Technical white paper

HP Latex 3000 Printer
HP 881 Latex Inks
HP 881 Latex Printheads

Third-generation HP Latex Printing Technologies

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HP Latex 3000 Printer

HP Latex Printing Technologies

Proven HP Latex Printing Technologies are revolutionizing the way the world prints. Introduced in 2008 as a result of over 10 years of research and development investment, thousands of HP Latex Ink systems are now employed worldwide and have printed more than 35 million square meters.

Introduction

HP Latex Printing Technologies produce high-quality images on a broad range of coated and uncoated media including PVC banner, self-adhesive vinyl, PET films, paper, wallcoverings, and textiles.[1] This gives print service operators the versatility to cover applications including retail and outdoor advertising, event and exhibition graphics, vehicle graphics, and interior decoration. The water-based formulation of HP Latex Inks meets high environmental standards that improve the work environment and meet customers' environmental objectives for indoor displays and wallcoverings.

The HP Latex 3000 Printer features a writing system with more than 70,000 nozzles and advances based on HP 881 Latex Inks, HP Latex Optimizer, and HP 881 Latex Printheads to deliver industrial-scale efficiencies ideal for large print service operations. HP Latex Optimizer delivers consistent image quality and supports high-efficiency curing of HP Latex Inks at lower temperatures and with less energy than previous HP Latex Printing Technologies. Dynamic swath alignment suppresses banding even at the highest levels of productivity.

This technical white paper provides an in-depth look at the new technologies in the HP Latex 3000 Printer.

HP 881 Latex Inks

HP 881 Latex Inks are formulated to optimize and maintain the high performance and print quality of HP 881 Latex Printheads, and they work with HP 881 Latex Optimizer to provide high print quality at high productivity.

HP 881 Latex Inks have a water-based formulation with an innovative "latex" polymer that produces a durable, flexible film protecting the image. Prints are completely dried and cured in the printer and are ready to use. A 6-color system of pigment inks—cyan, magenta, yellow, black, light cyan, and light magenta—produces a wide color gamut.

HP Latex Inks are supplied in recyclable 5-liter containers[2] for low intervention rates that support industrial productivity. Ink cartridges can be hot-swapped while the printer is running and are mechanically and electronically keyed to prevent ink mixing by installing the wrong cartridge.

HP Latex Ink cartridges feature built-in electronic intelligence that communicates ink color, remaining ink quantity, and other information to the printer. For example, the printer reads a "use by" date from each cartridge to that indicates 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 cartridge is reinstalled, the remaining ink level is read by the printer and displayed to the operator. Intelligent supplies improve printer up-time because the operator has the information to determine if the ink remaining is sufficient to complete the scheduled job(s).

HP 881 Latex Inks contain both liquid and solid components.

[1] Performance may vary depending on media—for more information, see hp.com/go/mediasolutionslocator or consult your media supplier for compatibility details. For best results, use textiles that do not stretch. The optional ink collector is required for porous textiles on the HP Latex 3000 Printer.
[2] Approximately 70% of the weight of the used ink cartridge is a recyclable cardboard container.

Liquid components

The *ink vehicle* is the colorless, liquid component of the inks. It provides reliable, consistent drop ejection by the HP Thermal Inkjet process and carries the ink's solid components to the surface of the print. Once on the surface, the ink vehicle controls how the ink and media interact. The ink vehicle is evaporated by heaters in the HP Latex 3000 Printer to produce a dry and ready-to-use print.

The physical and chemical properties of the ink vehicle are critical both for drop ejection performance and control of ink-media interactions. These properties are obtained by formulating the ink vehicle with a combination of water, *humectants and wetting agents*, and *liquid additives*.

Water gives HP Latex Inks the high surface tension, low viscosity, and energetic vapor bubble that are ideal for use in HP Thermal Inkjet printheads. Inside each drop generator, a vapor bubble—lasting only about 10 microseconds—drives a drop of ink out of a nozzle with the repeatable volume and velocity required for reliable, high-quality printing.

Composed of more than 60% water, HP Latex Inks offer important benefits to commercial and industrial production environments: water produces no VOCs, requires no special handling, and is non-toxic, non-flammable, and non-combustible. And, unlike printers using solvent inks, HP Latex Printers do not require daily manual maintenance of printheads and service station components.[3]

Water alone is not a practical ink vehicle for printing on the wide variety of media used in commercial and industrial applications— humectants, wetting agents, and additives are used to obtain the required performance characteristics for an ink. These ingredients play an important role in drop ejection and ink-media interactions by

- lowering the ink's surface tension to improve wetting of the internal surfaces to keep drop generators primed with ink and ready to print;
- keeping the drop generators clean for consistent drop ejection performance;
- suppressing viscous plugs in the nozzles (from evaporation of liquids) that can cause missing or misdirected drops;
- affecting how the ink droplet wets the surface of the print media to control dot formation.

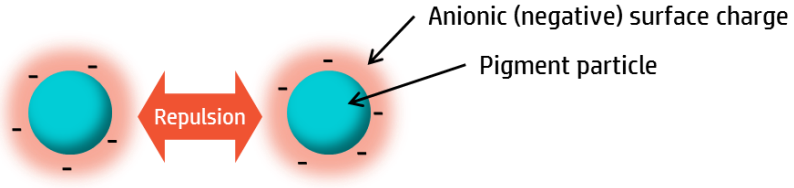
The print zone is located on the printer platen under the scanning carriage. Here, heaters evaporate some of the water allowing the concentrated humectants and wetting agents to soften the surface of uncoated vinyl for better adhesion of the colorant layer. Remaining liquids in the ink film are evaporated by curing zone dryers to produce a completely dry and odorless print that can be immediately handled, stored, shipped, or displayed indoors.[4,5]

Solid components

HP Latex Inks contain solid particles that are suspended in the ink vehicle—pigments, latex, and an anti-scratch agent. While the liquid components are evaporated, the solid components remain on the media to form a durable image.

Pigments produce the color in HP Latex Inks. Unlike dyes, which are dissolved in the ink vehicle, pigment particles must form a stable suspension to prevent settling during ink storage and use. The pigments used in HP Latex Inks are anionic—they have a negative surface charge. This promotes a stable particle suspension because particles with like electrical charges repel each other to prevent aggregation—sticking together. The repulsion between two anionic pigment particles in HP Latex Ink is shown schematically in Figure 1.

Figure 1. Repulsion between anionic pigments



[3] HP Latex Printers have fully-automatic printhead service stations that perform printhead capping, cleaning, and other functions to provide reliable drop ejection. The service station in the HP Latex 3000 Printer has a web wipe cartridge that is replaced by the user on average every three weeks.
[4] Special ventilation is not required to meet U.S. OSHA requirements on occupational exposure to VOCs from HP Latex Inks. Special ventilation equipment installation is at the discretion of the customer – no specific HP recommendation is intended. Customers should consult state and local requirements and regulations.
[5] Some substrates may have an inherent odor.

Pigment aggregation in the ink delivery system and printheads can clog ink tubes and the tiny passages in the printhead reducing printer reliability. But, rapid aggregation and immobilization of pigments on the print surface is important to image quality and high productivity. Aggregation is accomplished in the print zone by HP Latex Optimizer and dryers.

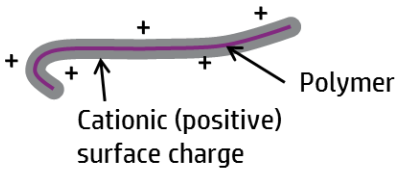
Latex polymers are a key innovation of HP Latex Inks. Latex polymers form a durable film on the surface of the media that protects the pigments. "Latex" is simply a term that describes a stable, aqueous dispersion of microscopic polymer particles. It is important not to confuse the latex polymers used in HP Latex Inks with those found in natural materials, such as latex rubber. While some individuals experience skin irritation from contact with natural latex compounds, the synthetic polymers used in HP Latex Inks are non-allergenic.

An *anti-scratch agent* has been added to HP 881 Latex Inks. This material lubricates the surface of the print to resist penetration by sharp objects that could damage the ink layer. It does not affect the ability to laminate the print or to weld prints together.

HP Latex Optimizer

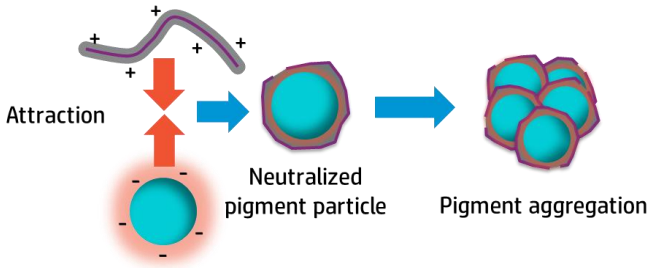
HP Latex Optimizer—OP—is a new component of HP 881 Latex Inks. HP Latex Optimizer consists of positively-charged (cationic) polymers suspended in a colorless, water-based ink vehicle as shown schematically in Figure 2.

Figure 2. Cationic polymer in HP Latex Optimizer



OP is applied proportional to local ink coverage by an HP 881 Latex Printhead, and the amount can be adjusted by the user for specific materials. The use of OP has a low impact on the cost of the print. On the print, the positively-charged OP polymers are attracted to and adsorb onto—"coat"— the negatively-charged pigments. This process is shown schematically in Figure 3. The surface charge of pigments is neutralized causing them to aggregate and become immobilized on the print surface. This produces sharp text and image detail by suppressing feathering and color bleed, especially at high productivity levels.

Figure 3. HP Latex Optimizer neutralizes charges on pigments causing aggregation

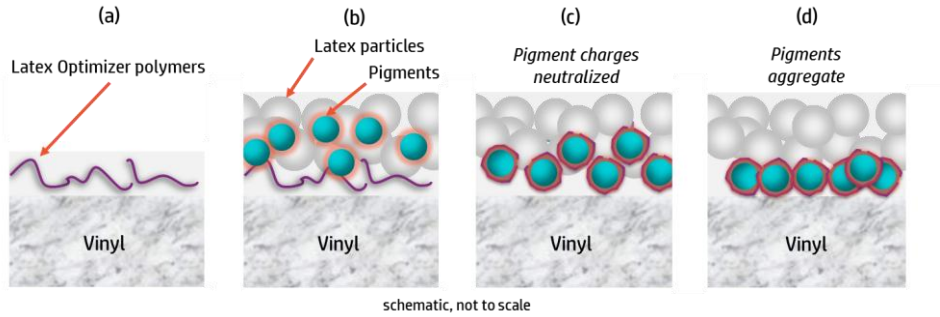


Previous generations of HP Latex Inks use print zone heating to immobilize the pigments on the print. Evaporating water from the ink causes a rapid rise in the viscosity of the liquid ink film, and this keeps pigments in place. HP Latex Optimizer accomplishes this effect chemically—by charge neutralization—so that water does not need to be evaporated so rapidly. As a result, the print and curing zone dryers in the HP Latex 3000 Printer are more energy efficient and operate at lower temperatures than previous generations of HP Latex Printers.

Image formation process

Figure 4 is a schematic representation of how HP Latex Optimizer and the pigments in HP 881 Latex Inks interact on the surface of the print. For clarity, the drawings and the relative sizes of latex, pigments, and OP polymers are not to scale.

Figure 4. HP Latex Optimizer immobilizes pigments on the print surface



In Figure 4a, an HP 881 Latex Printhead has placed drops of HP Latex Optimizer in a region of the print that will receive ink.

In Figure 4b, a thin liquid layer of HP 881 Latex Ink has been printed over the OP drops.

In Figure 4c, the oppositely-charged OP polymers and pigments attract. OP polymers are adsorbed onto the pigments to neutralize their net charge.

In Figure 4d, pigments aggregate and are immobilized on the surface of the print.

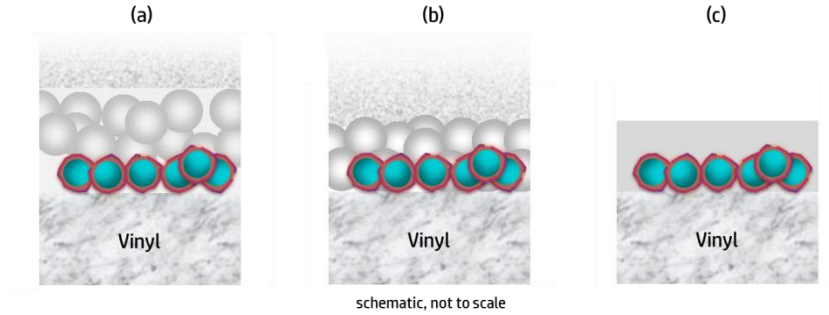
During the process described in Figure 4, the media is heated by IR lamps and forced hot air directed along the media surface from dryers on the scanning print carriage.

Curing HP Latex Inks

The HP Latex 3000 Printer has two internal systems to produce a print that is completely dry out of the printer and ready for finishing, shipment, and display: the *print zone* and *curing zone* dryers.

Figure 5 is a schematic of the drying and curing process for HP Latex Inks. The elements of the illustrations are not drawn to scale.

Figure 5. HP Latex Inks: drying and curing process



In Figure 5a, water is shown evaporating from the ink layer in the print zone. This occurs while pigment particles interact with Latex Optimizer polymers.

In Figure 5b, the remaining liquids now evaporate in the curing zone.

In Figure 5c, with further heating, the latex particles coalesce into a durable film that bonds to the surface of the print media to encapsulate and protect the pigments. The print is now completely dry and ready for finishing.

Some print zone and curing zone settings for heat-sensitive materials are presented in Table 1.

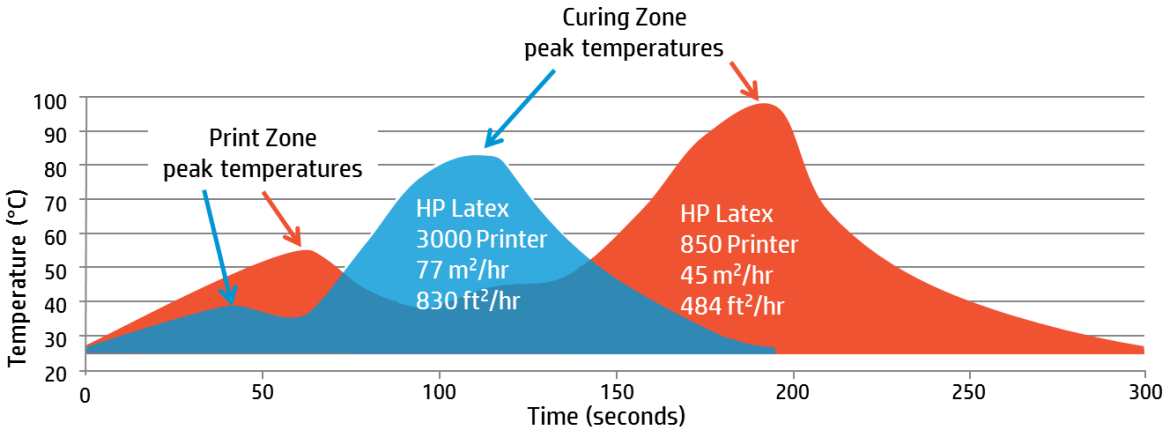
Table 1. HP Latex 3000 Printer with HP 881 Latex Inks: Print and curing zone temperatures for heat-sensitive materials

	Print zone setting	**Curing zone setting**
Self-adhesive vinyl	40 °C	80 – 90 °C
PVC banner	40 °C	80 – 85 °C
PET film	40 °C	85 – 90 °C

Compared to the HP Latex 850 Printer with HP LX610 Latex Inks (without HP Latex Optimizer), the print and curing zone temperatures in the HP Latex 3000 Printer are typically 10 – 20 °C cooler. This is important for handling temperature-sensitive materials such as PVC banner, self-adhesive vinyl, and PET films.

The time-temperature curves during print and curing zone exposure are compared in Figure 6 for HP Latex 3000 and 850 Printers. These results are for equivalent print quality—6-pass 6-color 100% indoor quality modes—and the HP Latex 3000 Printer is considerably faster: 77 m^2 (830 ft^2)/hr versus 45 m^2 (484 ft^2)/hr for the HP Latex 850 Printer. In addition to being exposed to lower drying and curing temperatures, the print spends less time in the HP Latex 3000 Printer.

Figure 6. Print and curing zone temperatures in the HP Latex 3000 and 850 Printers



Durability

HP 881 Latex Inks offer print service providers the versatility to produce a wide range of prints for outdoor and indoor use. Prints on self-adhesive vinyl and PVC banner can be used unlaminated for short-term applications. And, prints may be welded and laminated immediately after printing. The colorant layer produced by HP 881 Latex Inks is highly flexible—prints can be stretched and will conform to surfaces as required by the application. For example, this characteristic is valuable for prints made on self-adhesive vinyl that are used in vehicular applications.

Outdoor display permanence is up to three (3) years unlaminated and up to five (5) years laminated.[6]

On PVC banner and self-adhesive vinyl, prints made with HP 881 Latex Inks offer scratch resistance comparable to prints made with hard-solvent inks. [7]

Color gamut

When used in a 6-color printing system including cyan, light cyan, magenta, light magenta, yellow, and black inks, HP 881 Latex Inks in the HP Latex 3000 Printer produce a wide color gamut larger than many UV-curable and hard-solvent printers.

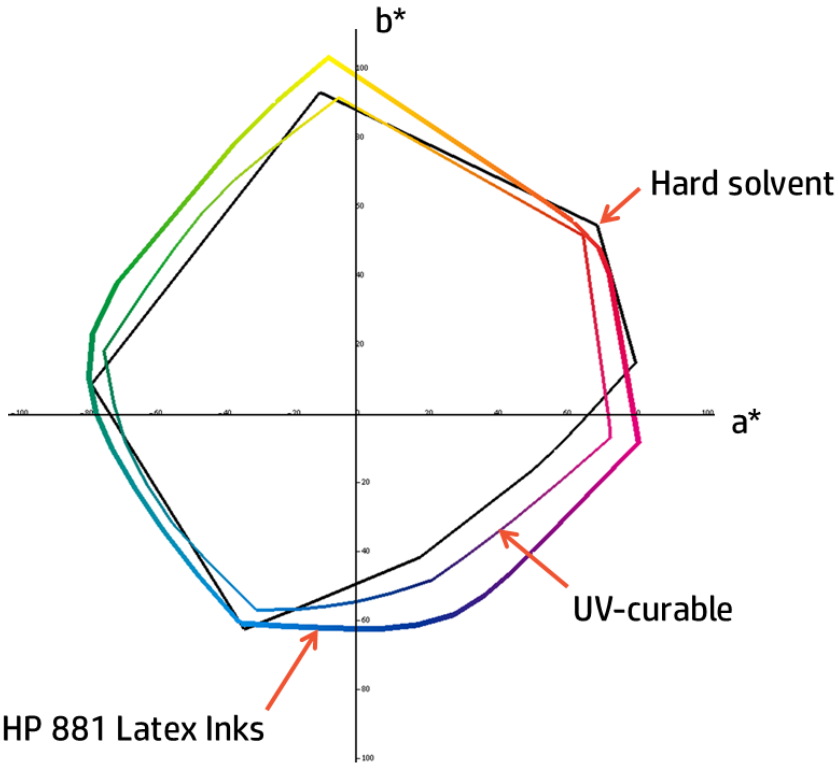
Figure 7 shows gamuts for three HP ink technologies projected onto the a*-b* plane of the CIELab color space. The gamuts are presented for Absolute Colorimetric rendering intent on self-adhesive vinyl.

- HP 881 Latex Inks in the HP Latex 3000 Printer produce the gamut shown by the bold colored line. These inks produce an L*min (black-point) of 7 in 6-pass, 6-color 100% mode with saturated reds, yellows, greens, and blues.
- A UV-curable ink gamut, for the HP Scitex XP2700 Printer with HP XP222 Scitex Inks, is shown by the light colored line.
- A hard-solvent gamut, for the HP Scitex XL1500 Printer with HP XL300 Supreme Scitex Inks, is shown by the black line.

[6] HP image permanence estimates by HP Image Permanence Lab. Outdoor display permanence tested according to SAE J2527 using HP Latex Inks on a range of media, including HP media; in a vertical display orientation in simulated nominal outdoor display conditions for select high and low climates, including exposure to direct sunlight and water; performance may vary as environmental conditions change. Laminated display permanence using HP Clear Gloss Cast Overlaminate. Results may vary based on specific media performance.

[7] Scratch-resistance comparison based on testing HP Latex Inks and representative hard-solvent inks. Estimates by HP Image Permanence Lab on a range of media.

Figure 7. Color gamuts of HP Latex, UV-curable, and hard-solvent inks on self-adhesive vinyl



Environmental performance

The water-based formulation of HP 881 Latex Inks and HP Latex Optimizer differentiates the HP Latex printing solution from other technologies and helps customers' meet environmental objectives for their work area and for indoor prints and wallcoverings.

HP Latex Inks are UL ECOLOGO Certified,[8] have no hazard warning labels, no HAPs, and are non-flammable and non-combustible.[9] Prints made with HP 881 Latex Inks are odorless,[10] and no special ventilation is required in the work area.[11]

HP 881 Latex Inks are GREENGUARD Children & Schools Certified[SM]. Prints produced using HP Latex Inks on HP PVC-free Wall Paper meet AgBB criteria and are rated A+ according to Émissions dans l'air intérieur.[12]

Media portfolio

HP 881 Latex Inks are compatible with a broad range of printing materials to support applications in retail and outdoor advertising, event and exhibition graphics, vehicle graphics, and interior decoration. The HP printing materials portfolio for HP Latex Inks is listed in Table 2.

Media listed in **boldface** are recyclable through the HP Large Format Media take-back program.[13] Media listed in *italic* are recyclable through commonly available recycling programs.

[8] UL ECOLOGO Certification to UL 2801 demonstrates that an ink meets a range of stringent criteria related to human health and environmental considerations. See ul.com/EL.

[9] HP Latex Inks were tested for Hazardous Air Pollutants, as defined in the Clean Air Act, per U.S. Environmental Protection Agency Method 311 (testing conducted in 2013) and none were detected. Water-based HP Latex Inks are not classified as flammable or combustible liquids under the USDOT or international transportation regulations. Testing per the Pensky-Martins Closed Cup method demonstrated flash point greater than 110 °C.

[10] Some substrates may have an inherent odor.

[11] Special ventilation is not required to meet US OSHA requirements on occupational exposure to VOCs from HP Latex Inks. Special ventilation equipment installation is at the discretion of the customer—no specific HP recommendation is intended. Customers should consult state and local requirements and regulations.

[12] HP Latex Inks are GREENGUARD Children and Schools Certified[SM] (see greenguard.org). HP PVC-free Wall Paper printed with HP Latex Inks meets AgBB criteria for health-related evaluation of VOC emissions of indoor building products (see umweltbundesamt.de/produkte-e/bauprodukte/agbb). Émissions dans l'air intérieur provides a statement on the level of emission of volatile substances in indoor air posing health risks if inhaled—on a scale from A+ (very low-emission) to C (high-emission).

Table 2. HP Printing materials portfolio for HP Latex Inks

Type	Material	Available in 3-inch core
	"Green" banners PVC banners	HP HDPE Reinforced Banner HP Everyday Matte Polypropylene, 3-in Core HP Durable Frontlit Scrim Banner
Films		HP Backlit Polyester Film
PSA	PVC	HP Air Release Adhesive Gloss Cast Vinyl + HP Clear Gloss Cast Overlaminate HP Permanent Gloss Adhesive Vinyl HP Permanent Matte Adhesive Vinyl HP One-view Perforated Adhesive Window Vinyl HP Everyday Matte Polypropylene, 3-in Core
Papers		HP PVC-free Wall Paper - FSC®[14] and GREENGUARD^{SM} [15] certified *HP White Satin Poster Paper* *HP Photo-realistic Poster Paper* HP Blue Back Billboard Paper *HP Coated Paper, 3-in Core* *HP Universal Coated Paper, 3-in Core* *HP Universal Heavyweight Coated Paper, 3-in Core* *HP Heavyweight Coated Paper, 3-in Core* *HP Super Heavyweight Plus Matte Paper, 3-in Core*
Fabrics		HP Heavy Textile Banner - Oeko-Tex® certified[16] HP Light Textile Display Banner - Oeko-Tex® certified[16]
Specialty		HP Satin Canvas HP Dupont™ Tyvek® Banner

Writing system

The writing system of the HP Latex 3000 Printer employs major innovations in printheads, drying and curing, and media advance to achieve high print quality at industrial productivity.

HP 881 Latex Printheads

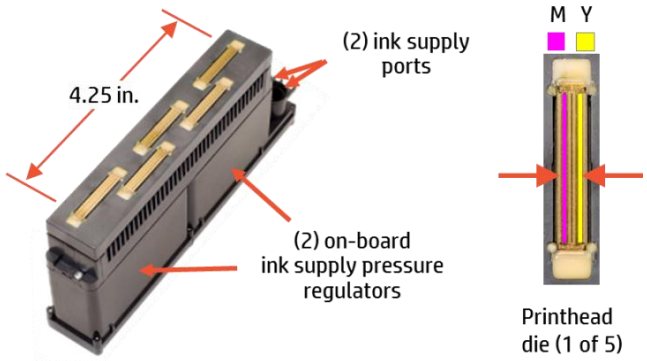
HP 881 Latex Printheads, shown in Figure 8, are a new generation of a printhead design proven to deliver reliable performance with high image quality in HP Latex Printers. HP 881 Latex Printheads have a bi-color configuration with two (2) columns of 5,280 nozzles per color. With 1,200 nozzles per inch, they produce a 4.25-inch (108-mm) print swath. Drop volumes are 12 picoliters for all HP 881 Latex Inks.

HP 881 Latex Printheads incorporate changes to the drop generator design that allow cooler operation. This improves productivity and reduces drop weight variation for better color consistency.[17]

[13] HP Large Format Media take-back program availability varies. Some recyclable HP papers can be recycled through commonly available recycling programs. Recycling programs may not exist in your area. See hp.com/recycle for details.
[14] Trademark license code FSC-C017543.
[15] HP Latex Inks are GREENGUARD Children & Schools Certified^{SM}. See greenguard.org.
[16] Unprinted HP Heavy Textile Banner and HP Light Textile Display Banner are Oeko-Tex® certified according to Oeko-Tex® Standard 100, which is a globally uniform testing and certification system for textile raw materials, intermediate, and end products at all stages of production. Tested for emissions of volatile organic compounds and chemical residues such as pesticides, allergy-inducing dyestuffs, or tin-organic compounds.

HP 881Latex Printheads are recyclable through the HP Planet Partners program.[18]

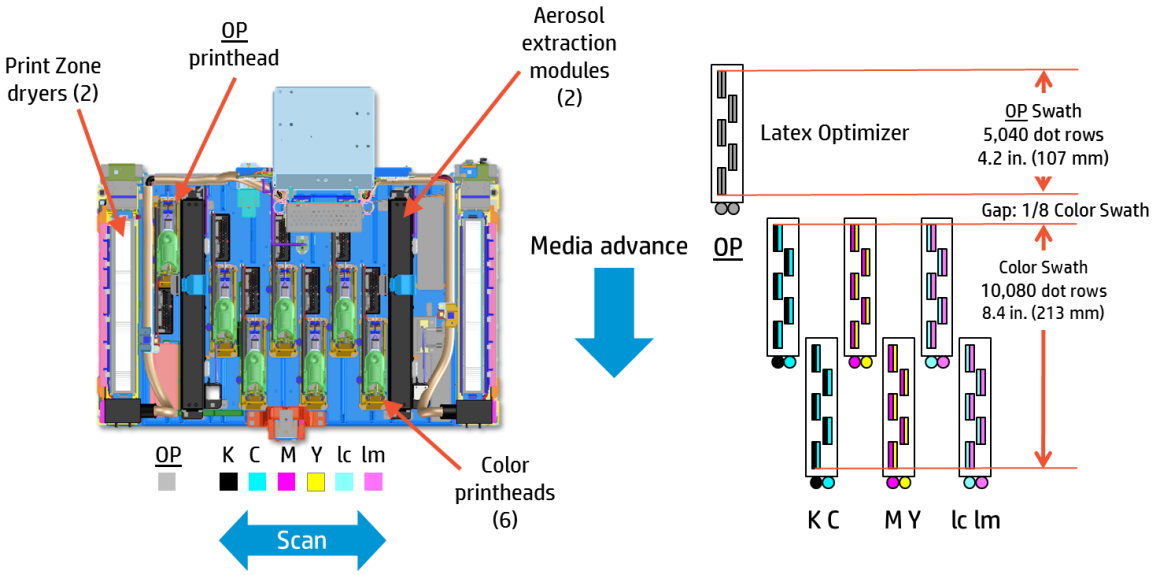
Figure 8. HP 881 bi-color printhead



Print carriage

The arrangement of the printheads, print zone dryers, and aerosol extraction modules are shown on the top-view of the print carriage at the left in Figure 9. The arrangement of the seven (7) HP 881 Latex Printheads, with more than 70,000 nozzles, is shown in the schematic diagram on the right. The print carriage scanning and media advance directions are shown by the arrows.

Figure 9. Print carriage and printhead arrangement



A single fiber-optic cable expands writing system control and diagnostic capabilities in the HP Latex 3000 Printer with high-speed data transfer between the writing system controller and the print carriage. Providing five (5) channels of 2.5 gigabits/sec data—up to 10 Gbps out to the carriage and up to 2.5 Gbps back for control and diagnostics—this single, lightweight cable handles the data rates that would require seven (7) conventional coaxial cables. This reduces cost, improves reliability, generates no EMC interference, and improves system ESD resistance.

Printhead pockets on the print carriage provide mechanical, electrical, and ink interfaces to the printhead. HP 881 Latex Printheads are designed for quick and easy replacement: the operator pulls open the printhead latch (shown in light green in Figure 9), pulls out the used printhead, inserts a new one, and resets the latch. No tools, mechanical alignments, or handling of ink tubes or electrical connectors are involved.

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[17] The color variation inside a printed job has been measured to be within this limit: maximum color difference (95% of colors) <= 2 dE 2000. Reflective measurements on a 943 color target under CIE standard illuminant D50, and according to the standard CIEDE 2000 as per CIE Draft Standard DS 014-6/E:2012. 5% of colors may experience variations above 2 dE 2000. Backlit substrates measured in transmission mode may yield different results.

[18] Visit.hp.com/recycle to see how to participate and for HP Planet Partners program availability; program may not be available in your area. Where this program is not available, and for other consumables not included in the program, consult your local waste authorities on appropriate disposal.

In the HP Latex 3000 Printer, OP is applied before the color inks. The OP swath is printed by a single HP 881 Latex Optimizer Printhead. Color is printed using a double-swath arrangement of bi-color HP 881 Latex Printheads, as shown. This configuration has twice the color printheads as the HP Latex 820 and 850 Printers to give industrial productivity of up to 77 m^2/hr (830 ft^2/hr) indoor quality (6-color, 6-pass 100% mode) and up to 120 m^2/hr (1,290 ft^2/hr) of outdoor quality (4-color, 4-pass 60% mode).

Aerosol extraction

The HP Latex 3000 print carriage has two (2) aerosol extraction modules. By extracting air from the gap between the print carriage and the media, these modules capture aerosol—fine droplets of ink—that could accumulate on the underside of the print carriage or the printhead orifice plates. Fans produce suction that extracts aerosol, and this does not affect drop placement accuracy. On average, the two (2) filters are replaced every four (4) weeks by the user.

High-efficiency drying and curing systems

HP Latex Inks do not air-dry—they must be dried and cured in the printer. Built-in drying and curing systems in the HP Latex 3000 Printer produce a print that is dry and ready-to-use. Third-generation HP Latex Printing Technologies, including HP Latex Optimizer, reduce the temperatures and energy requirements of drying and curing HP Latex Inks. Compared to the HP Latex 850 Printer, the HP Latex 3000 Printer consumes 50% less energy per square meter printed.[19]

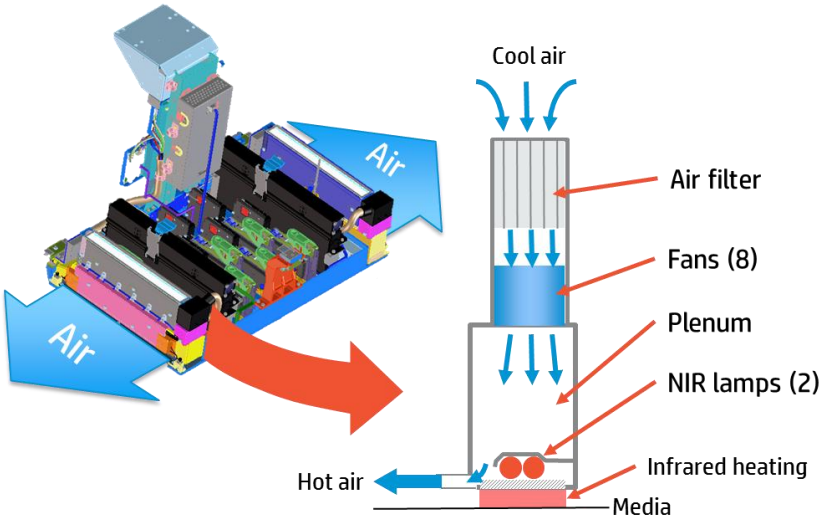
Print zone drying

The print zone is the region of the printer platen where HP Latex Optimizer and HP Latex Inks are applied onto the print.

Mounting print zone heaters on the leading and trailing edges of the print carriage is an innovation in the HP Latex 3000 Printer. This configuration improves the energy efficiency of the print zone dryer by placing near-IR ("NIR") heating lamps as close as possible to the print media, and directing hot air from the lamps along the surface of the print. System reliability is improved because printheads and carriage electronics operate at lower temperatures—rather than heating the air in a chamber around the scanning carriage, as done in earlier generations of HP Latex Printers, heat is generated and used close to the print surface—where it is needed.

The print zone dryers span the width of the print carriage and have the internal components shown in the schematic cross-sectional view in Figure 10. Cool air is drawn in through an air filter by eight (8) fans to pressurize a plenum—a chamber that produces uniform airflow across the width of the dryer. Two (2) NIR lamps heat the media through a glass window. After cooling the lamps, warm air is directed parallel to the media surface at about 12 m/sec.

Figure 10. Print carriage with two (2) print zone dryers



The heaters operate bi-directionally as the carriage scans across the width of the print media. Each drying lamp operates at variable power, up to 3 kW, with three (3) different power modes: *standby*— when the lamp is off of the media at each end

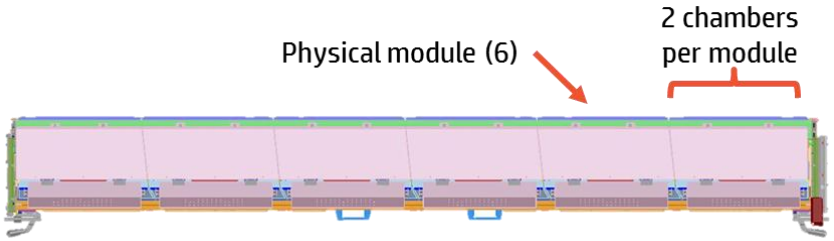
[19] Based on measurements and calculations by HP R&D comparing 45 m^2/hr printing on the HP Latex 850 Printer and 77 m^2/hr on the HP Latex 3000 Printer.

of the scan; *low*—for the trailing-edge lamp when the carriage is scanning; and *high*—for the leading-edge lamp when the carriage is scanning.[20] This scheme reduces energy consumption and extends the life of the lamps.

Curing zone drying

The remaining water and liquid components in the ink film are evaporated by the curing zone dryer. Advancing the media feeds the print out of the print zone and into the curing zone dryer, which is located on the outside front of the printer and spans the width of the print zone.

Figure 11. Curing zone heater (front view)

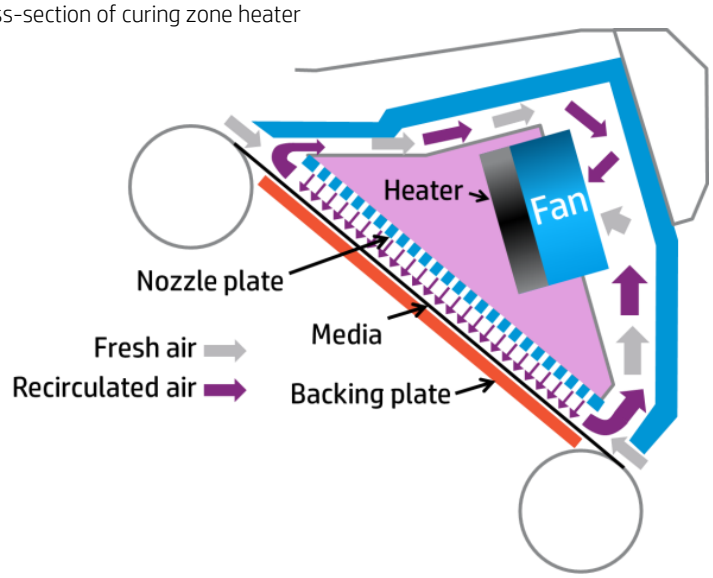


The curing zone dryer is shown in a front view in Figure 11. The print enters from the print zone at the top of this figure and exits at the bottom for collection and use.

The curing zone dryer has an energy-efficient, modular design. There are six (6) modules and twelve (12) independent chambers. Each chamber has a fan, heater, and closed-loop pressure and temperature control. To conserve energy, the number of curing modules activated depends on the width of the print. When there is a pause in production, the curing zone heaters go into a low-power mode and air flow is reduced to save energy. For pauses longer than about five (5) minutes, the heaters are completely shut-off while a low air flow is maintained.

Figure 12 shows a schematic cross-section of a curing zone heater. A fan drives air through a 900W heater into a chamber, where it passes through a nozzle plate that effectively directs warm air at 10 – 20 m/s onto the print. The intake to the fan is a mixture of fresh air and air that is recirculated after passing over the print. Recirculating the air, which is typically between 60 and 80 °C, conserves energy in the curing zone.

Figure 12. Schematic cross-section of curing zone heater



[20] High-efficiency curing includes two zones, drying lamps in the print zone and a curing module in the post-print zone. The drying lamps in the print zone include power settings that were designed for high performance and safe operation with HP 881 Latex Inks. If inks other than Original HP 881 Latex Inks are used, the drying lamps will be automatically switched off.

Dynamic swath alignment

A dark or light band across a print may be visible if there is an excessive gap or overlap between successive print swaths. The ideal case aligns successive swaths to within ½ dot row—10.6 um at 1,200 dpi. This is difficult to achieve mechanically in high productivity modes even with precision media advance mechanics and measurement of actual media motion by the HP Optical Media Advance Sensor ("OMAS"). But, by using OMAS measurements and dynamically aligning the print swaths by selecting which nozzles print on each scan, this level of accuracy can be obtained. This process is new to the HP Latex 3000 Printer and is called Dynamic Swath Alignment ("DSA").

Figure 13 is a schematic description of the DSA process with examples for nominal, under-, and over-advances of the media between print swaths.

Figure 13. Dynamic Swath Alignment

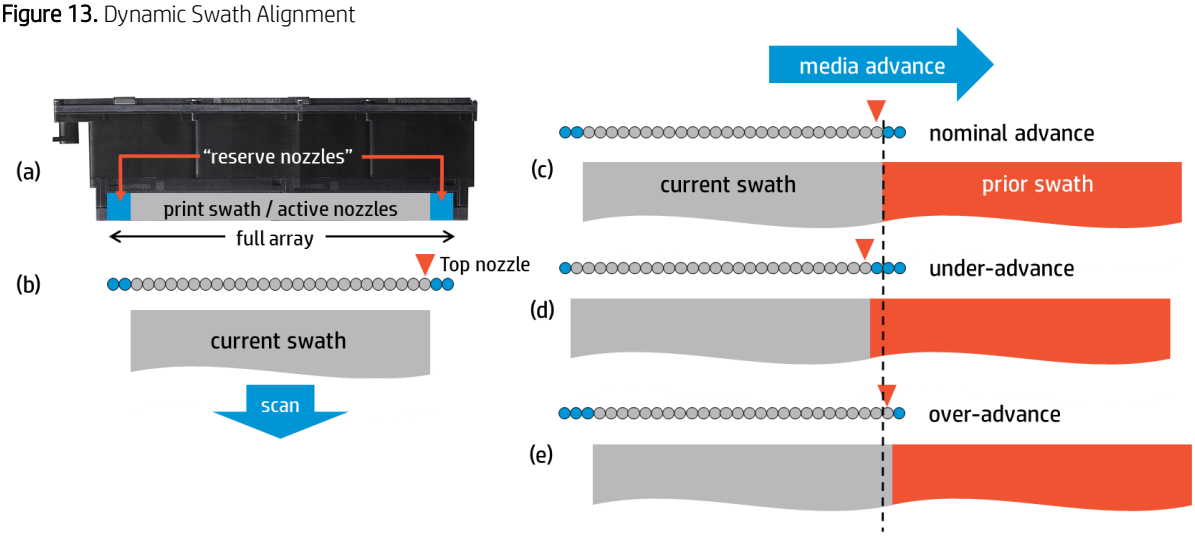


Figure 13a shows a side view of two staggered color printheads (see Figure 9) with a print swath of 10,080 dot rows. With DSA, the print swath is produced by active nozzle (gray dots) with nozzles in reserve at the top and bottom of the array (blue dots). Two (2) reserve nozzles on each end are shown here purely for illustrative purposes. The views in Figures 13b – 13e are looking down onto the print media with the scan and media advance directions indicated by the arrows.

In Figure 13b, the nozzle printing at the top of the swath being printed—the "current swath"—is indicated by the orange triangle. Nozzles shown in gray are active in printing the swath, and those indicated in blue are inactive—in reserve.

Figure 13c shows a nominal—accurate—media advance, where the orange swath was printed on the prior carriage scan. The nominal media advance mechanically places the top nozzle and current swath in the proper position at the bottom of the prior swath. The swaths are aligned. The dotted line represents a nominal advance of the prior swath. Notice the nozzles in reserve at both ends of the print swath.

In Figure 13d, the prior swath has not advanced far enough—an under-advance. Now, DSA shifts the top nozzle and the print swath to the left (in this figure) to properly align the swaths. Otherwise, the current swath would overprint the prior swath potentially producing a dark band. Notice that as a result of shifting the print swath, there are more inactive nozzles at the top of the swath and fewer at the bottom.

In Figure 13e, the prior swath has advanced too far—an over-advance. DSA shifts the top nozzle and the print swath to the right to fill in the gap that could appear as a white band.

Holding nozzles in reserve has a negligible effect on productivity while allowing DSA to effectively suppress banding.

Summary

HP's third-generation Latex Printing Technologies in the HP Latex 3000 Printer include a number of significant innovations that take the benefits of water-based HP Latex Inks to a new level with industrial-scale speed and efficiencies ideal for large print service operations. HP 881 Latex Inks with HP Latex Optimizer provide durable prints with a wide color gamut and expand media versatility using high-efficiency curing. Compared to previous HP Latex Printing Technologies, the HP Latex 3000 Printer consumes less energy per square meter printed. Dynamic Swath Alignment precisely places each print swath to suppress banding.

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