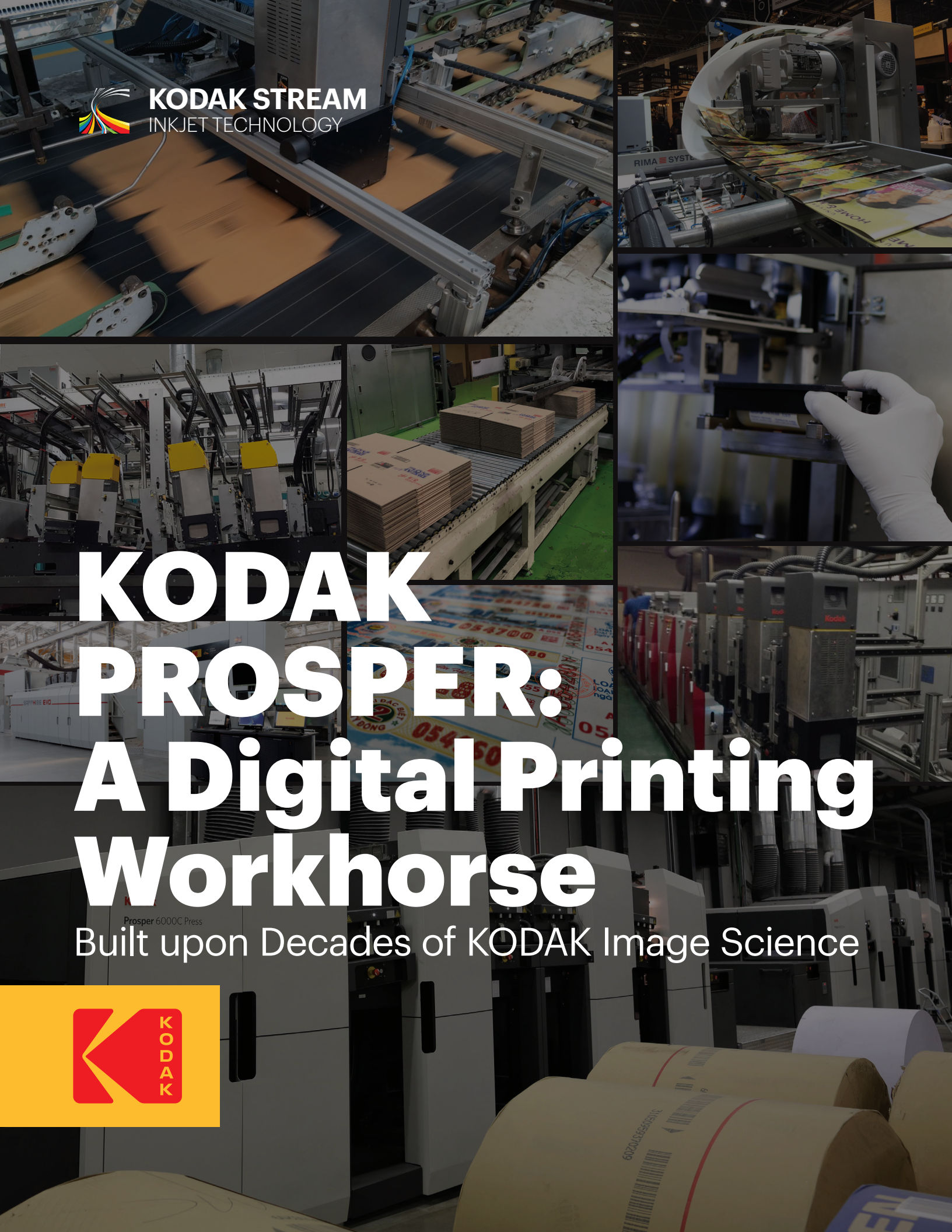

KODAK STREAM
INKJET TECHNOLOGY
KODAK
PROSPER:
A Digital Printing
Workhorse
Built upon Decades of KODAK Image Science
Prosper 6000C Press

Stream jetting module used in PROSPER S-Series, PROSPER Plus, PROSPER 1000, 5000, 6000 and EVO M presses

A History of Innovation

Eastman Kodak Company's rich legacy of color and image science is exemplified by the more than 700 Kodak patents that form the foundation for the inkjet technology that drives the KODAK PROSPER Press family of production inkjet printing systems. Inkjet printing relies on the fundamental interactions between the printing system, its inks, and the substrates it prints on. To this challenge, Kodak brings to the table something that few of its competitors can: Kodak designs and manufactures the printheads and the inks, and manages ink/paper interactions through a set of specially-developed optimizer fluids that allow the system to drive high-quality results at full production-level speeds. KODAK's Continuous Inkjet Technology, which has been highly productive and reliable in monochrome imprinting applications for many decades, is now equally effective in color and black & white offerings for a range of printing applications across commercial print and packaging.

THE ADVANTAGES OF KODAK CONTINUOUS INKJET TECHNOLOGY (CIJ)

KODAK Stream Inkjet Technology printheads in KODAK PROSPER Systems use a technology called continuous inkjet, often abbreviated as CIJ. The advantages of continuous inkjet build from the technology's ability to control dot placement extremely accurately at speeds up to 3,000 feet per minute (approximately 900 meters per minute).

The reliability, quality, and running cost of these systems tie back to key features of the printheads and the inks used. Let's start with the water-based inks used by PROSPER Systems. One key underlining tenet of Kodak's inkjet strategy is that the inks should be as uncomplicated as possible to keep ink costs low. This starts with carefully selected cyan, magenta, yellow and black pigments which are finely milled to produce very narrow particle size distributions (Figure 1) with most pigment particles being less than 50 nanometers (a nanometer is one billionth of a meter). Competitive milling methods cannot approach these levels. These finer pigments result in very thin dried ink layers, less scattering of light (Figure 2) which leads to richer and purer colors, and a superior color gamut without sacrificing image permanence. On top of that, due to the high color strength of these micromedia-milled particles, lower concentrations of these high-quality pigments are required to produce outstanding results, which also has an important impact on lowering running cost.

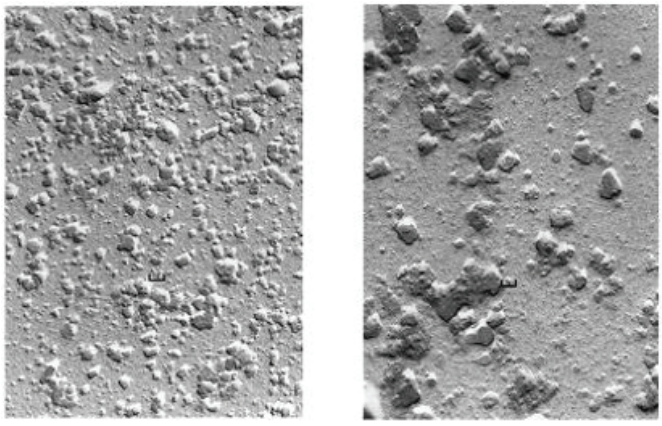


Figure 1: Photo comparing Kodak pigment size (left) with conventionally milled pigments (right)

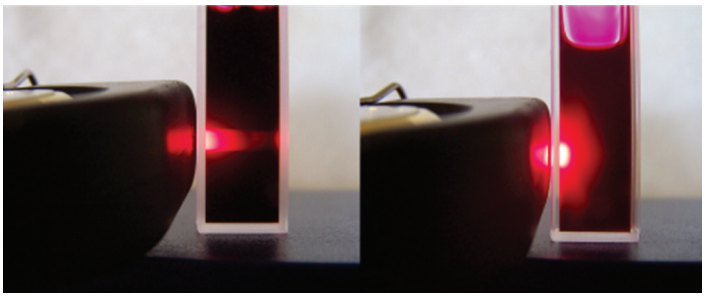


Figure 2: Kodak ink transparency: Light shined through finely milled KODAK pigment inks (left) is not scattered in the same way that it does with competitive inks

Another important advantage of a KODAK Stream Technology printhead is its drop placement accuracy and drop uniformity. As it exits the printhead's nozzle plate, the velocity of a Stream drop is 66 feet per second (20 meters per second), much faster than competitive systems, which average about 26 feet per second (8 meters per second). This allows for more accurate placement of drops as well as keeping the printhead's nozzle plate further from the substrate. Why is this important? The substrate (such as paper, cardboard, or film) is passing by the printheads at high speed and minor variations in its position or surface roughness can expose the printheads to

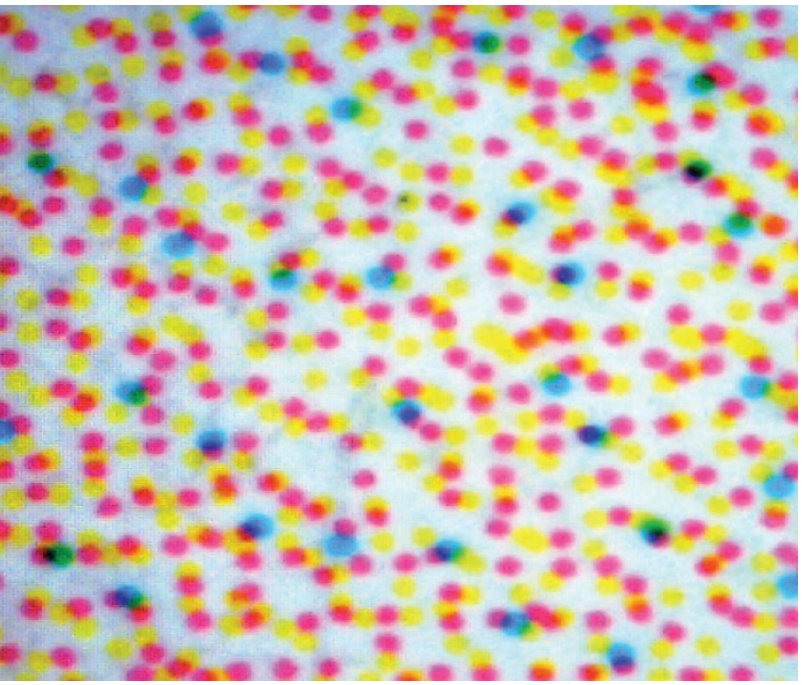


Figure 3: Kodak Stream drop placement: Comparison between Kodak drops (Left) with DOD (Right).

damage from collisions with its surface. The farther the throw distance, the less likely the damage. In terms of accuracy, imagine trying to throw a ball accurately in very windy conditions. The faster you throw it, the less likely it is that the ball's path will be altered. Stream's high drop velocity means that ink drops can be placed with high precision for high-quality print output.

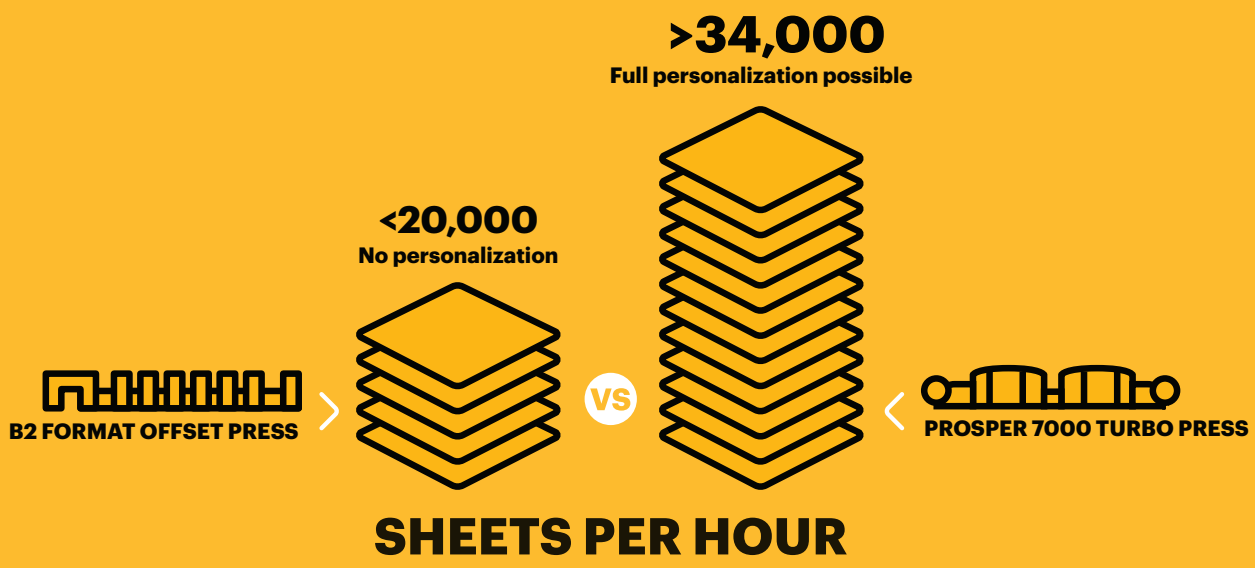
Another feature of KODAK's Stream printheads is that each drop is nearly perfectly spherical (figure 3), which results in well-formed spots on the substrate that lack the irregularities and artifacts that can occur with competitive methods. Stream drops are formed by thermal heaters changing the surface energy of a continuous flow of ink through the nozzles. Competitive drop-on-demand (DOD) systems create drops only when required for printing via a piezo vibration inside of the nozzle chamber or small thermal explosions. Each of the DOD drop-creation methods form teardrop-shaped drops and are more prone to the formation of small satellite drops accompanying the main drop. Note how round the KODAK Drops are compared to the teardrop-shaped tails of the competition.

The result is sharper drop formation, precise drop placement, and brilliant pigments, that when combined with KODAK Color Management and Screening, produce outstanding results at high speed and quality levels.

Stream drops are formed by thermal heaters changing the surface energy of a continuous flow of ink

SPEED AND QUALITY COMPETITIVE WITH TRADITIONAL PRESSES

The high speed and quality levels enabled by KODAK Stream Inkjet Technology allows it to compete effectively with conventional printing methods. In fact, PROSPER Imprinting Systems (Stream printheads) that are mounted on analog presses not only must keep up with the high speeds of the presses, but they also produce output that is indistinguishable from the traditional output. Running at up to 3,000 feet per minute, Stream printheads easily have the speed needed to be mounted on flexographic, offset or gravure presses and quality levels to match commercial, packaging, or other print applications. KODAK PROSPER Inkjet Presses also frequently come into competition with sheet-fed and web-fed presses. As an example of productivity, here is a quick comparison: a typical B2-format sheet-feed offset press can operate at speeds of up to 15,000 to 20,000 sheets per hour. The 19.7 width of a B2 sheet fits easily on the 24.5-inch image width of a PROSPER Press. The 27.8-inch length of the B2 sheet is equivalent to 2.3 feet. At 1,345 feet per minute a KODAK PROSPER 7000 Turbo Press can produce about 580 B2 sheets per minute, which works out to more than 34,000 B2 sheets per hour.



Ever wonder about the speed limitations of digital print? Not with KODAK PROSPER Presses. Add to that the capabilities of digital print to produce variable data output and act as a virtual document repository, and you can see why commercial printers are happy to give up the make-ready, paper waste, and multiple plates of the offset process, particularly when KODAK Inks provide a broader expanded color gamut (Figure 4).

DROP-ON-DEMAND INKJET COMPETITION

Most of the other high-speed inkjet systems on the market today use a technique called drop-on-demand (DOD) that produces drops of ink only when needed through either heat (thermal DOD) or pressure (piezoelectric DOD). Continuous inkjet, as its name implies, shoots a continuous stream of ink through each of the nozzles and creates drops of ink that speed towards the paper. CIJ drops are created as 'print drops' (i.e., those intended for the paper) or 'non-print drops' (i.e., those that will be recycled). Drops

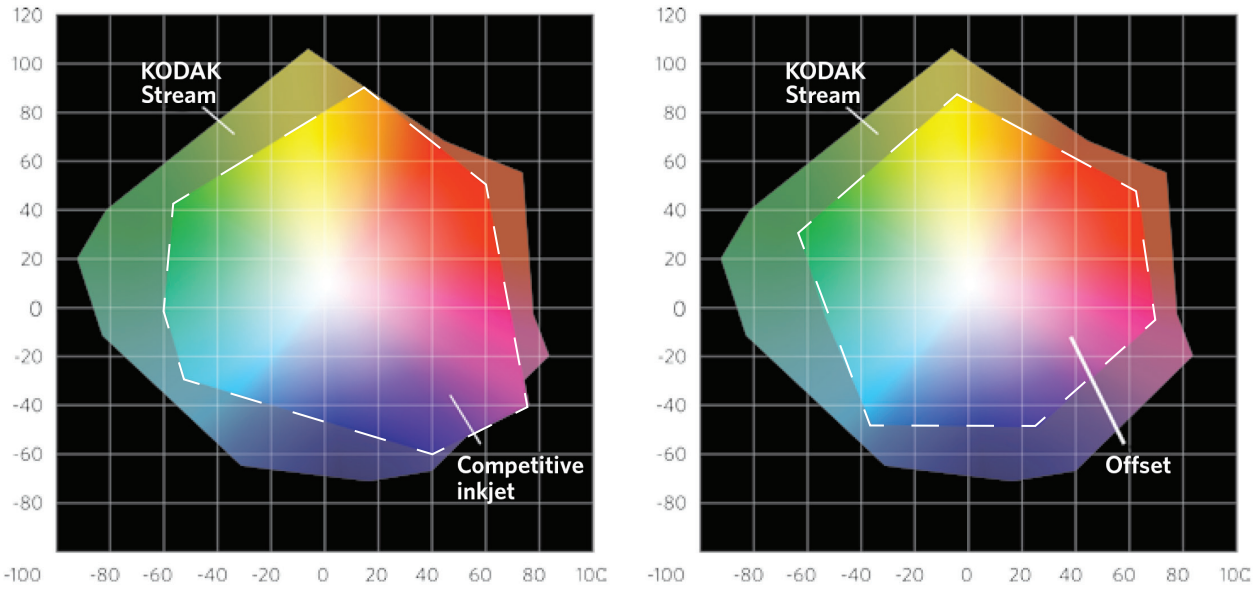


Figure 4: Color gamut comparison with offset: The color gamut of KODAK inks is much broader than offset inks

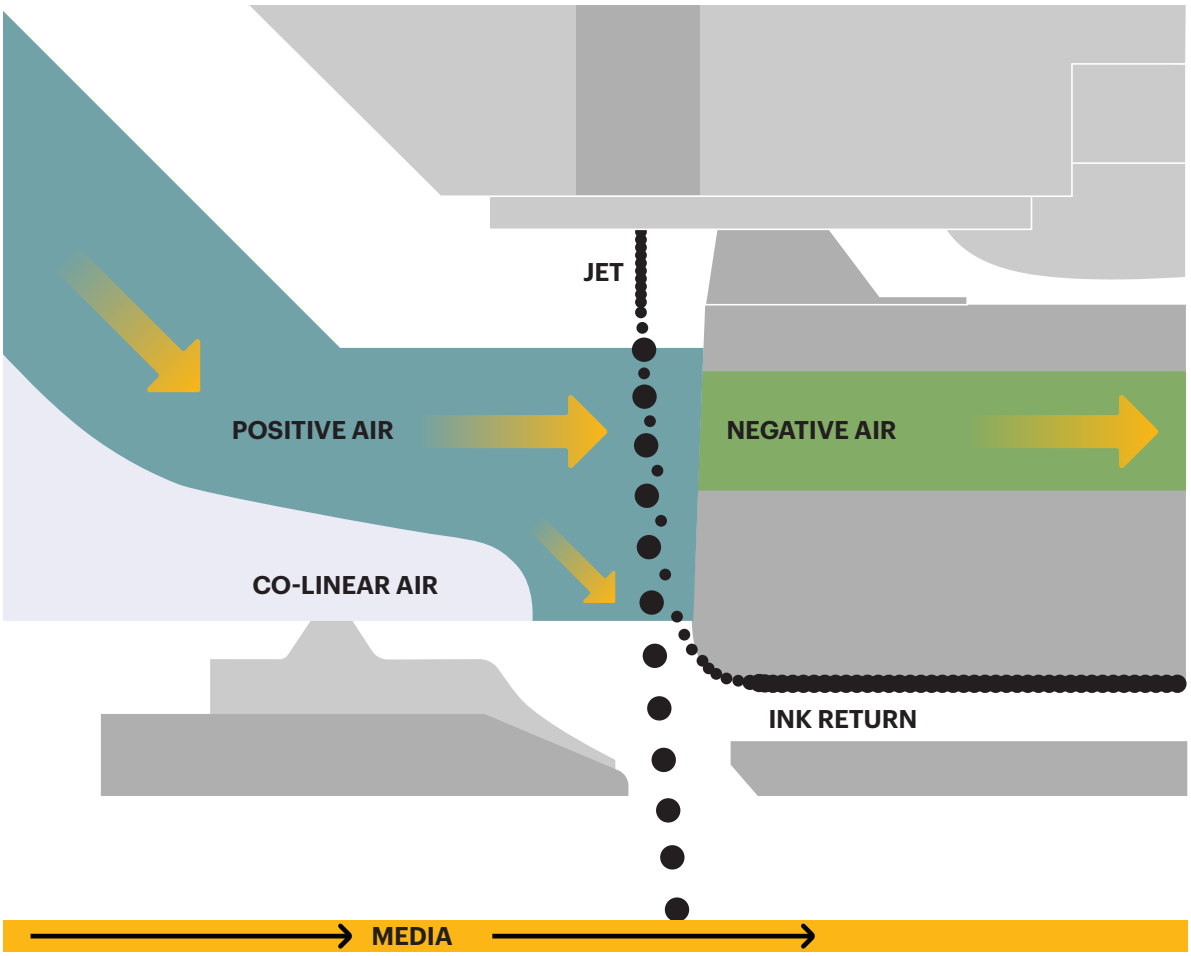


Figure 5: Detailed side view of Kodak Stream drop deflection and printhead operation

required for printing are allowed to continue to the paper. Non-print drops are deflected (Figure 5) and recycled back into the printer. DOD inkjet printheads only create drops of ink when they are required for printing. One of the most important differentiators between CIJ and DOD builds on this principal. The inks for drop-on-demand inkjet contain high levels of humectants, a chemical required to keep the inks from drying and clogging the inkjet head when it is not firing. And while all inkjet systems require some level of humectants in their inks, the potential time lag between drop creation in drop-on-demand systems create more opportunity for ink to dry in the nozzles. Drop-on-demand systems overcome this problem by adding higher levels of humectant to their ink. Why is this important? Because as soon as the ink hits the paper, it needs to be dried quickly and without spreading. That task is harder when an ink contains elevated humectant levels. Sure, humectants help keep the heads clear of dried ink, but at the same time they make it harder for inks to dry on the substrate, especially if it is a glossy paper or flexible film, since these surfaces do not readily absorb liquid.

STREAM TECHNOLOGY IN PRESSES AND HYBRID CONFIGURATIONS

Kodak has implemented its Stream printhead technology in color and black & white product lines. The color product line includes four variations:

• The KODAK PROSPER 7000 Turbo Press is the world's fastest inkjet press, operating at speeds of up to 1,345 feet per minute (410 meters per minute). This press offers three modes — Turbo for high speed, low coverage work, Performance for most commercial medium coverage printing, and Quality for high coverage applications.

• KODAK PROSPER 6000C Press is intended for commercial high coverage duplex applications such as direct mail and publishing, printed on glossy papers.

• KODAK PROSPER 6000P Press is intended for publishing medium to low coverage duplex applications printed on newsprint and uncoated papers.

• A standalone and a hybrid configuration of the KODAK PROSPER 6000S Press are intended for simplex applications, including folding carton packaging, product decoration and imprinting.

Stream printhead technology is also implemented in the KODAK PROSPER 1000 Plus Black & White Presses. The PROSPER 1000 and 6000 presses account for the bulk of impressions produced by KODAK full-page inkjet printing systems to date, but there is also a family of Stream products that were developed for imprinting applications in which the printheads are mounted on printing presses or finishing systems. PROSPER S-Series and PROSPER Plus Imprinting Systems range in speed from 500 feet per minute (152 meters per minute) for the KODAK PROSPER S5 System to 3,000 feet per minute (900 meters per minute) for the

KODAK PROSPER 7000 Turbo Press

KODAK PROSPER S30 System. PROSPER imprinting solutions support a top resolution of 600 by 900 dots per inch and are targeted at applications like direct mail, packaging, bar-coding, numbering, product decoration, circulars, flyers, and inserts. When used with specially formulated optimizers, Stream expands the application set beyond printing on paper to include printing on films for applications like flexible packaging, product decoration, and labels.

Kodak partners have also implemented Stream heads in their own products. For example, the UTECO SAPPHIRE EVO M Press, which is designed for flexible packaging and product decoration, uses KODAK Stream printheads, inks, and optimizers. UTECO'S SAPPHIRE EVO M is the recipient of a 2020 Intertech Technology Award and a Keypoint Intelligence 2021 Outstanding Achievement award.

ULTRASTREAM PRINTHEADS

Stream printheads are not the only continuous inkjet technology in Kodak's portfolio. KODAK ULTRASTREAM Inkjet Technoloy, a more recently developed technology has many of the same benefits as Stream. The main differentiator between Stream and ULTRASTREAM Technology is the way in which the non-print drops are deflected away from the printed substrate. Stream uses air deflection while ULTRASTREAM uses an electrostatic charge. An added benefit of electrostatic deflection is that ULTRASTREAM Printheads create drops that are less than 4 picoliters, enabling much higher print resolution up to 600 by 1800 dpi. For more details on ULTRASTREAM Technology, see the Kodak white paper entitled, KODAK ULTRASTREAM: Productivity, Quality, and Flexibility.

Hybrid packaging printed on PROSPER

Stream printheads easily have the speed needed to be mounted on flexographic, offset or gravure presses and quality levels to match commercial, packaging, or other print applications.

HIGHLY PRODUCTIVE WORKHORSES

KODAK Stream Inkjet Technology, whether in imprinting applications or as standalone systems, is a true workhorse that combines design simplicity, printhead reliability, and productivity in a platform that offers low operating cost, high print quality, and speed levels that challenge offset for commercial print applications and open up new opportunities in packaging. Combine that with the print-on-demand and variable imaging capabilities of digital print, and you have a product platform that will serve you well today and into the future.

KODAK STREAM
INKJET TECHNOLOGY

KEY TERMS

Continuous inkjet (CIJ): Printhead technology used by Kodak and other manufacturers of industrial inkjet printing systems

Drop-on-Demand (DOD) inkjet: Printhead technology generally used in home and office printers and extended for use in production systems

Duty cycle: The maximum volume (generally in A4/letter-sized page equivalents) that a production printing system is capable of producing in a month

Humectants: A chemical component in inkjet inks that helps prevent ink drying and clogging of printhead nozzles

Micromedia-milling: Kodak proprietary technique of grinding pigment particles to less than 50 nanometers and very narrow particle size distributions

Optimizer: Optimizers are Kodak-developed precoat / priming solutions that are designed to facilitate the ink/paper interaction by instantly immobilizing the pigment and adhering it to the paper or other substrate at extremely high speeds

Stream: Air-deflection CIJ printhead technology used in the PROSPER 1000 and 6000 Presses and in partner products like the UTECO SAPPHIRE EVO M Press for flexible packaging and product decoration

KODAK ULTRASTREAM Technology: Electrostatic-deflection CIJ printhead technology used in the KODAK PROSPER ULTRA 520 Press and also in partner products like the UTECO SAPPHIRE EVO W Press for flexible packaging and product decoration.

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