Technical white paper

HP Scitex High Dynamic Range Printing Technology

HP Scitex HDR300 Printheads and HP240 Scitex Inks

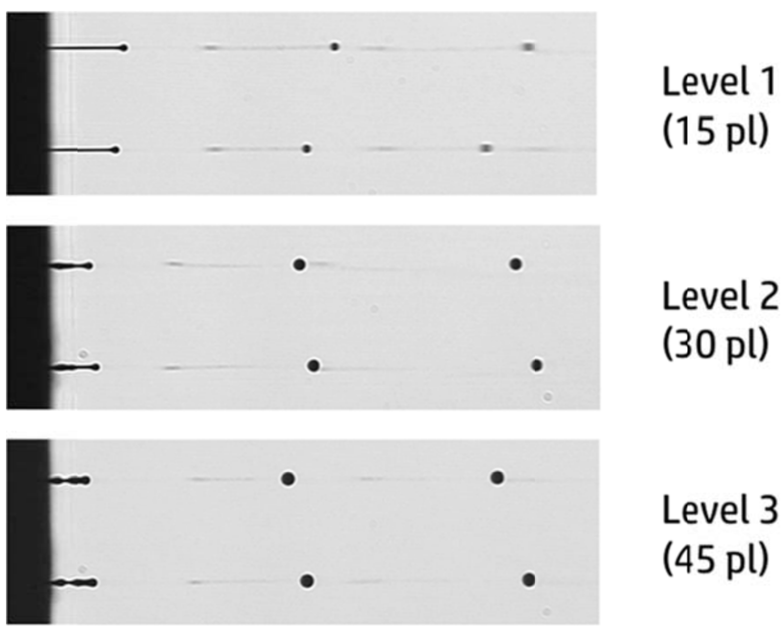
Table of contents

Inkjet printing ... 2
- Basic concepts ... 2

Quality and productivity ... 4

HP Scitex HDR Printing Technology ... 5
- Overview ... 5
- Gray-level dots ... 5
- HP Scitex HDR300 Printheads ... 8
- Precision dot control ... 10
- HP HDR240 Scitex UV-curable Inks ... 11

Summary ... 12



High quality and industrial productivity—at the same time

HP Scitex HDR Printing Technology provides smooth color and tone transitions, sharp edges on text and graphics, and high image smoothness for print quality that can meet the needs of applications now using Offset or Flexo technologies. HP Scitex HDR printing is ideal for jobs with demanding print-quality requirements—from POP and retail graphics to corrugated displays and high-impact graphics for packaging and retail advertising—on the broadest range of flexible and rigid media.

Inkjet printing

To understand HP Scitex HDR printing and its benefits to users, it will be useful to begin by reviewing some basic terms and concepts in inkjet printing.

Basic concepts

Binary dots

Binary inkjet printing forms an image from "binary dots", where a drop of ink is either ejected or not at a specific location. Each color of ink has a specific drop volume, and drop volumes are measured in picoliters— there are one million-million (10^{12}) picoliters in a liter.[1]

Inks and ink colors

There are four main types of inkjet inks: water-based, solvent-based, hot-melt, and UV-curable. The choice of ink depends on many factors including the physical and chemical characteristics of the substrate—usually called the "media"—and the application's requirements for durability (e.g., resistance to light fade, weather, abrasion, etc.), image quality, and cost of production. Industrial inkjet printing gives users a wide variety of choices and capabilities spanning the full range of applications from packaging, displays, and building and vehicle wraps.

The physical and chemical characteristics of the different types of inkjet inks are different from each other and from inks used in Offset, Gravure, Flexography and Electrophotographic processes. Because inkjet inks have unique chemistries and color characteristics, the CMYK values specifying a color on an Offset press will produce a different color on an inkjet press.[2]

As with Offset presses, the basic ink configuration of an industrial inkjet press is four-color: cyan, magenta, yellow, and black. Some inkjet presses have the capability to print light inks—light cyan, light magenta, and light blacks (grays)—to reduce image grain and provide finer color control within the color gamut. Special colors, such as orange, green, and violet, may be available to extend the color gamut. A protective coating ("varnish") and a pretreatment for certain media may also be applied by inkjet printheads during job production. Some presses also feature a white ink for printing white in text, graphics, and as a base for images on colored media.

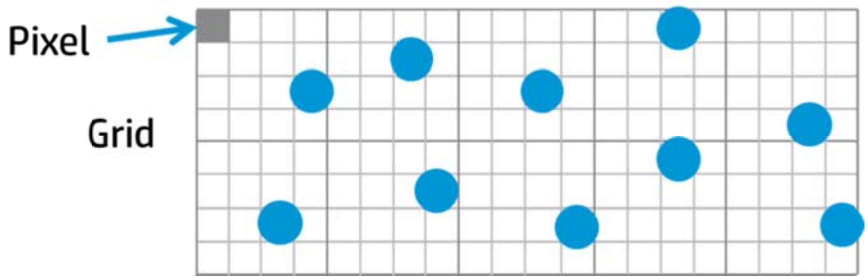
[1] Drops may also be characterized by their weight in nanograms. For inks with a specific gravity of 1.0, the numerical values are the same.

[2] This should not be a surprise: the CMYK color space is a device-dependent color specification. Image files composed in the CMYK color space of an Offset press color must be converted to the CMYK color space of the target inkjet press to produce the correct color. This is generally done by an ICC color management system and ICC profiles for the source image and target press.

Dot placement

In a digital press, dots are printed at addressable points on the image. These grid locations—called pixels[3]—are formed from a horizontal and vertical grid, as shown in Figure 1. While *dpi* —dots per inch— is a term that has come to be used in many different ways, a common use is to specify the printing resolution as *the number of grid locations that can be addressed in the horizontal (H) and vertical (V) direction*. And, while ink drops ideally produce round dots, these numbers are not necessarily the same. Hence, terms such as *450 (H) by 600 (V) dpi* may be found in specification sheets.

Figure 1 - Dot-placement grid, a pixel, and stochastic dots



Printing color

Digital inkjet presses produce a color by combining a specific number of drops of the available inks in each pixel. Primary colors—the colors of the inks installed in the press—are printed by filling the pixel with one or more ink drops of one color. Secondary colors are produced by printing two or more different color inks in a pixel. For example, red is made from drops of magenta ink and yellow ink.

For each type of ink and media there is a practical limit on the quantity of ink that can be placed in each pixel. This limits the number of drops of the primary inks that can be combined to produce different colors. Using small and intermediate-sized drops of ink offer more combinations than large ones alone, and this allows more colors to be printed.

Dot-placement accuracy

The accuracy of placing dots in the grid is an essential element of print quality. Dot-placement accuracy depends on a number of factors including a printhead technology that can produce drops that are uniform in volume, speed and trajectory, precision manufacturing and calibration of the printheads, precise placement and color-to-color alignment of printheads in the ink channels,[4] and precision electronic timing of drop ejection.

High dot-placement accuracy allows the press to properly combine dots in each pixel to produce the desired color, reduces color-to-color misalignment, and is important for producing text, barcodes, and graphics with sharp edges.[5]

Note: The drop ejection characteristics of HP Scitex HDR300 Printheads and features of the HP Scitex FB10000 Industrial Press are designed to provide both precise and accurate dot placement.

Stochastic screening

Printing a full range of colors from a limited number of inks requires *halftoning*—the ability to print intermediate levels of color and tone. Inkjet presses typically uses a halftoning technique called "stochastic screening"[6] to print full-color images. Stochastic screening randomly places dots over a field of neighboring pixels to generate the average density (for each primary) that is needed to produce a desired color.

Stochastic screening of binary dots is shown schematically in Figure 1. Here, an average cyan density of 6.25% is produced when 1 out of every 16 pixels receives a drop of cyan ink.[7] Random placement of dots breaks up repeated patterns that could appear as unwanted texture in the image. For example, if the dot were always placed in the upper-left of a 4 x 4 array of pixels then a regular pattern of dots might be visible in a large, uniform area-fill.

While halftoning produces more printable colors, there may still be too few colors printable by binary dots. This produces a situation of *coarse color addressability* within the gamut—there are in-gamut colors that can't be directly printed. In this case, printing artifacts—called *tone-breaks*—are visible as color and density contours in areas of an image where there should be smooth color or tone transitions.

[3] "Pixel" is a term meaning "picture element", the addressable element of an image. Pixels can be formed from a binary dot or from an array (usually 2X2 and typically up to 4X4) of binary dots.

[4] An ink channel is the array of printheads printing one color of ink. In the HP Scitex Industrial Press, there are 52 HP Scitex HDR300 Printheads in each channe..

[5] As a measure of dot-placement accuracy, the HP Scitex FB10000 Industrial Press can produce readable 4pt text and barcodes.

[6] This is also called "FM" (frequency modulation") screening.

[7] To illustrate this point, the grid is highlighted by darker lines defining 4 x 4 arrays of pixels to make it easy to see that there is 1 dot in every 16 pixels.

Tone-breaks are seen—exaggerated for illustrative purposes—in the sky in Figure 2. Here, the effect of a limited number of printable colors is evident from undesirable color and density bands where a smooth transition of color—from deeper to lighter shades of blue—is expected.

To increase color addressability, stochastic screening may be applied over a larger field of pixels. This gives more combinations of dots to produce more colors, but it may reduce the sharpness and clarity of fine image detail especially when printing at lower values of dpi.

A better way to increase color addressability is to print more colors directly. This can be done using gray-level dots, where the press produces multiple sizes of dots of each primary color. This substantially increases the number of dot combinations available for fine color addressability while preserving image detail.

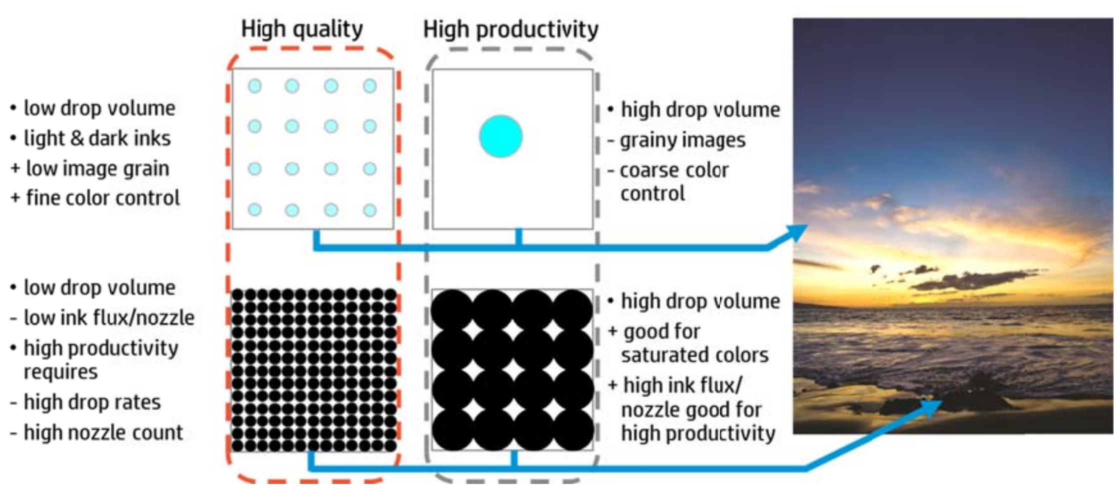
Note: Dynamic dot size control using gray-level dots allows HP Scitex HDR printing to print more colors directly and to fine-tune ink coverage to meet the requirements of the job and the media.

Figure 2 - Example of tone-breaks

Quality and productivity

We've just seen that small drops allow more colors to be printed directly. This is an important element of image quality. But, productivity is also a key performance requirement for an industrial inkjet press. Figure 3 shows a trade-off between quality and productivity with binary inkjet printing based *either* small *or* large drops.

Figure 3 - Binary printing: quality <u>or</u> productivity

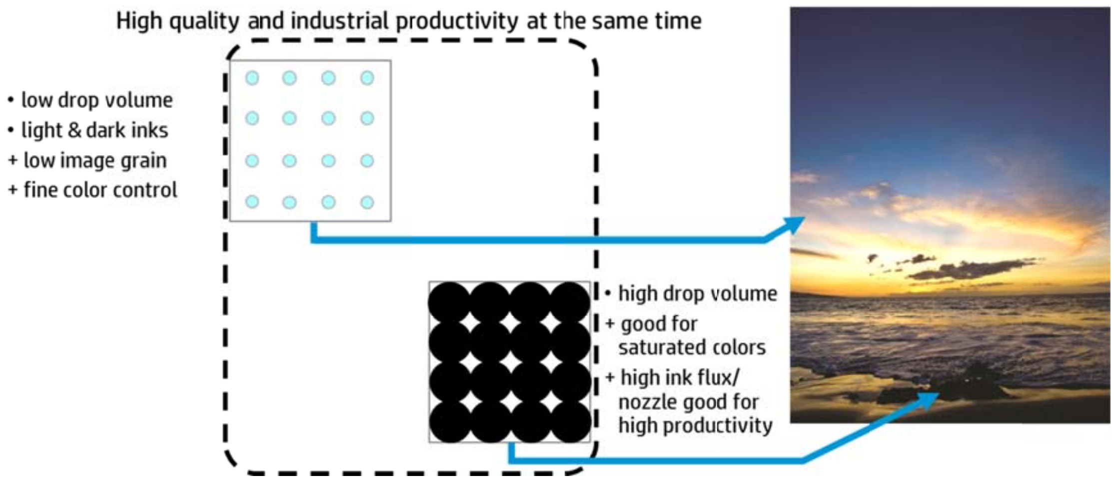


Small drops mean low ink flux—ink flow rate—unless high drop ejection rates are achieved. Because there are practical limits to drop ejection rates with every inkjet technology, small drops generally sacrifice productivity for quality because many drops are required to produce an area of solid or saturated color. Adding nozzles can increase the ink flux, but this adds complexity and cost to the press.

Large drops produce high ink flux, which is good for high productivity especially when applications contain large areas of solid or saturated colors. But, large binary drops increase image grain and have coarse color control.

If the image quality characteristics of small drops could be combined with the productivity capabilities of large drops, then the user can have high quality and industrial productivity at the same time. This principle, shown schematically in Figure 4, is a key benefit to users of HP Scitex High Dynamic Range Printing Technology.

Figure 4 - HP Scitex HDR printing: quality and productivity



HP Scitex HDR Printing Technology

Overview

HP Scitex HDR Printing Technology involves a number of algorithmic, hardware, and system elements to meet the speed and quality needs of applications now using Offset or Flexo technologies. HP Scitex HDR300 Printheads and HP HDR240 Scitex Inks print multiple-size dots of light and dark inks. Dynamic dot size control supported by precision mechanical elements and automatic press calibration place the proper-sized dot of the appropriate color and density in the right place.

HP Scitex HDR printing extends the halftone capabilities of stochastic screening by adding the ability to modulate the density of each pixel among sixteen (16) levels. Compared to binary printing, HP Scitex HDR printing produces more directly-printable colors for fine color addressability within the gamut. This allows HP Scitex HDR printing to produce fine image detail with low image grain and smooth color and tone transitions, especially in highlights and shadows, with industrial-grade productivity.

Each nozzle on an HP Scitex HDR300 Printhead can generate up to 24,000 15-, 30-, or 45-pl drops per second. These gray-level drops are used in print modes providing different combinations of quality and productivity with printing resolutions typically ranging from 450 to 750 dpi.[8]

A 6-color configuration of HP HDR240 Scitex Inks includes both light (Lc, Lm) and dark (C, M, Y, K) colors. For HP Scitex HDR printing, the pigment load of the light inks is chosen to be about 25% of the dark ink. This allows light and dark inks to be combined as described in Figure 5 to produce a smooth density ramp across 16 gray-levels for each dot (pixel).

Gray-level dots

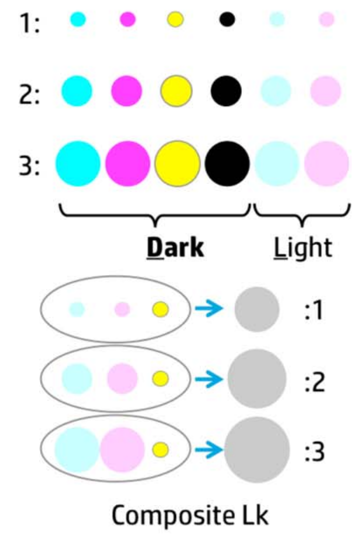
HP Scitex HDR gray-level printing is described schematically in Figure 5. This figure shows how light and dark inks are combined to produce dots of cyan, magenta, and black with 16 gray-levels. Because a light yellow ink is not used, yellow dots can be printed with 4 gray-levels.

In Figure 5, drop volume levels labeled 1, 2, and 3 correspond to 15-, 30-, and 45-pl drops, respectively, for C, M, Y, K, Lc, and Lm inks. Three levels of a composite light black can be produced by combination of Lc, Lm, and Y as shown.

[8] In flatbed press applications, multiples of the 150 nozzle per inch native resolution of HP Scitex HDR300 Printheads are achieved by multiple passes of the print under a fixed array of printheads that is indexed laterally between passes.

Figure 5 - Gray-level printing of CMYK dots using HP Scitex HDR Printing Technology

Gray-level	Drop Combination	Gray-level	Drop Combination
0	-	8	**2D**
1	1L	9	**2D** + 1L
2	2L	10	**2D** + 2L
3	3L	11	**2D** + 3L
4	**1D**	12	**3D**
5	**1D** + 1L	13	**3D** + 1L
6	**1D** + 2L	14	**3D** + 2L
7	**1D** + 3L	15	**3D** + 3L



The tables in Figure 5 describe how different levels of light and dark HP HDR240 Scitex Inks are combined to generate each of 16 gray-levels for CMK. Table entries are coded by level—1, 2, or 3—and whether the ink is light (L) or dark (D). For example, “3L” represents level 3 of a light ink and “1D” represents level 1 of a dark ink.

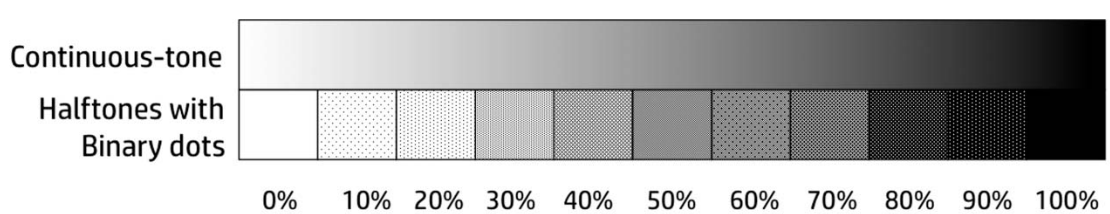
The following definitions and examples illustrate some basic principle of HP Scitex HDR printing:

- Gray-level 0 represents no ink and produces the media’s background color.
- Gray-levels 1-3 (of 16) are printed with levels 1, 2, and 3 of Lc, Lm, or Lk, represented by 1L, 2L, and 3L, respectively.
- Level 4 is printed with a level 1 drop of dark ink (1D) for C, M, Y, or K.
- Level 5 is printed with a level 1 drop of dark ink and a level 1drop of light ink (1D + 1L).
- The gray-levels available for yellow dots—1D, 2D, and 3D—correspond to levels 0, 4, 8, and 12 for cyan, magenta, and black dots.
- The gray-levels available for each dot of CMYK are printed using a stochastic halftone screen generated by the raster image processor (“RIP”) to produce the desired color.

Continuous tones and halftones

When halftones using binary dots are used to simulate continuous tones, grain appears in the image when individual dots (or white space between dots) are visible with high contrast against the background. Continuous-tone and halftone gray ramps are shown in Figure 6. The gray ramp of halftones made with binary dots appears grainy when isolated, high-contrast black dots are visible against the white background in highlights (0 - 30% density), and when the unprinted background is seen against a dense field of dark dots in shadows (70-100% density).[9]

Figure 6 - Continuous tone and binary halftone density (“gray”) ramps

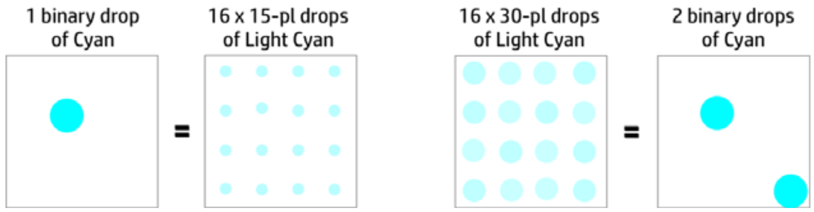


Note: Images with low grain, smoother colors, and smoother neutral tones are produced by reducing the dot-background contrast. This is accomplished using gray-level dots in HP Scitex HDR printing.

[9] Note that in Figure 6 the position of dots has deliberately not been randomized to illustrate the fixed pattern noise that may appear without stochastic screening. This effect is particularly visible in the 10% and 20% patches.

For example, in light tones HP Scitex HDR printing replaces isolated, high-contrast binary dots of cyan, magenta, or black inks by small, light dots distributed across the field of pixels used by stochastic halftoning. This is shown schematically in Figure 7 for a field of 4 x 4 pixels. [10]

Figure 7 - Examples of HP Scitex HDR and binary halftones producing equivalent gray-levels over a 4 x 4 field



On the left in Figure 7, HP Scitex HDR printing places sixteen (16) 15-pl drops of light cyan ink to generate cyan density equivalent to a single binary drop of dark cyan ink—about 6.25% or 1/16 of full density.

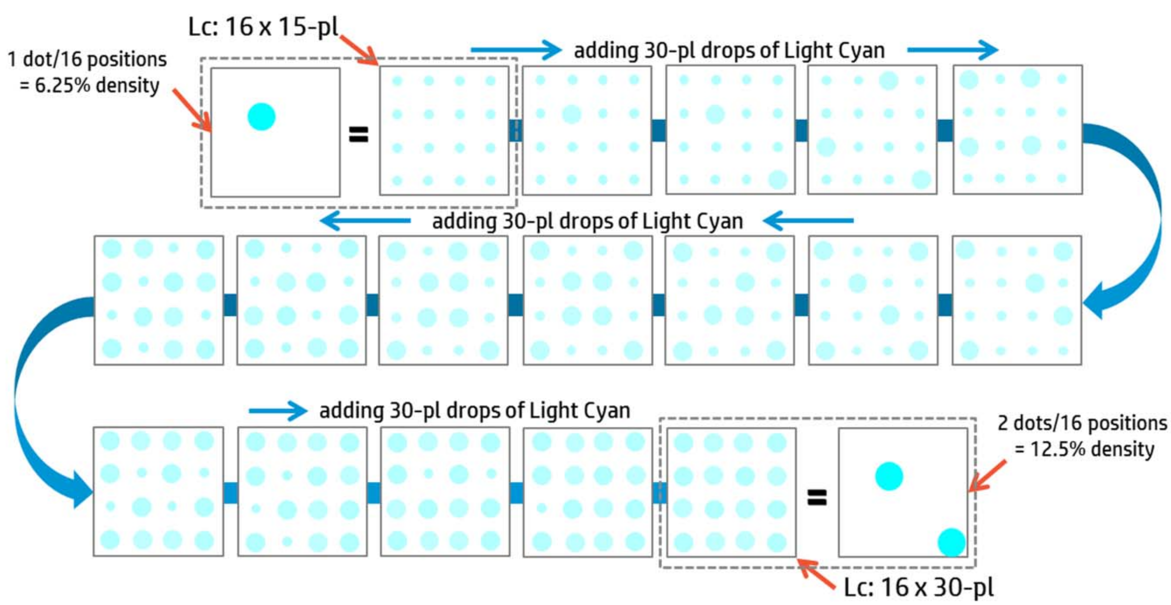
On the right in Figure 7, sixteen (16) 30-pl dots produce density equivalent to two (2) binary drops of dark cyan ink. With HP Scitex HDR printing, small, low-contrast dots produce significantly lower image grain than binary drops of dark ink.

A key advantage of HP Scitex HDR printing is the ability to print more colors directly. With a fine color resolution within the gamut, subtle variations in color and density can be produced that are ideal for printing skin tones and smooth shading without tone-breaks. Image detail can be preserved in shadows and highlights. Dividing the range from 0% to 100% saturation into more addressable values is the essence of printing with higher dynamic range.

The following discussion and Figure 8 further illustrate how HP Scitex HDR printing offers more options for gray-level printing than with binary dots. In simplest terms, HP Scitex HDR printing adds amplitude modulation of dot size and dot density to the dot frequency modulation of stochastic screening. This enables HP Scitex HDR printing to print more colors.

The examples of Figure 7 appear at the upper-left and lower-right in Figure 8, corresponding to the binary gray-levels of about 6.25% and 12.5% produced by the average of one or two binary dots over a 4 x 4 field. Figure 8 shows how HP Scitex HDR printing offers fifteen (15) intermediate combinations of dots (gray-levels) between consecutive binary gray-levels. In the sequence of 4 x 4 arrays of pixels, successively darker cyans are obtained by replacing 15-pl drops with 30-pl drops of light cyan.

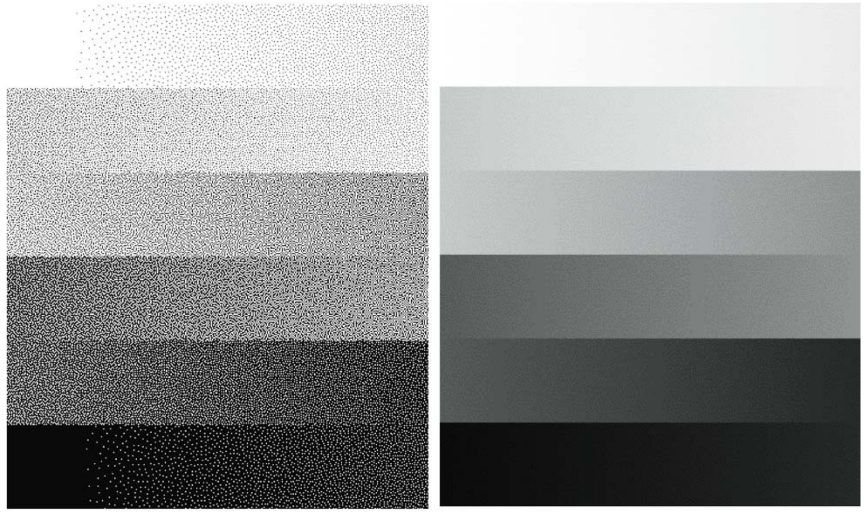
Figure 8 - Example of binary and HP Scitex HDR halftone levels



The density ramps in Figure 9 illustrate how HP Scitex HDR printing produces smooth density transitions with lower grain. Gray ramps are printed using binary halftoning (left) and HP Scitex HDR printing (right). Compare the smooth density transitions with HP Scitex HDR printing—especially in the highlights and shadows—to those with binary halftoning that show tone-breaks and image grain.

[10] A 4 x 4 field of pixels is not an essential element of HP Scitex HDR printing. It is simply a field of pixels that is large enough for illustrative purposes.

Figure 9 - Gray ramps with binary and HP Scitex HDR printing



HP Scitex HDR300 Printheads

HP Scitex HDR300 Printheads employ an innovative piezo inkjet technology, developed by HP, where each nozzle produces drops at three volume levels—15, 30, and 45 pl—at up to 24,000 drops per second. The printhead is a compact, self-contained module with a robust, industrial design. Pull-out/plug-in servicing offers easy assembly and press maintenance. Glass, silicon, and epoxy are the only materials that come into contact with ink for long and reliable service life.

HP Scitex HDR300 Printheads are manufactured by HP in Corvallis, Oregon (USA). Large-scale silicon production at this HP facility provides the benefits of high quality control and economies of scale in printhead manufacturing.

Each printhead has 192 nozzles spaced at 150 nozzles per inch for a 32.5 mm (1.28 inch) print swath. The 24-kHz design produces high ink flux for high printing productivity: each printhead can eject up to 12 ml of ink per minute. Printheads are calibrated during manufacture for uniform drop velocity and drop volume across the nozzle array.

HP Scitex HDR300 Printheads feature mechanical, ink, and electrical connections that allow the printhead to be simply plugged into place and secured with two screws. Two locator pins provide better than 10-micron positioning accuracy without adjustment. Ink connections are made through two ports, each sealed with an O-ring, and there are no ink tubes to attach and tighten. Electrical power and control signals come through a standard 30-pin connector that interfaces to a solid electrical bus bar to ensure reliable, error-free printhead replacement.

Components

The components of an HP Scitex HDR300 Printhead are shown in Figure 10a along with a schematic view of the silicon die in Figure 10b. The printhead consists of three major components: a silicon die with drop generators, a chip holder, and an electronics module.

Silicon Die

Shown schematically in Figure 10b, a silicon die (or "chip") with 192 drop generators—nozzles—is built with integrated circuit precision using MEMS[11] technology on a silicon wafer. Highly uniform features of the drop generators across each printhead and from printhead to printhead mean consistent drop volumes, drop velocities, and high dot-placement accuracy.

The printhead features a unique, two-sided "side-shooter" design.[12] 96 nozzles, ink channels, and piezo actuators are formed on each side of the silicon chip for a total of 192 nozzles.

Referring to Figure 10b, an array of ink channels is etched into the silicon. Each channel forms a chamber, supplies ink from the ink inlet, and forms a nozzle on the polished edge of the silicon die. There is no nozzle plate to align during printhead manufacture or to delaminate with use. In the cross-sectional view, a thin glass plate is bonded on each side of the silicon

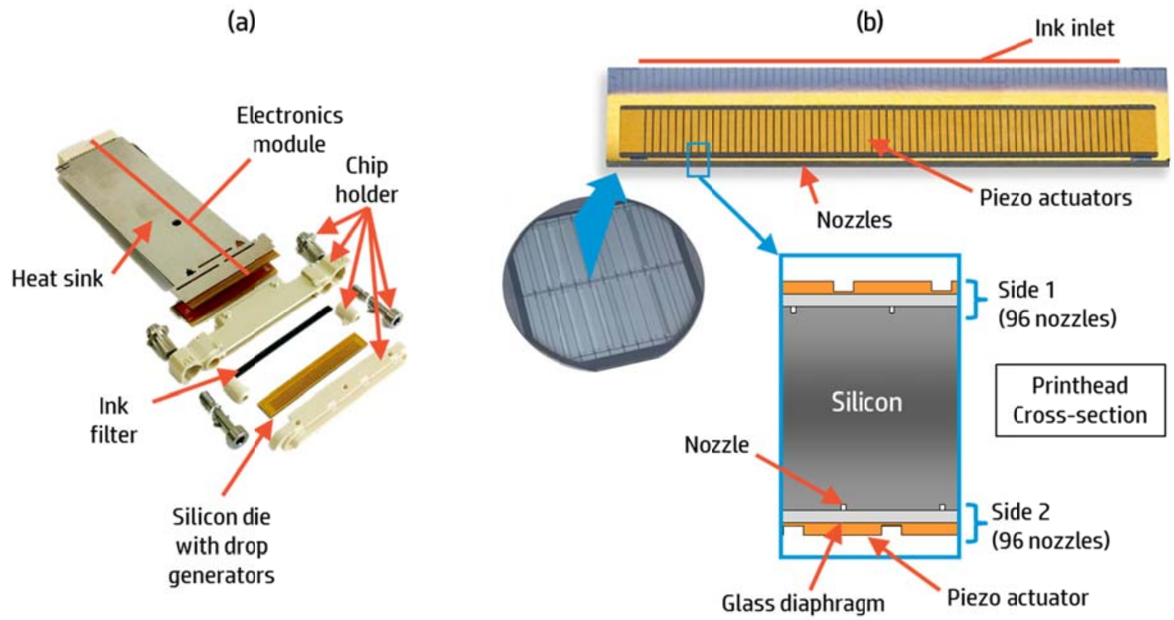
[11] MEMS stands for micro electromechanical system. Silicon-based MEMS technology fabricates microscopic mechanical and electrical components with processes developed from integrated circuit manufacturing.

[12] "Side-shooter" means the ink drops are ejected parallel to the plane of the chip. In the cross-sectional view in Figure 10b, drops would emerge perpendicular to the page.

die to form the drop generators. The glass plate seals between the channels and creates a flexible top wall that forms a diaphragm for each channel. Piezo actuators and their electrodes are completely isolated from ink exposure by placing them on the outside surface of the glass.

To eject a drop, an electrical pulse deforms the piezo actuator for a specific nozzle. This deflects the diaphragm into the drop generator chamber to change its volume and force ink out the nozzle.

Figure 10 – (a) HP Scitex HDR300 Printhead, (b) Detail of a silicon die



Chip Holder
Shown in Figure 10a, the chip holder is an assembly that has many functions. It holds and aligns the silicon die, locates and mounts the printhead onto the printbar, connects the drop generators to the ink supply through an ink filter and ink manifold, and supports the flexcircuit from the electronics module that is soldered to the array of piezo actuators.

The chip holder includes parts made from glass and glass-reinforced liquid crystal polymer. Liquid crystal polymers are strong and offer very high dimensional stability and chemical resistance to industrial inkjet inks. The chip holder is assembled using ink-resistant epoxy adhesives.

Electronics Module
The electronics module processes printhead control signals, regulates voltages, and drives the piezo actuators. It contains two identical electronic assemblies built on a flexcircuit, one each for the top and bottom arrays of 96 nozzles.

The electronics module delivers the precise drop ejection timing and voltage regulation that is essential for high dot-placement accuracy.

The flexcircuit is laminated onto two thin aluminum heatsinks and connects through a standard 30-pin connector to a bus bar carrying power and control signals from the printer. The flexcircuit is folded at the 30-pin connector, and the conductors at each end are soldered to leads on the top and bottom of the silicon die connecting the piezo actuators. The flexcircuit registers to molded pins on the chip holder.

Multiple drop volume operation
In Figure 11, the process of drop formation is seen through a microscope under high-speed stroboscopic illumination. The printhead is on the left, and drops fly left-to-right. Three (3) drop volumes are produced at the printhead's nominal operating frequency of 24 kHz. The printhead uses a multi-drop method to generate different drop volumes: 15, 30, and 45 pl drops are formed by rapid, repeated ejection of drops of fixed volume. The drops from multiple ejections merge into a single drop as they leave the printhead.

Figure 11 - 15-, 30-, and 45-pl drops in flight

The top image in Figure 11shows a single 15-pl drop emerging from a nozzle and two drops in-flight moving left-to-right. This is the level 1 drop introduced in Figure 5. Each pulse of the piezo actuator produces a 15-pl drop. Two rapid pulses produce a level 2 (30-pl) drop (middle image), and three pulses produce a level 3 (45-pl) drop (bottom image). The 15-pl drops can clearly be seen merging into a single 30- and 45-pl drop in these figures.

Note: Getting all drops—no matter what size—to travel at the same speed is a critical element of dot-position accuracy. It is important to understand that HP Scitex HDR printing achieves this consistency—by design—because the three (3) drop levels are produced by the same process: the precise and repeatable ejection of 15-pl drops.

Precision dot control

Placing drops of ink in their proper location—while printing at high speed—is essential both to print quality and to realize the potential of HP Scitex HDR printing. Rigid ink beams, an improved vacuum table, and a built-in densitometer provide precision dot control in the HP Scitex FB10000 Industrial Press.

Maintaining precise printhead location during duty-cycle stresses and environmental conditions, the HP Scitex FB10000 Industrial Press uses a cast-iron bridge structure to hold three (3) ink beams in the standard—CMYK—configuration.[13] Each ink beam carries two (2) ink channels with 52 HP Scitex HDR300 Printheads per channel. Cast iron provides superior mechanical stability, rigidity, vibration damping, and accuracy compared to welded steel, and holds the printheads in precise alignment. The bridge shifts laterally up to five (5) printhead widths—for a total of 162.6 mm/6.4 in.—to support nozzle mixing, nozzle redundancy, and nozzle replacement. These three processes benefit print quality by using different nozzles to print adjacent dots on each pass of the vacuum table under the ink beams.

Nozzle mixing means that adjacent dots in the image are printed by nozzles that are on different parts of a printhead or even on a different printhead in the ink channel. This hides systematic errors—such as drop volume variations and misdirection that are still with specifications—that could cause visible streaks down the print if adjacent dots on multiple passes were printed by the same nozzle. "Dot scrambling" is a descriptive term often used for nozzle mixing.

Nozzle redundancy means that nozzles from other parts of the printhead—or elsewhere on the ink channel—are available to take over printing for nozzles that are weak or missing. *Nozzle replacement* is the process of substituting a redundant nozzle for a weak or missing one.

A new vacuum table was developed for the HP Scitex FB10000 Industrial Press to hold the media flat from corner-to-corner during printing. Compared to previous designs, it is stiffer, flatter, and generates up to five (5) times the vacuum level using improved internal ducting. Flatter media allow tighter control of the printhead-to-media spacing, which improves dot position accuracy. The adjustable vacuum level gives better control of substrates from thin paper to 25 mm-thick boards.

Note: The higher vacuum available in the HP Scitex FB1000 Industrial Press helps to hold materials that warp—such as corrugated board—flat against the table. This is important not only for achieving high print quality on these substrates, but also for avoiding downtime and expense from printhead strikes and wasted output. An iron roller built-into the press also improves media flatness on substrates ranging from paper to thick stock.

The HP Scitex FB10000 Industrial Press features a built-in densitometer. This sensor measures printhead alignment and nozzle health from a printed test pattern in an automatic process that takes about 10 minutes. Results are used in algorithms for automatic nozzle replacement. Detecting and compensating for weak and missing nozzles improves

[13] The bridge structure can be upgraded to hold up to four (4) ink beams for an 8-ink configuration. See the section on upgradability for details.

productivity, uptime, and print quality. Because the test pattern is printed and read automatically, press calibration is reliable, independent of operator skill, and convenient to use.

HP HDR240 Scitex UV-curable Inks

The HP Scitex FB10000 Industrial Press uses new HP HDR240 Scitex UV-curable inks. These inks are specifically designed for HP Scitex HDR printing with HP Scitex HDR300 Printheads.

Wide range of media and applications
HP HDR240 Scitex Inks produce high quality on a wide range of flexible and rigid media including acrylics, polyethylene, polypropylene, vinyl, polystyrene, polycarbonate, cardboard, paper, and metals. More than 40 media have been tested with HP HDR240 Scitex Inks. For details, visit www.hp.com/go/mediasolutionslocator .

With ink coverage up to 15% higher than HP FB225 Scitex Inks,[14] HP Scitex HDR240 Scitex Inks provide enhanced versatility by extending applications into more cost-sensitive jobs.

High durability
HP HDR240 Scitex Inks achieve cross-hatch level adhesion to plastics without the need for pretreatment.[15] For example, "Corex"—fluted polyethylene board—is a challenging material for most UV-curable inks to achieve high adhesion at high productivity, and HP240 Scitex Inks achieve excellent adhesion on Corex.[14]

Elongation up to 300% allows HP HDR240 Scitex Inks to offer improved flexibility that resists cracking when prints are folded or stretched for conformable applications such as in vehicle wraps using self-adhesive vinyl.[16]

Prints made with HP HDR240 Scitex Inks offer up to 2 years outdoor weather resistance.[17]

Intelligent supplies
To prevent color mixing, ink supplies are designed to ensure correct installation. Ink supplies feature built-in electronic intelligence that communicates ink color, remaining ink quantity, and other information to the press. For example, the press reads a "use by" date from each supply to ensure that the ink is fresh and meets requirements for system reliability and performance.

Intelligent supplies support smart inventory management and reduce waste: if a partially-used supply is reinstalled, the remaining ink level is read by the press and displayed to the operator. Intelligent supplies improve press up-time because the operator has the information to determine if the ink remaining is sufficient to complete the queued print job(s).

Environmental benefits
Important for indoor POP displays, cured HP HDR240 Scitex Inks deliver improved environmental performance with reduced odor compared to HP FB225 Scitex Inks. HP HDR240 Scitex Inks are nickel-free,[18] and have achieved GREENGUARD GOLD Certification[19] making them ideal for applications targeted to sensitive indoor environments.

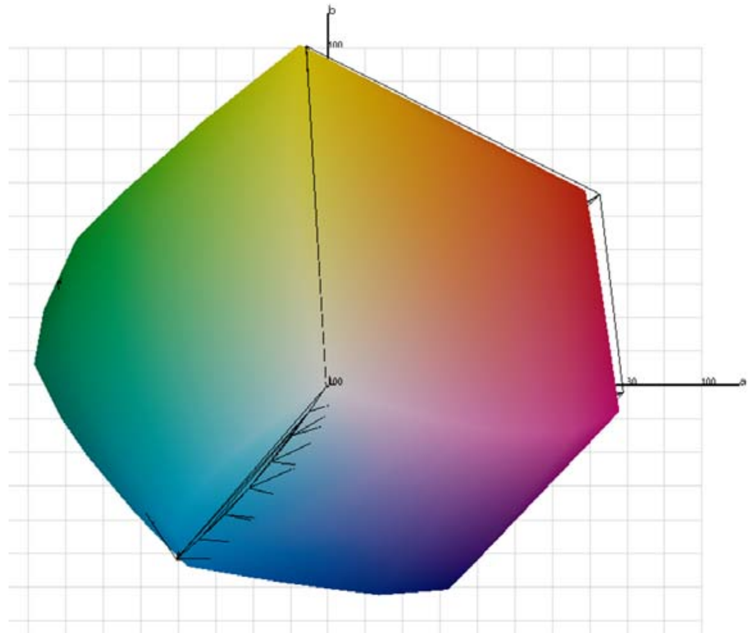
HP HDR240 Scitex Inks are available in 10-liter supplies that reduce the use of packaging material per liter of ink. To limit the amount of residual ink, ink is drawn from the bottom corner of the supply. Clean ink handling with a "click-in" dry connector reduces ink waste and keeps the press and press area free of spilled ink. No operator protection gear is required to handle or replace the ink supplies.

High-performance color
HP HDR240 Scitex Inks are available in six (6) colors: C, M, Y, K, Lc, and Lm.[20] Pigment loads in the light inks (Lc and Lm) have been optimized for HP Scitex HDR printing.

The color gamut of HP HDR240 Scitex Inks in CIELab space on coated paper is shown compared to the offset ISO Coated_v2_eci standard in Figure 12.[21] HP HDR240 Scitex Inks achieve a gamut of 421,815 CIELab units compared to 345,488 units for the ISO 12647-7 Offset Standard. HP HDR240 Scitex Inks meet the ISO 12647-7 proofing standard.[22]

[14] Based on testing by HP R&D.
[15] According to D3359-02 ASTM Standard Test Methods for Measuring Adhesion by Tape. Tested in 2013 in POP65, POP80, and POP100 print modes.
[16] Elongation of HP HDR240 Scitex Inks measured in March 2013 according to ASTM 63808.
[17] According to ASTM D2565-99. Tested on 3M self-adhesive vinyl.
[18] Nickel is not present in any of the inks at levels above 10 parts per million. Testing conducted by HP in 2012.
[19] GREENGUARD GOLD Certification to UL 2818 demonstrates that products are certified to GREENGUARD standards for low chemical emissions into indoor air during product usage. For more information, visit ul.com/gg. Test prints submitted at Sample 65 print mode. Using GREENGUARD GOLD Certified inks does not indicate the end product is certified.
[20] Additional ink colors to be announced.
[21] Rendering intent is absolute colorimetric.
[22] Printed in POP100 gloss mode on CalPaper, validated with the Ugra/Fogra media wedge V3 and IDEAlliance Digital Control Strip 2009. Color verified with GMG ProofControl. Tested March, 2013.

Figure 12 - CIELab gamuts for HP HDR240 Scitex Inks (solid) and Offset ISO Coated_v2_eci (wireframe)



HP HDR240 Black Scitex Ink offers high black optical density for high-impact text and graphics in POP applications.

Summary

HP Scitex High Dynamic Range ("HDR") Printing Technology extends press performance while offering precision control over printing results. High print quality is obtained with six colors of HP HDR240 Scitex Inks and dynamic dot size control from three drop volumes produced by HP Scitex HDR300 Printheads.

HP Scitex HDR printing gives fine control over dot size and optical density with gray-level dots. This produces more directly-printable colors for images with lower grain and smoother colors and neutral tones. The ability of HP Scitex HDR Printing Technology to use both small and large ink drops is key to providing high quality and industrial-grade productivity at the same time.

HP HDR240 Scitex UV-curable Inks produce a wide color gamut on a broad range of materials including paper, plastics, acrylics, polypropylene, polycarbonate, polyethylene, and PVC. In addition, these new ink formulations give up to 15% greater coverage per liter than previous generations of HP Scitex UV-curable inks and they offer important environmental benefits.

Learn more at

hp.com/go/ScitexFB10000

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