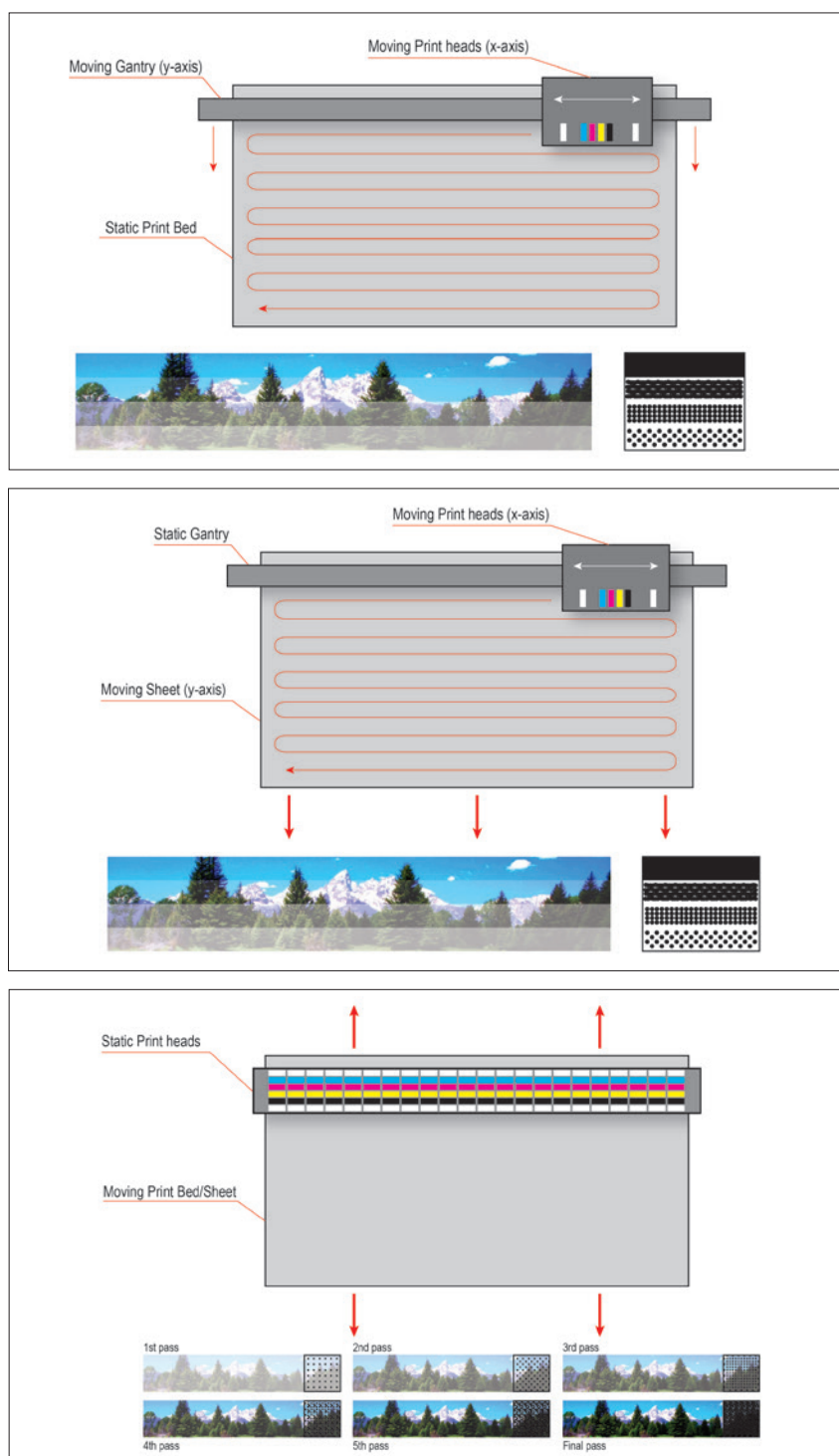
On a multi-pass printer the final image is composed of droplets of ink applied in multiple passes. There are different methods or configurations of multi-pass printing illustrated at right.

Multi-pass printers can be configured to print in different settings. For more of a production, higher volume setting, fewer passes can be made on a sheet with denser ink coverage per pass. Fewer passes can result in a grainier print or colors that may appear washed out or not as rich/deep. In some applications this is suitable and will result in more square footage per hour.

With a fine art/high-quality setting, less square footage will be printed per hour – but the quality in print will increase. Increased print quality can be defined as smoother process images and richer, more vibrant solid blocks of color.

Inks developed for multi-pass printing are generally more translucent and brighter. This gives you the ability to build up your printed images or graphics in multiple passes and results in richer, more vibrant prints.

Multi-pass printers



SIMILAR TO FLEXO OR LITHO, MISS-REGISTRATION SIMPLY MEANS THAT TWO OR MORE COLORS THAT SHOULD PRINT/REGISTER IN THE SAME LOCATION, DO NOT.

### Single-Pass Printers

In single-pass printing the final image is composed of droplets of ink applied in a single pass. There is really only one configuration for single pass printing and that is in a linear format. The substrate, whether on a roll or in sheet form, passes under the print heads a single time.

Most single-pass printers have the functionality to control the speed of the substrate passing by the print heads. Slower speeds lend to a higher quality print, where faster speeds result in higher production. There are challenges that come with increased speed, maintaining consistent, solid print and registration of colors.

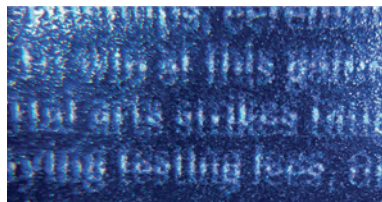
Inks developed for single-pass printing are generally darker or dirtier than those used in multi-pass printing. Single pass printers only have one chance to lay down the appropriate amount of ink to create the desired print.

Currently, single-pass printers that are printing directly to the substrate cannot achieve a visual resolution as good as a multi-pass printer and images tend to be grainier. The upside to single-pass printing is higher production rates – more square feet printed in an hour.

### Digital Print Quality

To understand what good looks like from a digital printer, we will need to know what bad looks like.

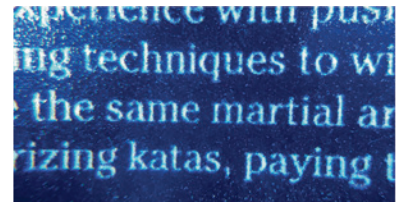
Similar to flexo or litho, miss-registration simply means that two or more colors that should print/register in the same location, do not. This can be seen visually on a print either with the naked eye or through the use of a loupe. Miss-registration would be an issue from color to color within a press.



Miss-registration. Left: Poor registration

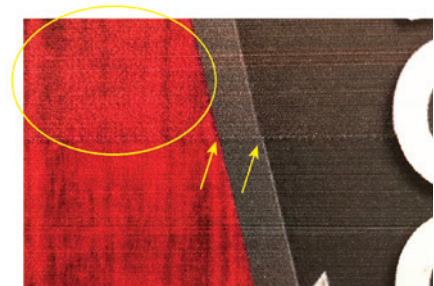
print head may be printing slightly in front of or behind another print head, in the direction of the print.

Misalignment contributes to swathing or banding in solid areas of color and a distinct change in quality in a process image. For example, if the process image is spanning across multiple print heads and one of the colors utilized to build that image is misaligned, you may notice the area of the misaligned print head appearing fuzzy or grainy.

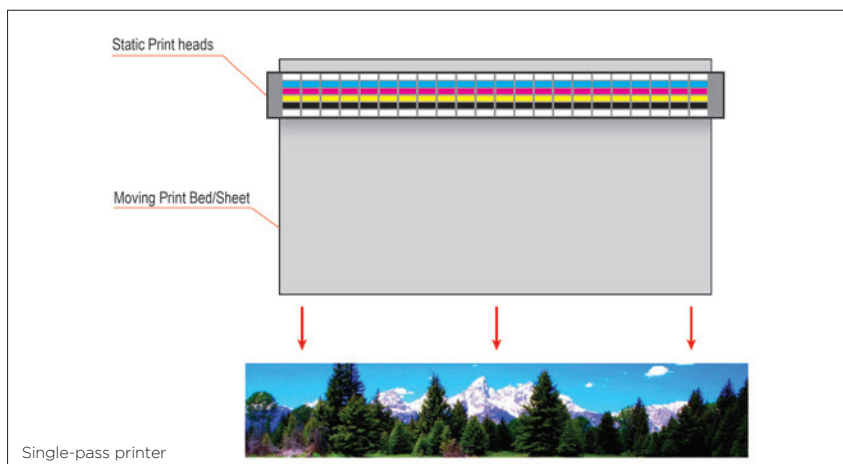


Right: Acceptable registration

Depending on the configuration of the digital printer, issues with alignment will also appear as miss-registration. Misalignment, in this context, is isolated to printers with multiple print heads printing the same color. Misalignment occurs within the same color on a press, where multiple print heads printing the same color are not in sync. One

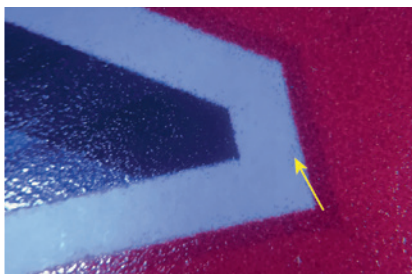


Misalignment



Satellites are inevitable, to a certain degree, in all digital printing. These are droplets of ink that are landing in an undesired or unintended location. To combat this issue, print heads should be as close as possible to the substrate. The shorter the distance from the print head to the substrate, the more likely you are to have droplets of ink land in their desired location. Besides the distance between the print head and the substrate, other factors that contribute to satellites are speed, static charge and vacuum. In severe cases, this is what is referred to as over spray.

THE HARDEST COLORS FOR ANY DIGITAL PRINTER TO PRINT ARE THOSE THAT UTILIZE ALL OF THE RAW INKS THAT A PRINTER POSSESSES TO A MODERATE TO HIGH AMOUNT, WITH THE EXCLUSION OF A RICH BLACK.



Satellites

Clogged or defective print head nozzles are one of the easiest defects to spot in any digital print. A clogged nozzle will appear as a line through the entirety of a graphic or image where that specific color is being printed. Ink is not able to pass through the nozzle and print onto the board in that specific location. A defective print nozzle can also appear as clogged. Ink is actually able to pass through the nozzle, but the ink droplets are not landing in the desired location. Defective nozzles can also contribute to satellites.



Clogged or defective print head nozzles

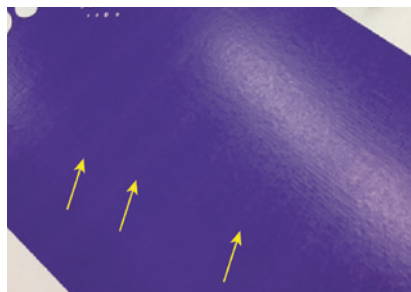
Swathing on a multi-pass machine, commonly referred to as column banding or just banding on a single-pass printer, is most noticeable in solid areas of color. Swathing appears as lines or columns of varying density of print.

The hardest colors for any digital printer to print are those that utilize all of the raw inks that a printer possesses to a moderate to high amount, with the exclusion of a rich black. For example, colors like brown, burgundy,

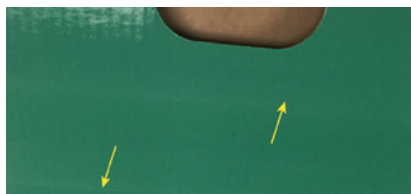
rich dark gray and dark purple, are all more difficult colors to successfully print digitally. Rich black is typically an easier color to print successfully because all of the inks in a printer are layered on top of one another to cover the substrate underneath.

Swathing on a multi-pass printer can occur from a few issues, and these will also depend on the configuration of the printer. One of the most common causes is over spray. This can occur when the head height is too high and droplets of ink spray onto a finished area of the print. Over spray would result in darker areas of a solid color of print. Misaligned heads can also create a swathing or banding effect. This could appear as a darker or lighter column throughout a solid block of color. The lighter or darker effect depends on the specific final color intended to print and the misalignment of the print head.

The following examples illustrate swathing.



Above and below: Swathing



### A Final Note

What makes digital printing difficult? When printing small copy or fine details on an uncoated substrate the

ink droplets begin to absorb into the liner and if not cured or dried almost instantly, the droplets begin to spread. This is helpful when trying to achieve a consistent solid block of print. Once droplets begin to absorb into the liner they spread and can create a soft, blurry, or fuzzy edge. Sometimes this effect appears miss-registered.

Printing solid blocks of a consistent color on coated substrates make for an excellent canvas for printing fine details. But for solid blocks of color, ink droplets bead on top of the liner and do not spread as evenly.

Simply put, on larger printers there are more variables to control: alignment, cleaning and preventative maintenance. The printer must maintain an absolutely consistent state through the print of an image. If any one factor is slightly out of sync, a larger print will amplify the effects.

Regarding speed, for a single-pass machine, just like the size of print, all factors are amplified. All factors on the printer must be completely in sync. The same can be said for a multi-pass printer, but as discussed earlier, as speed increases on a multi-pass machine, visual resolution and color depth will decrease. ■



Colton Freeze is Creative Services Manager at Bennett Packaging where he oversees the graphic, structure, and prepress operations.

He has several years of experience in digital printing specific to corrugated packaging and Point-of-Purchase displays. Bennett Packaging was the first company in North America to invest in single-pass, direct-to-corrugated print technology.