Canon

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GAME-CHANGING TECHNOLOGY

Canon UVgel Technology Backgrounder

UVgel

01 Content

01 Content

02
The Market Need

The large format graphic arts market is dynamic and exciting. Change is constant and occurring faster than ever before.

Within this market we see two undeniable trends:

2.1 Market Trends

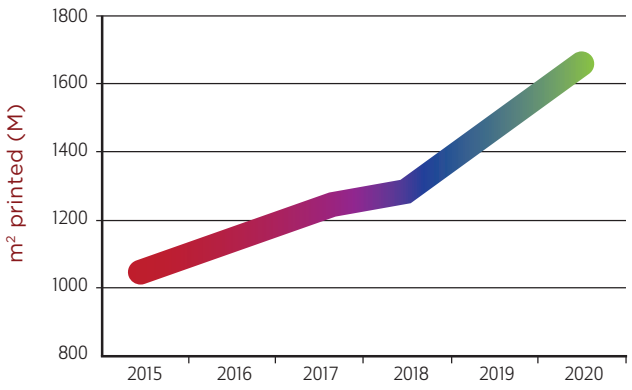
2.1.1 Market Growth

Volumes are growing. More and more is being printed, and new applications are continuously being developed. Research into wide-format trends conducted by PRIMIR for the NPES found 75% of respondents expected their wide-format print volumes to increase in the coming 12 months. The top three current applications were banners (84%), signs (80%), and posters (79%). However, when they asked which applications they expected to increase in the coming year, packaging (73%) easily led the way.[1]

IT Strategies[2] forecast worldwide growth of combined wide format print volumes across latex, eco-solvent and UV roll-to-roll printing technologies to increase from 1 billion m^2 to over 1.6 billion m^2 in 2020.

Looking at the wide-format sector as a whole, InfoTrends expects print volumes to see a compound annual growth rate of about 3% between 2015 and 2020. This continued growth is the result of increased adoption, new technologies, and expanding range of applications, as well as more efficient workflow solutions.

Forecasted Worldwide Eco-solvent/Latex/UVgel Print Volumes



[1] PRIMIR Wide Format Inkjet Printing Trends, June 2015

[2] IT Strategies WF InkJet Graphics Summary 2015

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The Market Need

The large format graphic arts market is dynamic and exciting. Change is constant and occurring faster than ever before.

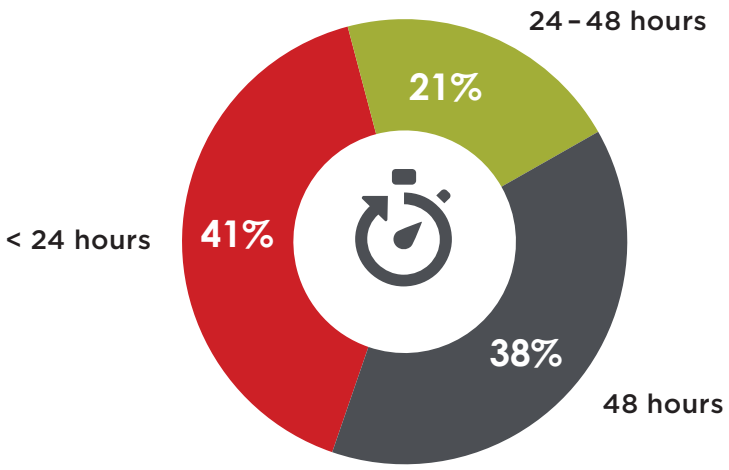
Within this market we see two undeniable trends:

2.1.2 Pressure on job turnaround

Turnaround times for customers are becoming shorter and shorter. According to InfoTrends research, more than 40% of wide-format print jobs need to be turned around within 24 hours.

Both these trends are expected to continue. This makes increased productivity a key driver for wide-format print service providers (PSPs) to invest in technology. Market Analyst PRIMIR US comments: "Demand for higher service levels drives investment in faster printers, with instant drying."[3]

"What percentage of your digital wide format jobs need to be produced in the following time frames?"[4]



[3] PRIMIR Wide Format Inkjet Printing Trends, June 2015

[4] Wide Format Printing Critical Element in the Communications Mix, InfoTrends 2013; N=310 respondents

02 The Market Need

2.2 Limitations of current technology offering

In considering the parameters of greatest value to customers from an innovative wide-format printing technology, Canon conducted in-depth discussions with a variety of PSPs—large and small—in Europe, the United States, and Asia.

All had multiple printers: the ten European PSPs had between two and six printers, the 13 Asian PSPs (in China and Japan) ran from three to 40 devices; and the ten US customers had between four and 14 printers.

The aim of the qualitative research was to understand these PSPs' day-to-day operational frustrations, and how technology innovation could support their business growth and development. This customer insight is the foundation of Canon's R&D philosophy of "Outcome Driven Innovation."

The PSPs' feedback demonstrated clearly that, with the current output technologies in the market, there is a gap in today's product offering. Most of the products available to PSPs today are low-volume 64" (1.6m) latex and eco-solvent systems.

These printers have the advantages of requiring a relatively low initial investment and being easy to use. However, they have three key limitations which mean that they do not fully address the needs of PSPs today.

- Productivity
- Quality at adequate speed
- Media versatility

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2.2.1 Productivity

Canon's own qualitative research among PSPs highlighted production speed as the key limitation of prevailing roll-to-roll technologies.

According to the customers surveyed, the 64″ latex and eco-solvent devices available in the market today are not adequate for the demands of higher and peak volume production.

While developers of 64″ latex and eco-solvent printers have improved output speed with later iterations of these technologies, gains have been incremental rather than radical due to the inherent limitations of the technologies, namely:

• The high degree of dot gain/ coalescence of 64″ latex and eco-solvent inks limits the volume of ink that can be laid down without compromising image quality

• This means that 64″ latex and eco-solvent technologies require a high number of passes to achieve desired image quality over a given area

• This slows printing down, or forces PSPs to compromise quality for higher output speeds

• 64″ latex and eco-solvent processes require a drying stage to evaporate the water/solvent

In practice, PSPs using prevailing technologies reported that they typically find themselves managing production bottlenecks. This means that they cannot actively pursue increased job volumes, and may indeed be reluctant to accept certain jobs—especially for large volume jobs or applications where the PSPs perceive an element of risk associated with delivery to a fixed deadline or working with an unfamiliar substrate.

PSPs currently address this challenge in several ways:

Multiple printing machines

PSPs may seek to resolve this productivity challenge by running multiple printing machines side by side.

This approach requires significant space, as well as increasing staffing levels and complicating maintenance requirements. Extended shifts are another pragmatic solution, but also come with increased operator costs. In regions where labor costs are high, this may fundamentally limit the growth potential of PSPs because business owners are reluctant to increase staffing commitments, and will therefore restrict technology investment plans involving multiple engines.

Use of multiple printers is often cited as a benefit in terms of production flexibility. However, Canon customer research indicates that, in practice, even PSPs running multiple roll-to-roll printers often have individual devices set up to print on their most popular media types, and are reluctant to incur the time delays associated with switching media and amending profiles. Thus, they do not really obtain the expected flexibility gains, and still lack the true production capacity to take on larger job volumes and diversify their applications offering.

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2.2.1 Productivity

Outsourcing

Another pragmatic solution used by PSPs today is to outsource support with large volume or perceived "high-risk" jobs. However, there is reluctance to do this, as the PSP sacrifices margin, quality control, and control over delivery. Most PSPs would prefer to enhance their in-house capabilities to service most customer print requirements.

Closing the gap

Today there is no technology alternative between these two extremes of productivity and investment. There is a substantial gap in the middle, which points clearly to the need for a breakthrough new technology to meet the needs of PSPs for a better balance of productivity and investment.

High-end industrial systems

Customers looking for a more "industrial" production solution may also turn to high-end 10 ft./3.2 m UV and latex systems. These technologies offer high output speed, the scope to work in dual-roll mode, and are therefore able to cope with industrial production volumes. However, they represent significant capital investment (> $150,000), which may be beyond the scope of small– to medium-sized PSPs. To invest in this type of printing device, the PSP requires clear visibility of consistently high production volumes to assure them of an acceptable ROI. Usability for short runs is questionable with these systems. They also occupy a large physical footprint, which may not be suitable for certain businesses.

Technology Gap Between Productivity and Investment

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2.2.2 Quality

The available technologies today mean that PSPs must compromise productivity for quality, or vice versa.

Indoor applications—advertising and POS for example, or décor products such as wall coverings—are subject to close scrutiny and require precision image reproduction, smooth output with no banding, excellent repeatable color, consistency from print to print and across the printed image.

Existing technologies may deliver an acceptable range of quality for many applications, but higher-quality print modes force a dramatic slowdown in output speed, exacerbating the productivity frustrations described above.

For example, a latex printer producing backlit applications in highest-quality mode may only be able to print at a working output speed of approximately 65 $ft.^2$/hr.

2.2.3 Media versatility

While the opportunity for PSPs to diversify into new application areas continues to grow, the prevailing printer technologies limit PSPs' ability to produce multiple applications with a single device.

Latex and eco-solvent printers are suitable for a broad range of media types and applications. However, there are some limitations due to the need for heat drying to evaporate the water/solvent.

The evaporative process makes these technologies fundamentally unsuitable for heat-sensitive media, creating challenges with certain applications—using film, for example.

Depending on application, performance qualities such as abrasion resistance and lightfastness must also be taken into consideration.

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2.3 Conclusion

The prevailing technologies have their individual advantages, but also their limitations.

For PSPs looking for the optimal combination of productivity, quality and media—and therefore applications—versatility, there is no single choice today. The reality is that PSPs must compromise one attribute for another.

Productivity is one of the most important technology factors limiting business growth for small- to medium-sized PSPs today.

The fundamental technical properties of evaporative latex and eco-solvent technologies mean that, despite ongoing research and development efforts, it will be much more difficult to fulfill the growing productivity requirements of PSPs in the near future.

There is a clear opportunity for radical innovation in the roll-to-roll market to match customers' productivity requirements, while also meeting or exceeding their expectations of quality and applications diversity.

03 Introducing Canon UVgel Technology

Introduction

Having identified this technology gap, Canon set out to create a more comprehensive technology solution that would put an end to the compromises PSPs have to make today when choosing from latex, eco-solvent or conventional UV solutions. Canon's objective was to develop a technology that would offer:

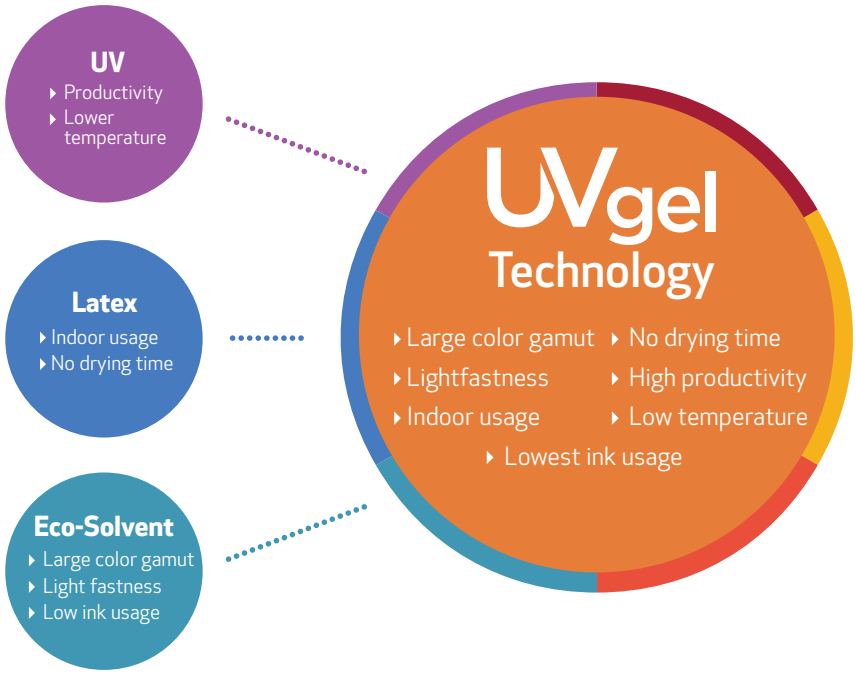
• Industrial speed and end-to-end productivity, for growing volumes of fast turnaround jobs.

• High output quality, suitable for a wide applications spectrum including demanding indoor and décor applications.

• Maximum media versatility, to enable PSPs to produce multiple applications using a single device.

Canon also focused on controlling total cost of ownership (TCO), to assure PSPs of rapid return on their capital investment and low ongoing running costs.

The result is Canon UVgel technology, and the Océ Colorado—the first printer to feature UVgel technology (see page 22).



03 Introducing Canon UVgel Technology

3.1 What is Canon UVgel technology?

Canon UVgel technology comprises several specially-developed elements that combine to achieve a process that retains the advantages of current printer technologies, while eliminating many of the compromises.

- Canon/Océ UVgel piezo-electric printhead, (with automated nozzle compensation)
- Canon UVgel ink
- Low-heat media platen
- LED-curing concept

The ink, essentially a gel developed according to UV curing principles, is the key to Canon UVgel technology.

The simplified stages of the Canon UVgel printing process are as follows (see illustration below):

Inside the printheads, Canon UVgel ink is heated and turns from gel into liquid.

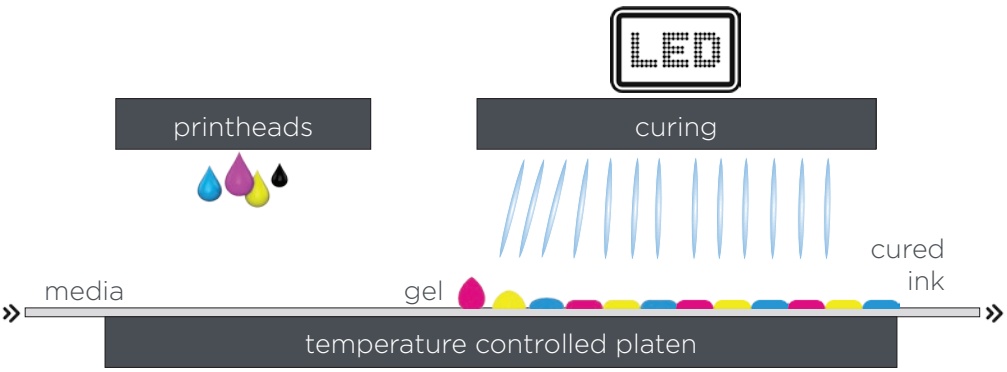
The temperate controlled platen maintains the substrate at a constant 82.4˚F temperature regardless of environmental factors.

On contact with the media, the liquefied ink drops return immediately to their gel state.

In their gel state, the ink droplets are “pinned” instantly to the media, assisted by a partial LED “precure” process.

Full LED curing takes place at a later stage, after the image is completely formed and gelled on the media.

Stages of Canon UVgel Printing Process



03 Introducing Canon UVgel Technology

3.2 Key benefits of Canon UVgel process

The gel ink enables this innovative, instant dry, “print-then-cure” process. The Canon UVgel technology concept delivers multiple productivity and quality benefits:

• The solidified state of the pinned gel dot prevents coalescence (merging) between individual ink drops, delivering optimal control over the dot to prevent spread (dot gain).

• By controlling dot gain, much more ink can be deposited in fewer passes, improving speed.

• Because LED curing is performed later than with existing technologies, images have a more uniform, smoother surface.

• By eliminating the need for immediate curing, productivity is substantially increased compared with conventional UV because curing no longer limits print speed.

• Prints are instantly dry, requiring no evaporative drying process.

The printhead, the ink, the platen, and the curing concept are all owned and developed Canon Océ technologies. They combine to create the Canon UVgel technology, which is unique and new to the large-format graphics arts market.

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Introducing Canon UVgel Technology

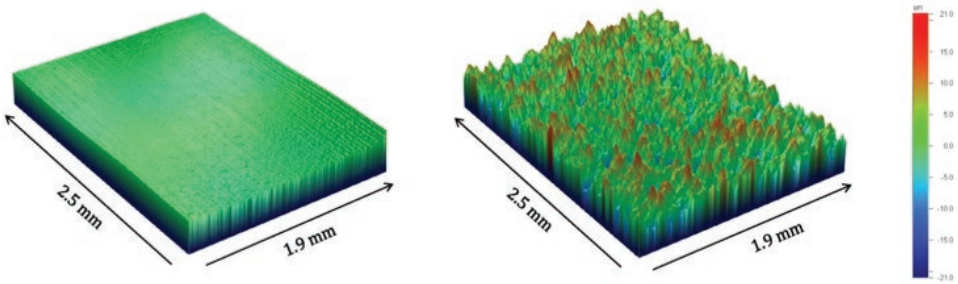
3.3 How is Canon UVgel different than traditional UV?

Although based on UV-curing principles, the main disadvantages of traditional UV do not apply to Canon UVgel technology.

Traditional UV printing creates an uneven surface, due to the multiple ink layers being individually cured, resulting in a relief effect.

In contrast, the LED UV curing system employed in UVgel technology moves independently from the printing carriage. This means that Canon UVgel ink is not cured until the complete image has been deposited, giving the individual ink drops the opportunity to settle. This delivers a flatter, smoother profile, more ideally suited for lamination, as illustrated below.

Curing Process Leads to Smoother Image with UVgel Ink vs. Traditional UV Ink



UVgel Ink

Traditional UV Ink

03 Introducing Canon UVgel Technology

3.4 How does Canon UVgel technology influence print speed and overall productivity?

Canon UVgel technology is completely different to evaporative ink technologies such as latex, eco-solvent and aqueous.

Canon UVgel ink is “pinned” to the substrate by virtue of the physical gel characteristic of the ink itself.

Every droplet of Canon UVgel ink is pinned instantly upon contact with the media. Once pinned, the UVgel ink drop is fixed to the substrate and dot gain is highly controlled.

This is in sharp contrast to evaporative ink technologies, in which the ink drops naturally flow on the media, growing in size and coalescing with adjacent drops in an uncontrolled way until dried by evaporation of the water or solvent content.

Consequently, evaporative technologies — e.g. 64″ latex and eco-solvent technologies — exhibit substantial dot gain and uncontrolled growth on the media.

To overcome the challenges of this characteristic, it is necessary to build the printed image gradually, in multiple passes, to minimize the effect of ink coalescence. This has a substantial impact on productivity in higher-quality modes.

The natural behavior of Canon UVgel technology delivers unprecedented control of dot gain or coalescence of the ink between jetting and curing.

Therefore, with Canon UVgel, the appropriate amount of ink can be laid down in fewer passes, reducing the time required to produce the finished print.

03 Introducing Canon UVgel Technology

3.4 How does Canon UVgel technology influence print speed and overall productivity?

Visualization of reduced dot gain/coalescence UVgel vs evaporative technologies

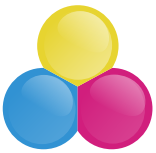
The diagram below depicts the print quality difference between evaporative digital ink technologies and Canon UVgel.

Latex, Eco-Solvent

Ink drops flow until dried
» large dotgain

UVgel

Separate dots on media
Instantly pinned



Evaporative process (64" latex/eco-solvent)

You can see evaporative ink droplets immediately beginning to grow when reaching the substrate. This spread of the ink on the media results in uncontrolled dot gain and undesirable coalescence of the ink droplets, filling the print area with poorly focused, erratically spaced and overlapping ink droplets, all contributing to lower print quality.

The limitations of evaporative ink technologies actually get worse at higher print speeds and/or on media with higher rates of absorption.

Canon UVgel

Canon UVgel ink drops are deposited on the media and immediately form a gel on contact with the temperature-controlled substrate, preventing uncontrolled dot gain or unintended coalescence. The ink is effectively "pinned" to the media on a drop-by-drop basis, delivering more accurate area coverage and drop position. The result is superior print quality compared to evaporative ink technologies.

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Introducing Canon UVgel Technology

3.4 How does Canon UVgel technology influence print speed and overall productivity?

Other positive performance factors also improve end-to-end productivity compared with existing technologies.

For example, continuous nozzle performance is critical to inkjet productivity and image quality. Temporary failure of printhead nozzles is a well-known problem in inkjet printing that can be caused by dust, for instance.

Canon UVgel technology deploys on-the-fly quality control called “Piezo Acoustic Integrated Nozzle Technology” (PAINT). In the printheads, the nozzle status is continuously monitored acoustically (by sending a small, electro-acoustic pulse though each nozzle and listening for an uninterrupted “echo”).

This monitoring occurs without the need to fire droplets, thus eliminating the need to waste ink to check nozzle function.

When a malfunctioning nozzle is detected, the affected nozzle is (temporarily) switched off and replaced by neighboring nozzles. This whole process is fully automated, requiring no operator intervention.

Being instantly dry and cured, the Canon UVgel print is suitable for immediate post-processing and lamination, further improving end-to-end productivity.

Evaporative process Non-evaporative process

03 Introducing Canon UVgel Technology

3.5 How does Canon UVgel technology influence print quality?

Print quality is the result of many interacting parameters such as:

- Ink drop volume
- Dot gain on the media
- Coalescence with adjacent drops
- Spatial resolution
- Dot placement accuracy
- Number of ink colors
- Number of printing passes
- Ink film thickness
- Media used
- Color management

Many of these are characteristics of the piezo-electric printhead system (e.g. native resolution, drop placement accuracy, control over drop volume, number of ink colors, etc.).

However, when assessing real-world print quality, the determining factor is how the final ink layer is formed on the media.

Controlled dot gain

The relationship between how the ink is jetted and the resulting ink layer on the media is strongly dependent on the technology used. The gel property of Canon UVgel ink—the fact that it is instantly pinned to the substrate with controlled dot gain—results in superior drop geometry, giving inherently higher print quality, whatever the target media. By controlling dot gain, Canon UVgel also delivers excellent color consistency, over the full area of the print, and from print to print (see page 30).

Extended color gamut

Canon UVgel ink has been developed specifically to deliver extended color gamut, beyond that of prevailing roll-to-roll technologies, even eco-solvent (see page 35).

03 Introducing Canon UVgel Technology

3.5 How does Canon UVgel technology influence print quality?

Smooth texture

The gel property of the ink means that each dot has a flatter profile than other UV cured technologies. Combined with the separate LED curing process, this gives the Canon UVgel printed image a smooth, untextured surface, creating rich, glossy prints with no lamination limitations (see page 14).

Improved nozzle performance

Print quality is also compromised by nozzle failure. This may result in white lines appearing in the printed output where the faulty nozzle has failed to fire ink, particularly with eco-solvent.

Canon UVgel technology incorporates continuous automatic nozzle failure compensation on the fly (see page 17). This ensures that even when a malfunctioning nozzle is detected it is temporarily switched off and replaced by neighboring nozzles — a fully-automated process that requires no operator intervention.

By testing preemptively, nozzle defects are identified before they impact negatively on output quality.

In contrast, prevailing technologies check output quality by means of a camera-based quality control system. This only identifies quality defects when a flawed print has already been produced.

03 Introducing Canon UVgel Technology

3.6 How does Canon UVgel technology influence applications versatility?

Low heat process

Canon UVgel technology is a low-heat process. Ink drops are deposited on the substrate at 82.4˚F, controlled by the media platen. Furthermore, UVgel technology uses LED-curing so that no heat is required for drying; the ink and print are instantly dry when cured. Consequently, with Canon UVgel, media distortion is negligible, even with highly heat sensitive media.

**The platen temperature can be set by the operator from 28.4˚F to 39.2˚F from the default temperature if this is advantageous for the specific customer's applications mix and commonly used media.*

By contrast, evaporative technologies may heat the media to temperatures as high as 212˚F, leading to media deformation and distortion.

This fundamental difference in technology makes Canon UVgel ideal for applications requiring high geometric accuracy, such as wall coverings. It is also well suited to lower-cost applications on inexpensive, thin media.

Reduced water content

Canon UVgel ink does not contain water. Compared with other technologies, this ensures improved dimensional consistency, by eliminating the problems associated with media swelling.

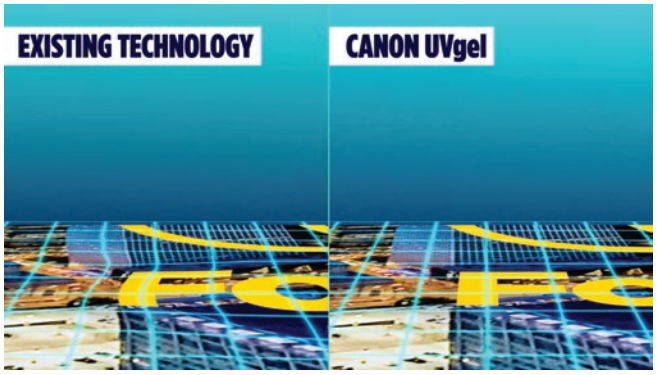
Due to its excellent interaction with a variety of substrates, including heat-sensitive media, UVgel is inherently versatile for a wide range of indoor and outdoor applications.

Durability

UVgel technology's suitability for outdoor work is enhanced by the high durability of the LED- cured image. The finished prints offer improved levels of outdoor UV lightfastness, abrasion resistance and washability/scrubbability compared with prevailing technology inks (see page 34).

Odorless

Canon UVgel technology has been developed to be odorless so it can be used for high-margin indoor applications, including those for health-sensitive environments (see page 35).



Evaporative process with high heat

Non-evaporative process with low heat

03 Introducing Canon UVgel Technology

3.7 How does UVgel technology influence total cost of ownership (TCO)?

Improved productivity

The productivity gains offered by Canon UVgel technology (see page 7) enable PSPs to deliver more finished jobs from a single printer without increasing staffing costs, resulting in accelerated return on their capital investment.

Reduced ink consumption and wastage

Benchmarking tests have shown that UVgel technology reduces ink consumption by up to 40%. This enables PSPs to produce equivalent output volumes with lower ink costs than those of 64″ latex or eco-solvent. The acoustic nozzle monitoring technology also removes the need to test nozzles by firing ink, significantly reducing ink wastage.

Option to use less expensive media

The low-heat Canon UVgel technology enables PSPs to work with thin and heat-sensitive media (see page 9). This gives PSPs the option to choose less expensive substrates, when appropriate to the application and customer expectation, which potentially reduces consumable costs.

Nozzle compensation and preemptive quality control

The automatic nozzle compensation technology (see page 19) ensures that prints remain at salable quality, even when nozzles are malfunctioning, reducing waste. The system preempts quality defects by testing the nozzles continually. This enables the operator to be proactive about printhead maintenance, rather than being alerted to issues by poor quality output.

Reduced routine maintenance

Automated nozzle compensation on the fly reduces the need for routine operator printhead maintenance, freeing up operator time for other tasks.

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Introducing Canon UVgel Technology

3.8 The Océ Colorado 1640 — the first UVgel roll-to-roll production printer

Canon's new UVgel technology will be at the core of a whole family of new roll-to-roll printing products. The first of these is the Océ Colorado 1640, a 64″ roll-to-roll printer developed to deliver unprecedented productivity, minimal maintenance, and excellent output quality on a broad range of media for optimum applications versatility.

The Océ Colorado 1640 exploits all the advantages of UVgel, and adds automation features that make the printer even more productive. With a **top speed of 1,710 ft.²/hr.** for applications such as billboards or outdoor banners, the Océ Colorado 1640 is faster than any other printer in this segment. Even at the highest level of quality for close-up indoor applications, the printer operates at a speed of 430 ft.²/hr.

The printer's automation features reduce operator handling time by up to a third compared to competitive technologies. The **dual-roll configuration** of the Océ Colorado 1640 further enhances productivity, not only decreasing the time required to load media but also enabling users to switch media quickly when producing mixed applications.

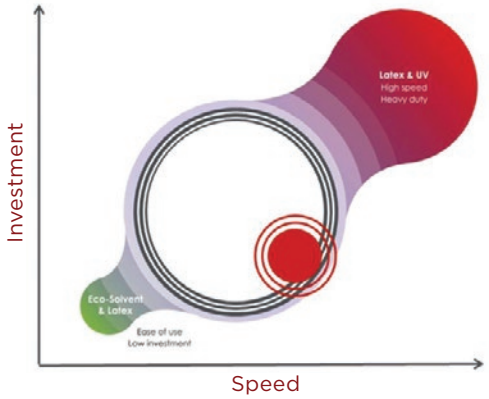
The heavy-duty drawer holds two rolls of media, of the same or different types. Both rolls can be fed into the print engine without operator assistance. The media height can be added to the media profile, and upon loading the media and media profile the printer then automatically adjusts the print gap accordingly, ensuring the best possible quality print and preventing printhead crashes. The new parameters are then stored into the media library for future use.

As with all roll-to-roll printers, an important factor in print quality and application range is the accuracy with which the printer advances the media. The printer's heavy, robust frame, class-leading rigidity and industrial components ensure stability of media handling. The printer also features **Océ MediaStep system**, which uses an optical feedback loop that continuously monitors media advance to automatically correct the subsequent step size as needed.

The **continuous nozzle monitoring** feature of the Canon/Océ UVgel printheads allows for unattended printing and reduces waste prints.

Engineered to the highest industrial standards, the Océ Colorado 1640 therefore meets the peak production requirements of businesses of all sizes, producing high volumes of wide-format graphics including posters, banners, signage, POS, billboards, window graphics, decals, and bespoke wall coverings, within the short turnaround times demanded by clients.

Canon UVgel Technology and the Océ Colorado 1640 Fill the Print Industry Gap



04 Measuring Canon UVgel Performance

Introduction

Canon has conducted stringent tests to evaluate the performance of UVgel technology under a wide range of conditions. The results confirm that the combination of UVgel and the Océ Colorado 1640 sets new standards for quality, productivity, automation, application range and operating costs.

The tests covered six critical performance parameters:

- Color gamut
- Color accuracy
- Color uniformity
- Repeatability and color consistency
- Surface tackiness and susceptibility to smudging
- Print durability

04
Measuring Canon UVgel Performance

Conclusion

The printer fulfills the Fogra 39 color space requirement.

The value of the color volume is not the only factor affecting print quality. A second indicator of color performance is how much of the color space, of Fogra 39 for example, can be simulated by a printer.

4.1 Color Gamut

Why it matters

The color gamut of a printer is the range of colors that can be printed on this specific device. Usually, the bigger the color gamut, the better the output can be matched to the viewer's expectations.

The tests

There are multiple ways to show the size of the gamut. For Canon UVgel we have measured:

- The maximum volume of the color space.
- The fraction of Pantone coated colors that can be addressed with the color space of the printer.

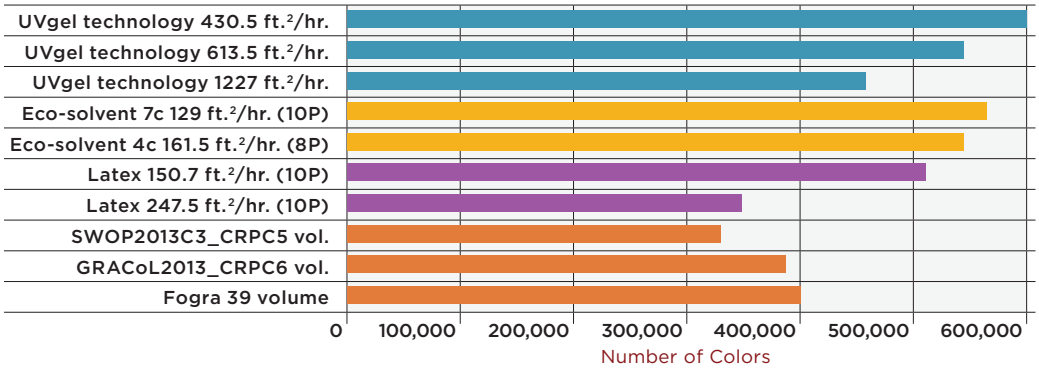
The printer gamut was measured in the high-quality print mode at a speed of 430 ft.²/hr. All measurements were made using a colorimeter using D50/2degree and M1 lighting conditions. Specification printer gamut > Fogra 39.

The results

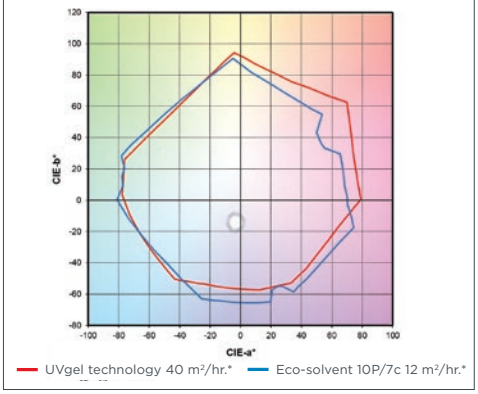
The gamut of the Canon UVgel technology is large enough to simulate most relevant industry standards, as is shown in the graph below.

Color Volume (MPI2000)

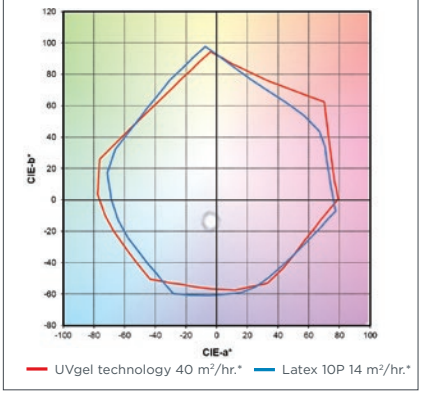
Color volume according to Profile Inspector V3.03



Color Gamut Contour of Maximum Chroma Colors + Tome Lines for Primary and Secondary Colors



Color Gamut Contour of Maximum Chroma Colors + Tome Lines for Primary and Secondary Colors



*1 square meter equals 10.7 square feet.

04
Measuring Canon UVgel Performance

Conclusion

UVgel color accuracy is well within Fogra target.

4.2 Colour Accuracy

Why it matters

When the color to be reproduced does reside in the color gamut of the printer, the next step is to check if the color accuracy of the system (controller, RIP, printer) is good enough to reproduce a color correctly. Color accuracy is a measure of how accurately a color can be reproduced.

The tests

We evaluated the color accuracy of UVgel and the Colorado 1640 against the Fogra 39 input profile.

Measurements were taken directly after profiling the printer.

Input profile : Fogra 39
Intent : Absolute
Printer profile : "Enhanced colors" and no color boost
Media : MPI2000 Avery Gloss White Vinyl
Measurement : D50, 2degr, M1 lighting

Patches are compared with Fogra 39 reference file (shown to the right).

The results

95% of all 1485 patches can be reproduced with an accuracy 2.33 dE00. This fulfills the requirement of 95% <3 dE00.

Fogra 39 Reference File

04

Measuring Canon UVgel Performance

Conclusion

UVgel color uniformity is well within Fogra target.

4.3 Uniformity

Why it matters

When printing certain colors, they should appear the same, regardless of where they are printed—ie, their position on the media or between two similar prints. This is most obvious when printing wall coverings: multiple tiles are printed consecutively, but will end up next to each other on a wall. There should be no color difference between them.

This performance criterion is called color uniformity: a measure of how reproducible the color is within one print. Color is measured on patches. (Note: Color variations due to banding or printhead artifacts are not considered in this analysis.)

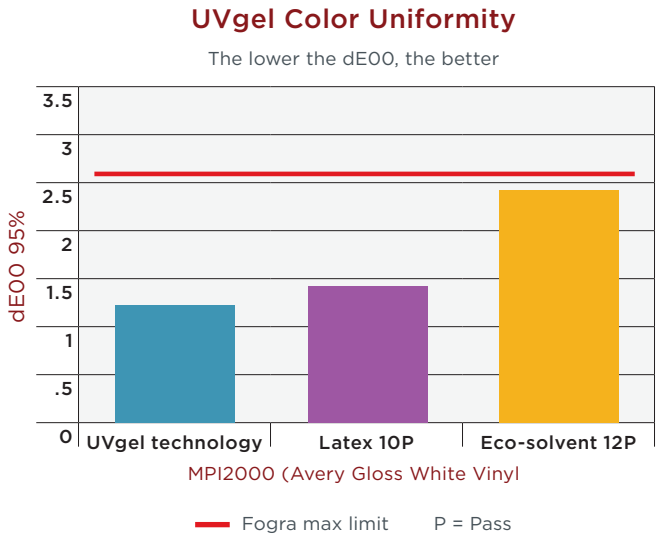
The tests

Nine targets were printed to Fogra specification on a meter-square sheet. The 90 percentile of the patches must have a dE00 of 3.0 or less.

The results

The graph below shows the results for a number of different types of media. The red line represents the Fogra specification. The lower the figure, the better the result.

The uniformity within a print is good, with 95% of all patches being reproduced with an accuracy of better than 1,24 dE00. This is also better compared to latex and eco-solvent.



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Measuring Canon UVgel Performance

Conclusion

The color repeatability of UVgel technology is very high and well within ISO 12647-8 criteria.

4.4 Repeatability and Colour Consistency

Why they matter

When a print is made, it is important to know the repeatability or consistency of the color reproduction.

The tests

We measured prints one hour and 24 hours after the reference print. Measurements were taken after profiling the printer.

Test file	: 1485 patch test chart ECI2002CMYK
Time interval	: 1 hour and 24 hours
Media	: MPI2000
Measurement	: D50, 2degr, M1 lighting

Patches were compared with Fogra 39 reference file.

The results

95% of all patches fulfill dE00 < 1,53. Moreover we can deduce from the measurement data that the ISO 12647-8 criteria are also matched: max. dE00 < 2,5 for solids CMYKRGB and max. dE00< 3 for midtones CMYK.

Fogra 39 Reference File

04 Measuring Canon UVgel Performance

4.5 Surface Tackiness and Smudge Susceptibility

Why they matter

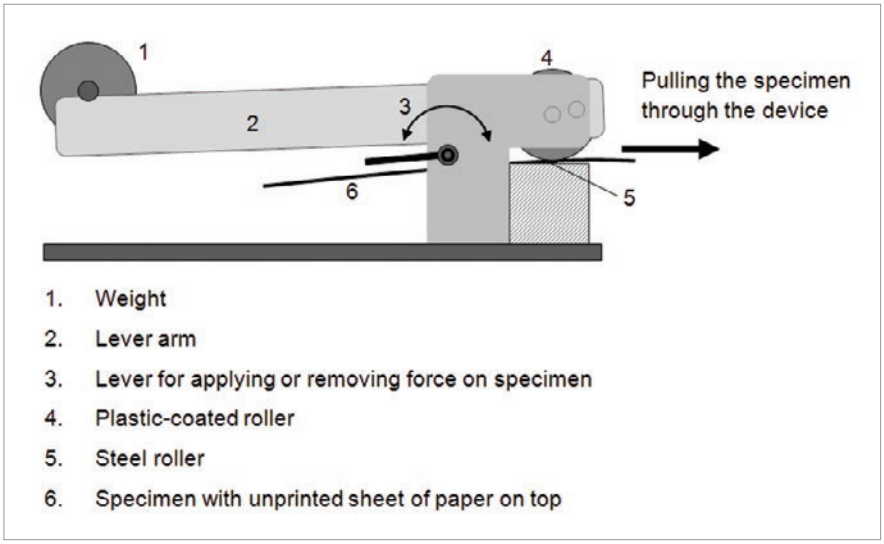
The sooner a freshly printed output can be handled, by finishing devices for example, the better. Ideally any waiting time should be avoided, in order to minimize turnaround time. The goal is to ensure that media can be handled and finished without the risk of distortion of the image or smudging on the winder.

In practice, many graphics applications require the ink surface to withstand mechanical load by, for instance, rubbing, stacking or winding.

The tests

The System Michael Huber München carboning tester (shown below) was used to quantify the tackiness of the ink top layer, which is an important factor in smudge resistance.

System Michael Huber München Carboning Tester



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Measuring Canon UVgel Performance

4.5 Surface Tackiness and Smudge Susceptibility

Conclusion

The UVgel printer fulfills the <0.025 requirement for all supported media.

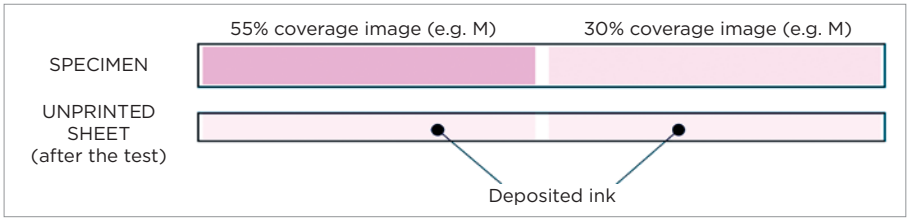
The test specimen was a strip partly printed with a coverage of 30% and partly printed with a coverage of 55%. An unprinted sheet of uncoated wood-free 80 gsm office paper was placed on top of the specimen and the stack of these two strips was pulled through the two rollers (shown below).

The optical density of the ink deposited on/transferred to the unprinted sheet was measured with a spectrophotometer. The optical density is the measure for surface tack/smudge. An optical density smaller than 0.025 (ie, hardly any transfer of ink) is considered to be sufficient to ensure post-processing and handling of the medium without risk of distortion of the image or smudging of the medium's rear surface on the winder.

The results

Canon UVgel fulfills the <0.025 requirement for all supported media. There is potential for higher values to be measured in the case of a medium with high roughness e.g. when fabric is used in banner media. There may be specific media that suffer from smudge susceptibility, but for most media smudging will be within acceptable limits.

Carboning Tester Results



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4.6 Print durability

Durability when subjected to external factors is critical for many applications, both indoor and outdoor, to ensure that the print is fit for purpose and maintains its quality and performance characteristics.

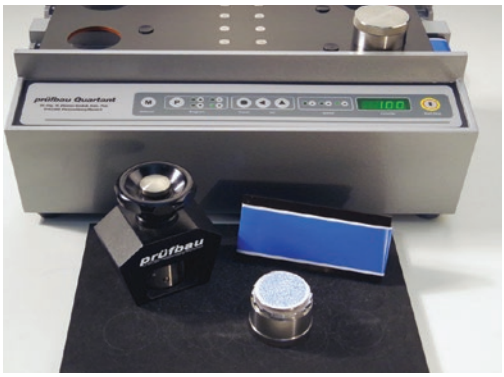
- Durability is defined as a combination of factors:
- Abrasion resistance
- Washability/scrubbability
- Lightfastness and weatherability

4.6.1 Abrasion resistance

Abrasion resistance is important in applications that are subjected to everyday contact, such as floor graphics, vehicle graphics or wall coverings.

The tests

To measure abrasion resistance, we apply the Prüfbau Quartant abrasion tester.



In the test the 200% ink areas of RGB were subjected to 1000 strokes against a defined counter paper. The abraded sample was judged on the following:

Color transfer to the counter paper according to ISO18947:2013 “Imaging materials — Photographic reflection prints — Determination of abrasion resistance of photographic images”

A visual assessment of the worn sample with regard to ink transfer and visible damage

Abrasion robustness, scale is 0–5 (see scale on page 31).

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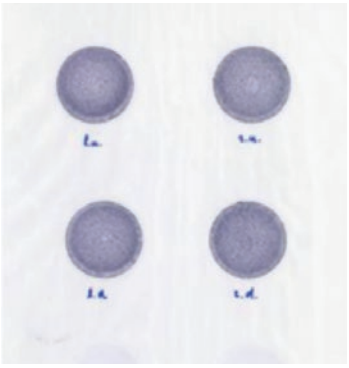
4.7 Abrasion resistance

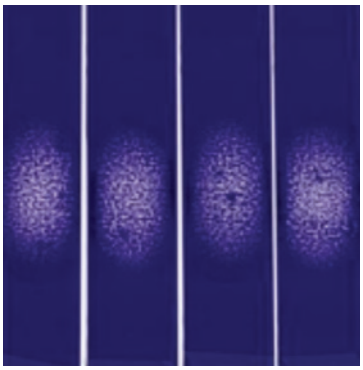
Conclusion

UVgel prints display the highest abrasion resistance.

The results

Bad results look like the images below:

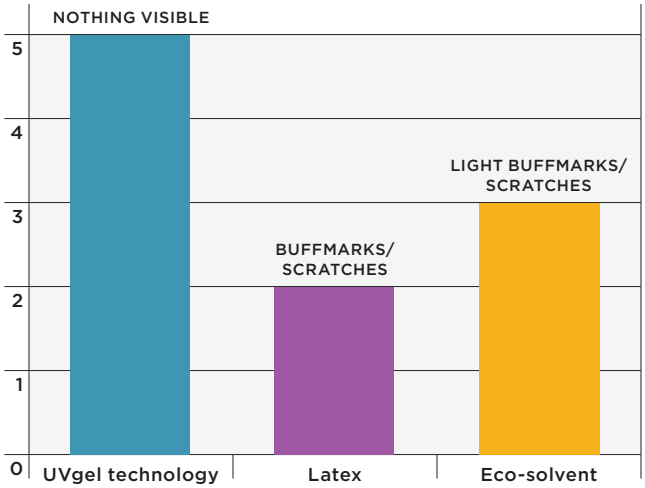




Note: Abrasion robustness has an impact on ink stretchability: the higher the abrasion robustness, the lower the ink stretchability. With Canon UVgel technology, the trade-off has been made in favor of abrasion robustness. As a consequence, vehicle wrapping around sharp edges (e.g., car mirrors) is not recommended.

We compared Canon UVgel technology with latex and eco-solvent, the chart to the right shows the outcome.

Print Durability Abrasion Resistance Test Results



Measured on the abrasion robustness scale, 0–5

0 = white media visible
1 = strong buff marks/scratches
2 = buff marks/scratches
3 = light buff marks/scratches
4 = visible under angle
5 = nothing visible

04 Measuring Canon UVgel Performance

Conclusion

In benchmarking tests, UVgel prints demonstrate excellent vv washability compared with latex and eco-solvent prints.

4.6.2 Washability/scrubbability

Printed products, wall coverings for example, need to be cleaned from time to time. Washability/scrubbability is also part of the EN233 classification for commercial wall covering products.

Figure 1: Elcometer 1720 Washability Tester

The tests

Washability/scrubbability of the ink/media combination is determined according to NEN-EN 12956/NEN-EN 259-1 including extra scrubability using the Elcometer 1720 Washability Tester (Figure 1). This is also known as the Timperley test.

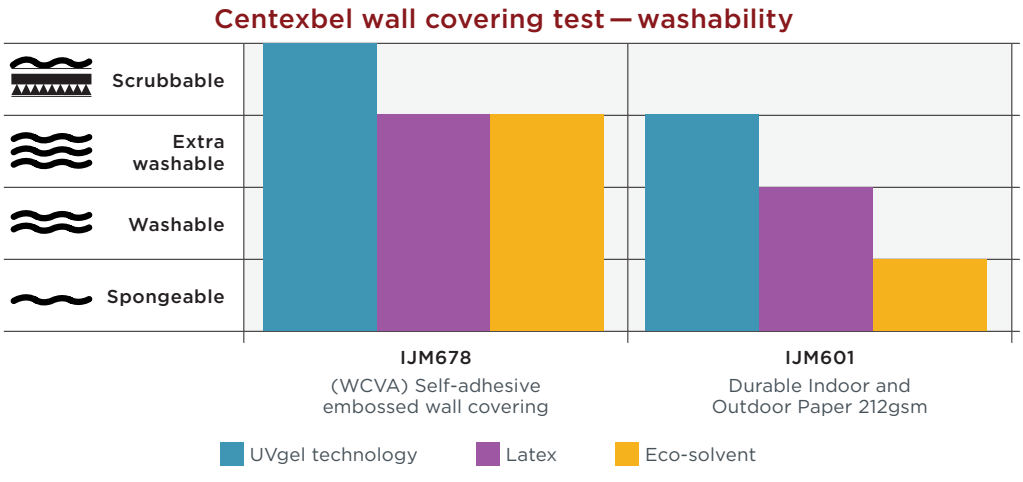
The following measurements were performed:

TEST PART	Rubbing Head	Reagent	Cycles	Speed (c./Min)
Spongeability	Sponge (polyether foam)	Distilled water	20	30
Washability	Felt (97% wool fiber)	Soap solution	30	120
Extra washability	Felt (97% wool fiber)	Soap solution	100	120
Scrubbability	Brush (polyamide 6.6)	Abrasive paste	30	30
Extra scrubbability	Brush (polyamide 6.6)	Abrasive paste	100	30

The results

The results are compared visually after each test on a typical test pattern as shown in Figure 2.

Figure 2: Test results



04
Measuring Canon UVgel Performance

Conclusion

UVgel shows excellent lightfastness and weather resistance.

4.6.3 Lightfastness and weatherability

Light, water, and heat are the most critical factors with respect to image degradation of outdoor prints, so it is important to determine the resistance of printed output to these influences.

The tests

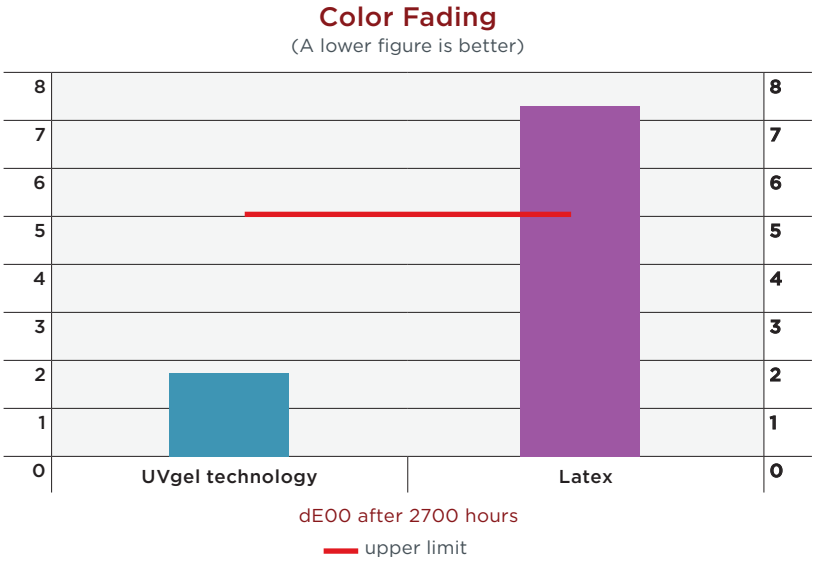
We used an accelerated testing cabinet, like the one shown below, to produce faster results, as the current ink technologies have multi-year resistance.

Lightfastness Testchart CMYK (v2)

The test target was measured at regular intervals using a spectrophotometer. From this data the color difference in dE was charted and judged on the visibility of color change (dE00) after 2700 hours.

The results

The chart below compares the performance of UVgel with that of latex technology. Usually dE 5 is considered the maximum color difference acceptable.



05
UVgel And The Environment

Introduction

Any new technology must clearly demonstrate sound environmental credentials. This is especially important in sensitive environments such as hospitals, schools and other public places. We, therefore, measured UVgel's performance in three key areas:

- VCL (Vinylcaprolactam)
- HAPs (Hazardous Air Pollutants)
- Odor

05
UVgel And The Environment

5.1 VCL-free ink

VCL (vinylcaprolactam) is a compound that has traditionally been part of inks. Most ink manufacturers plan to replace VCL with safer components. Canon UVgel ink is free of VCL.

5.2 HAPs

HAPs (Hazardous Air Pollutants) are a collective name for a group of 187 specific substances that are toxic.

TNO is a the Netherlands-based organization for applied scientific research, a well-respected and independent nonprofit knowledge organization, that certifies products and services and issues an independent evaluation of quality). TNO has performed extensive testing of preliminary emissions both from the Canon UVgel print technology and from the prints produced on it. They have concluded that no HAPs are emitted by the printer or the prints.

This means that working under normal condition with Canon UVgel technology and handling UVgel prints cannot expose the operator or the end customer to HAPs.

5.3 Odor

Indoor application of large format prints — wall coverings, for example — requires that the prints be odorless.

Measuring odor is, by its nature, a subjective rating involving a panel of people. For Canon UVgel, a panel of resellers and PSPs was asked to evaluate the prints. They unanimously judged the prints to be odorless.

UVgel technology is applying for all major indoor certifications, such as AgBB and Greenguard GOLD, which will allow prints to be used in sensitive environments such as hospitals and schools.

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