

## KPI Comparative Lab Test Report

NOVEMBER 2018

# Canon imagePROGRAF PRO-4000

vs. HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer

Advantage ✓	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Image Quality	✓	
Print Productivity	✓	
Ink Consumption	✓	
Direct Print Submission Functionality	=	=
Device Feature Set		✓
Print Driver Feature Set	✓	
Printhead Reliability/Cleaning Routines	✓	

## TEST OBJECTIVE

Keypoint Intelligence - Buyers Lab was commissioned by Canon Europe to conduct confidential document imaging device performance testing on the Canon imagePROGRAF PRO-4000 and the HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer, and produce a report comparing the relative strengths and weaknesses of the two printers in terms of image quality, productivity, ink consumption, direct print submission functionality, device feature set, driver functionality, and printhead stability and cleaning routines. All testing was performed in Buyers Lab's European test facility in Wokingham, UK.

## Executive Summary

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The Canon imagePROGRAF PRO-4000 had the overall advantage in Buyers Lab's graphic arts lab evaluation, delivering superior image quality, lower ink consumption in two of the three test scenarios, and a formidable productivity performance. The PRO-4000 had a clear speed advantage in all speed tests and modes, making it the more productive choice for high-resolution environments such as photographic studios as well as being well suited for medium-resolution work such as signs and posters. Both models' printheads performed reliably throughout the evaluation. However, while the Canon model's printhead did not experience nozzle clogging issues when powered off over a weekend, the HP model's printhead did suffer issues and required a clean cycle to rectify.

Image quality produced by both 44-inch printers in High/Best quality mode, was entirely congruous with the standard expected of models that are designed for technical, photographic and graphical printing applications. Both devices delivered highly accurate colour reproduction, consistent skin tone colours and smooth halftone coverage in both colour and black. However, the Canon model delivered superior image quality, overall, with better fine detailing in dark contrast areas, more natural-looking, smoother skin tones and more vibrant colours on photographic images. Text and fine line reproduction surpassed that of the HP model, as well, exhibiting none of the overspray that was observed on the HP unit's output. Both models exhibited an equally low Delta E colour drift of 2.9 when FOGRA39 colour patches were compared before and after their respective productivity and ink consumption tests.

The Canon PRO-4000 features Canon's hallmark productivity-boosting hot-swap ink tank design, which lets users replace empty inks while the device is still actively printing. In contrast, when the HP DesignJet Z9+dr runs out of ink, printing has to stop for the cartridge to be replaced, which leads to operator downtime. However, the HP model's device feature set is stronger overall; it comes with a higher 500-GB hard drive (a 320-GB hard drive is available with the Canon PRO-4000) and higher memory, to aid job processing and job storage. It comes with an inline XRite i1 Spectrophotometer to provide more precise colour management control. While the Canon PRO-4000 does not offer this as an option, the device comes with standard calibration features for calibrating the printer not only with the manufacturer's own-brand of genuine paper, but also with other media brands. The HP model's V-Trimmer functionality provides additional benefits of being able to trim most media supported on the Z9, including HP Artist and Professional Matte Canvas and Scrim Banner, and allows borderless output on all sizes and media supported. Both models offer a dual-roll unit design; the HP unit has an Auto Take-Up Reel as an optional extra, while the PRO-4000's dual-roll system operates with auto take-up.

The Canon PRO-4000 offers a richer driver feature set. It comes with a unidirectional print driver option to eliminate banding on image output even when printing in Fast mode, offers a greater number of media profiles, as well as a flexible layout nesting option to help users save on paper. The HP model features HP Professional PANTONE Emulation, which allows users to create and print a swatchbook of multiple PANTONE colours and see how the printer will reproduce them on selected media. For added flexibility and convenience for workers who travel between sites or work remotely, both printers offer robust direct print submission functionality and support for mobile printing, as well as direct printing of JPEG and PDF files from a USB flash device (with TIFF files also supported on the HP model), providing additional convenience to walk-up users.

All things considered, the Canon PRO-4000 had the advantage in Buyers Lab's large-format evaluation delivering faster productivity, lower ink consumption overall, a stronger driver feature set, and better image quality.

## Image Quality

Advantage ✓	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Text	✓	
Fine Lines	✓	
1x1 Pixel Grid	✓	
Halftone Range	=	=
Halftone Fill	=	=
Solid Density	=	=
Colour Drift across FOGRA39	=	=
Consistency of three skin tones	=	=
Consistency of neutral grey	=	=
Photographic Images	✓	
Colour Gamut	=	=

+, – and O represent positive, negative and neutral attributes, respectively.

- O Buyers Lab’s image quality test evaluation was conducted using Canon’s Semi-gloss Photo 280gsm media and HP’s proofing Semi-gloss Satin media, with quality set to High on the Canon model and the HP model set to Best.
- + As would be expected of two models aimed at the Graphic Arts (GA) marketplace, both units delivered a very high standard of output in colour appropriate for any poster and photo printing application. However, the Canon PRO-4000 delivered superior quality overall, with finer detailing in dark contrast areas and better depth of field.
- + The Canon model produced clearly formed and pin-sharp serif and sans serif fonts in both black and colour down to the smallest 3-pt. type size with no bleed observed. Although, the HP model also delivered dark sans serif and serif fonts in colour and in black that were legible to the 3-pt. type size, its characters weren’t defined as well as those from the Canon model as there was some overspray when viewed under magnification.
- + The Canon PRO-4000 delivered very good vertical and horizontal fine lines down to 0.1-pt size in both black and colour; fine lines produced by the HP model were slightly inconsistent and displayed minimal overspray and were rated good.
- + The Canon PRO-4000 produced smooth and clean circles that were judged very good. Circles produced by the HP unit exhibited some stair-stepping and so rated only fair in colour and good in black.
- + The Canon unit produced the CMY and black-on-white 1x1 pixel grids in High quality mode with no quality issues; the HP model delivered intact 1x1 pixel grids, as well but with slightly inconsistent dot formation in Best quality setting.
- O Both models delivered colour and black halftone output across the full range—from the 10% to the 100% dot-fill levels—with distinct transitions between all levels.

- Both models delivered an impressive range of halftone fills in colour mode, with no banding or graininess issues. Neutral greyscale halftone coverage was equally good from both units.
- The Canon PRO-4000 produced higher optical densities for yellow and black, while the HP unit produced higher cyan and magenta optical densities.
- The production of three different skin tone colours yielded fairly consistent results for the Canon model. And, although the HP unit displayed a slightly greater variance with two of the three skin shades, this would not be considered significant enough to be discernible to the naked eye.
- Neutral grey consistency was maintained well by both models, with an equally low variance across the page indicated by low Delta E values.
- During Buyers Lab’s colour drift analysis, in which the FOGRA39 media wedge is submitted to print before and after productivity and ink consumption tests, and measured using EFI Color Verifier software, both models displayed the same mean Delta E drift of 2.9. (The PRO-4000 tested was a pre-production model with a pre-matured mechanical structure, so results with production devices may differ).
- When printing on photo media in highest quality settings, both models produced colour gamuts of a comparable size—804,574 CIE volume for the Canon PRO-4000 versus 801,831 CIE volume for the HP model.
- + Buyers Lab technicians analyzed a wide range of colour and greyscale images output by both devices and found them to be of an exceptionally high standard. The HP model’s greyscale images displayed ‘truer’ neutral greys aided by its grey ink. However, the Canon PRO-4000 delivered better quality overall, with more vibrant colours and superior fine detailing in light and dark contrast areas, while output from the HP Z9 was slightly darker and therefore suffered from a loss of integrity in dark contrast areas.
- + The Canon PRO-4000 produced very good natural-looking skin tones in photographic images, with good definition in the light contrast areas and smooth tonal transitions; in contrast, the HP unit produced skin tones that were wan and yellowish.

## Print Productivity

Advantage ✓	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
First Print Out From Ready State Portrait Printing	✓	
First Print Out From Ready State Retail Poster Printing	✓	
Throughput Speed A1 Portrait Printing	✓	
Throughput Speed A1 Retail Poster	✓	
Throughput Speed A0 Portrait Printing	✓	
Throughput Speed A0 Retail Poster	✓	

- Productivity evaluation is based on Standard/Normal and High/Best modes only. Although both models offer a faster productivity mode, it was not tested due to the inferior (but entirely sufficient for internal use) image quality produced in Fast/Draft mode given that this is a graphic arts models’ assessment.
- + When printing a single high-resolution portrait, the Canon PRO-4000 was faster than the HP Z9 model in terms

of speed of the first-print-out from ready state. In Standard/Normal, the PRO-4000 was 35.6% faster than the HP Z9+dr, and it was 31.6% faster in High/Normal mode when compared with the HP model.

- + When printing a single medium-resolution retail poster from ready state, the Canon PRO-4000 was faster in the two tested modes. The Canon unit delivered its output with speeds that were faster by 8.3% in Standard/Normal mode, and 12.1% in High/Best mode when compared with the HP device.
- + In Buyers Lab's A1 throughput speed evaluation, the Canon model's per-page speed was 28.4% faster than the HP model when printing five copies of a single-page A1-size high-resolution portrait test document in Standard/Normal mode. In High/Best mode, the PRO-4000's per-page speeds were 25.8% faster when compared with the HP model.
- + When printing five copies of a single-page A1-size medium-resolution retail poster test document, the Canon model delivered its output with per-page speeds that were faster by 23.5% in Standard/Normal mode, and 16.5% in High/Best mode when compared with the HP DesignJet Z9.
- + In Buyers Lab's A0 throughput speed evaluation, the Canon model's per-page speeds were faster than those of the HP model when printing five copies of a single-page A0-size high-resolution portrait test document in all tested modes. It was 9.2% faster in Standard/Normal mode, and 23.7% faster in High/Best quality mode when compared with the HP model.
- + When printing five copies of a single-page A0-size medium-resolution retail poster test document, the Canon model delivered its output with per-page speeds that were faster by 24.8% in Standard/Normal mode, and 24.5% in High/Best mode when compared with the HP DesignJet Z9.
- Buyers Lab technicians conducted a selection of productivity tests on the HP DesignJet Z9+dr with the onboard V-Trimmer feature enabled. This was to gauge whether the V-Trimmer had an impact on the HP model's speeds compared to its performance without using the V-Trimmer. The results showed there was a slowdown in performance when the V-Trimmer was employed. For example, its per-page speeds increased by 23.37 seconds when printing five copies of a single-page A1-size high-resolution portrait test document with the V-Trimmer employed in Normal mode when compared with its result without using the V-Trimmer.

## Ink Consumption

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Buyers Lab technicians observed that, owing to the vagaries of inkjet technology (for example, head flushing and calibration routines can occur at any time during testing), the same test can produce different results at different times. Although Buyers Lab makes every effort to ensure that devices are tested on a level playing field, the test results should be regarded as an indicator of likely performance and not as a prediction of actual ink consumption in a real-world environment.

### Overall Weight of Ink Used (in Grams)

	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Packaging Proof	146.1	223.0
Retail Sales Poster	123.0	87.1
Studio Portrait	139.7	189.9

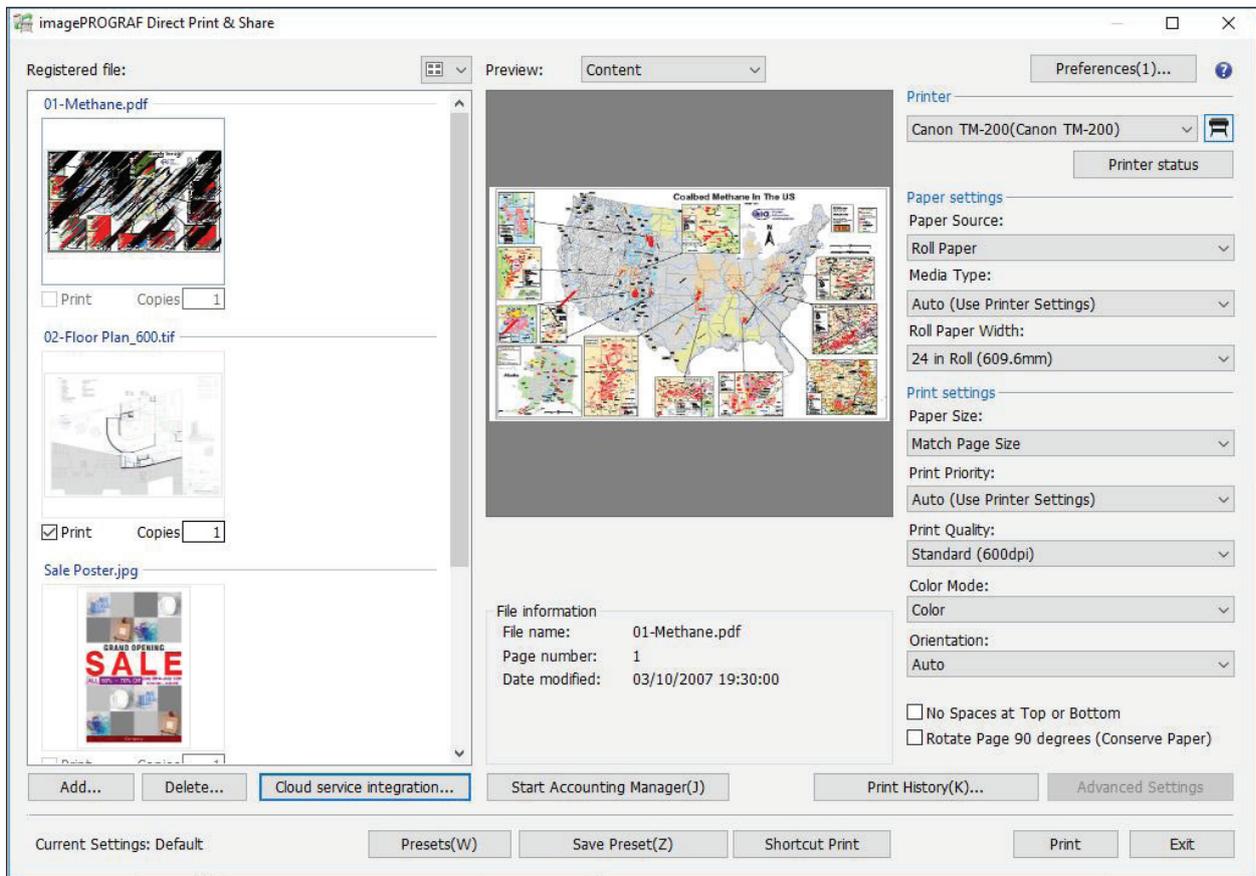
Results are averaged across three sets of 50-page A1 printing in Standard/Normal mode.

- + When printing Buyers Lab’s Packaging Proof test target in Standard/Normal mode on semi-gloss proofing media, the Canon PRO-4000 used 34.5% less ink in terms of net weight than the HP Z9.
- When printing Buyers Lab’s Retail Sales Poster test target in Standard/Normal mode on matte coated media, the Canon unit used 41.2% more ink than the HP DesignJet Z9 did.
- + When printing Buyers Lab’s Studio Portrait test target in Standard/Normal mode on semi-gloss photo media, the Canon unit used 26.4% less ink than the HP Z9 did.

## Direct Print Submission Functionality

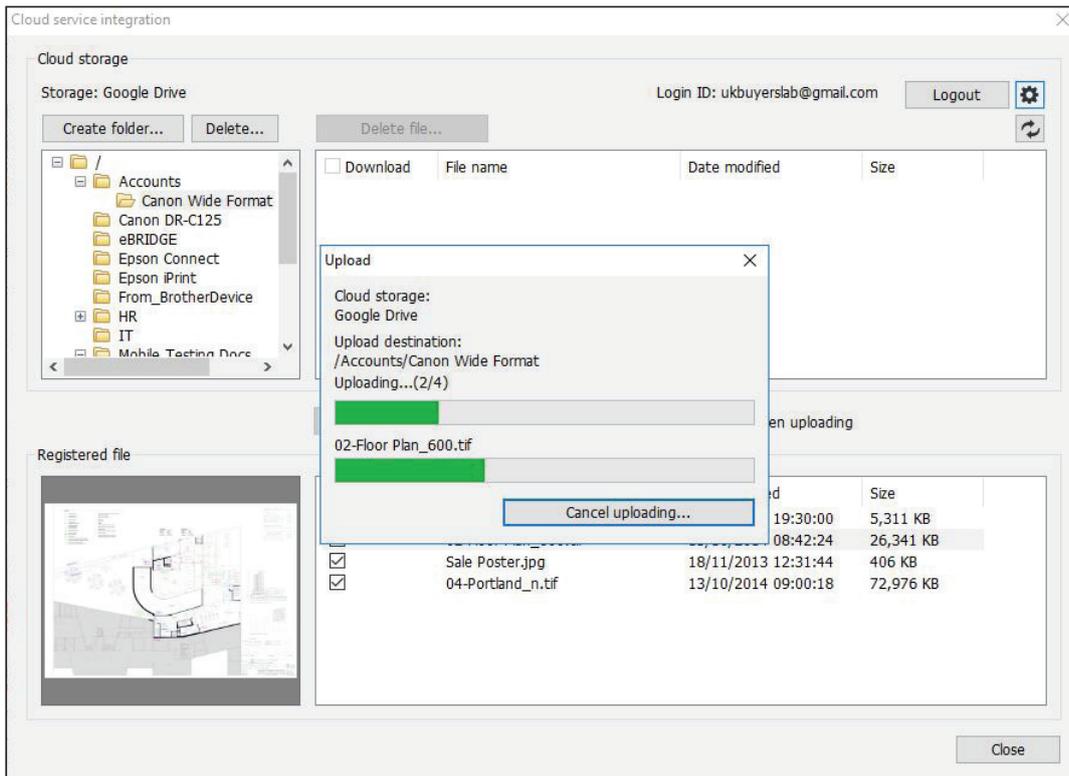
Advantage ✓	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Ease of Use	=	=
Direct Print Submission Functionality	=	=
Mobile App Integration	=	=

- Available as a free download from Canon’s website, the newly enhanced imagePROGRAF Direct Print & Share utility enables the direct printing of PDF, JPEG, TIFF and HPGL/2 files without the need for native applications or print drivers. Via the utility, users can preview print layouts and select print settings without the need to open up the driver properties. For added convenience, the utility provides thumbnail previews of multiple print jobs and users can modify and print multiple files simultaneously.

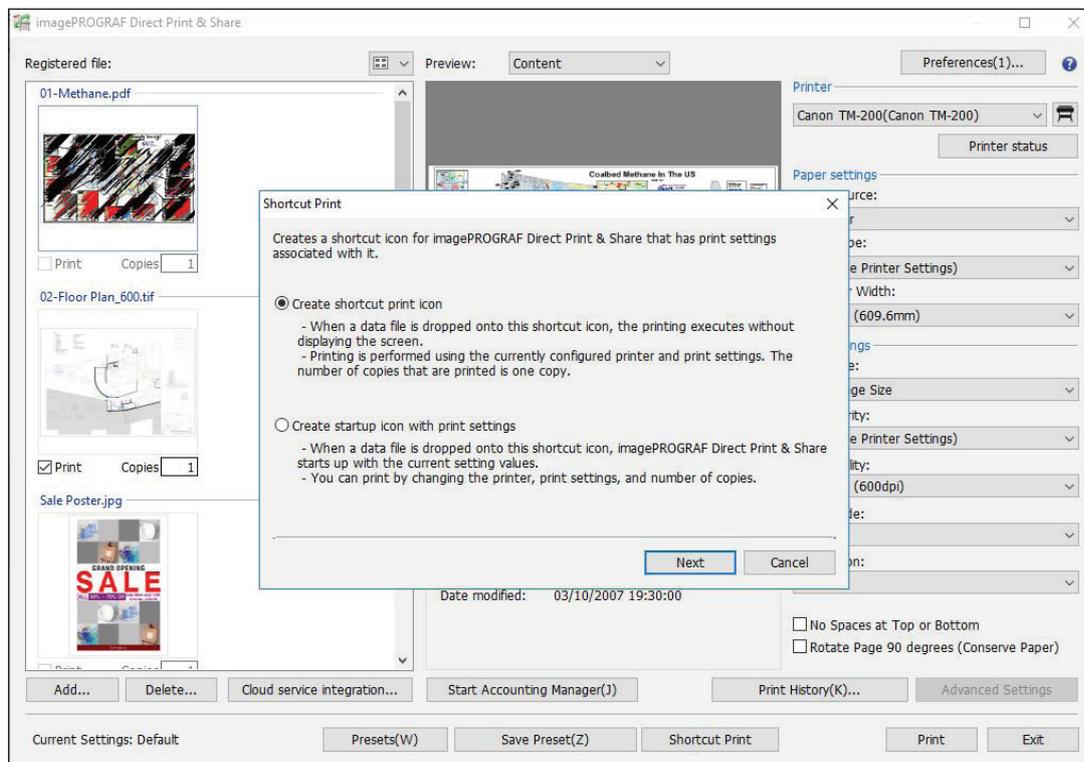


**Canon’s imagePROGRAF Direct Print & Share utility provides users with an image preview. Users can maximize the utility’s window to obtain a larger preview, which enhances usability.**

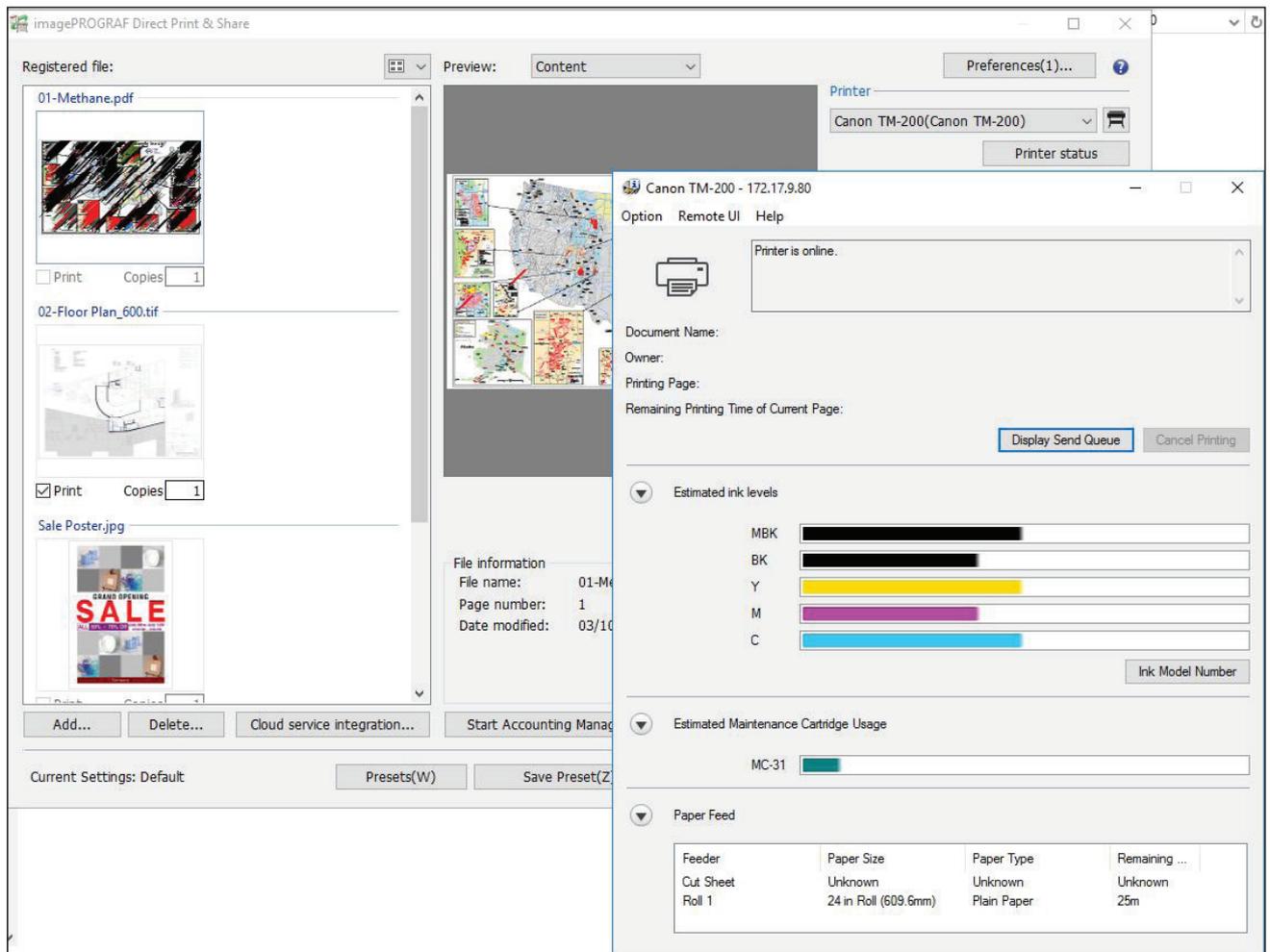
- The imagePROGRAF Direct Print & Share utility supports “Shortcut Print” functionality, enabling users to create a desktop shortcut that includes commonly used print settings, including output printer, print quality, paper type and paper size. Akin to a hot folder workflow, files are automatically printed with the predefined settings when users drag-and-drop the files to the desktop icon. Multiple desktop icons can be created that contain different print settings or combinations of print settings. In addition, users can register and save new job presets in the utility to expedite daily routine workflows.



**imagePROGRAF Direct Print & Share lets users retrieve files from as well as upload files to Google Cloud for easier collaboration.**

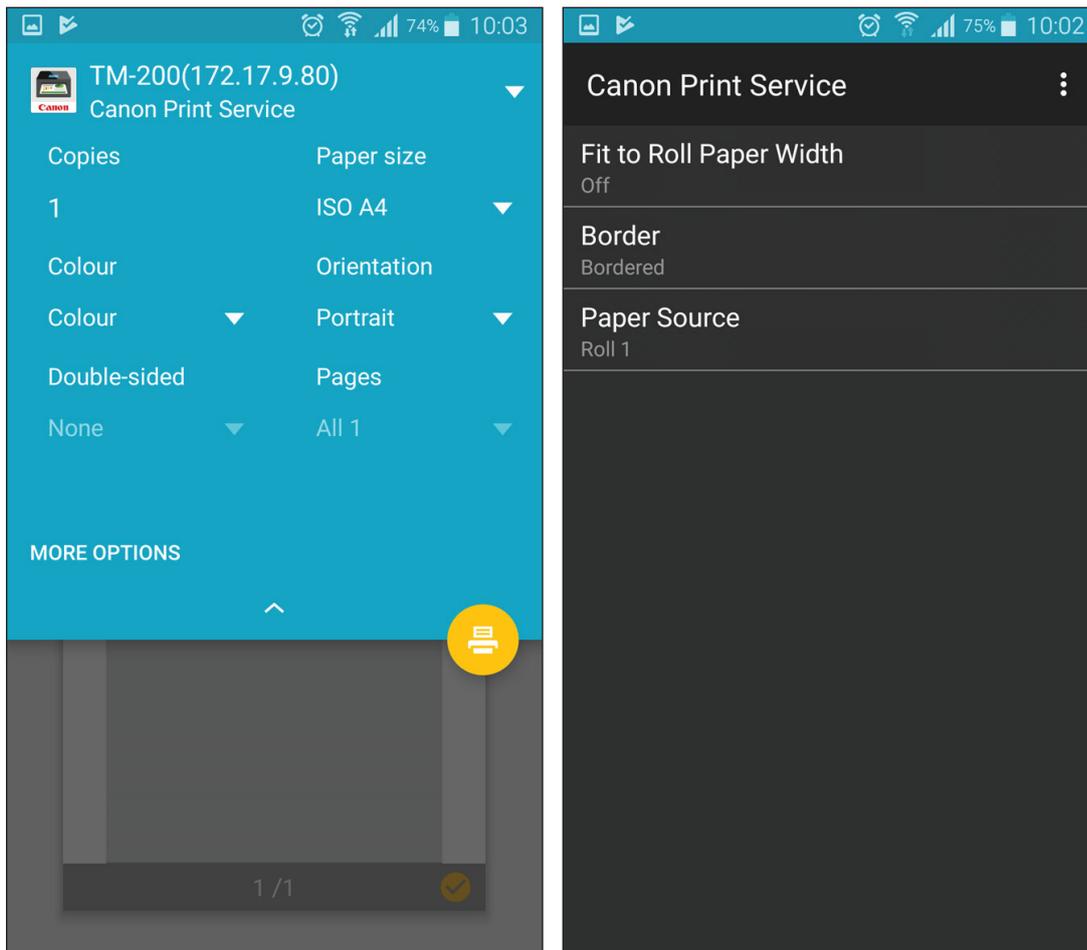


**To help standardize and streamline common print workflows, users can register and save job profiles in the utility as well as create desktop shortcuts that allow drag and drop automatic file printing with predefined print settings.**



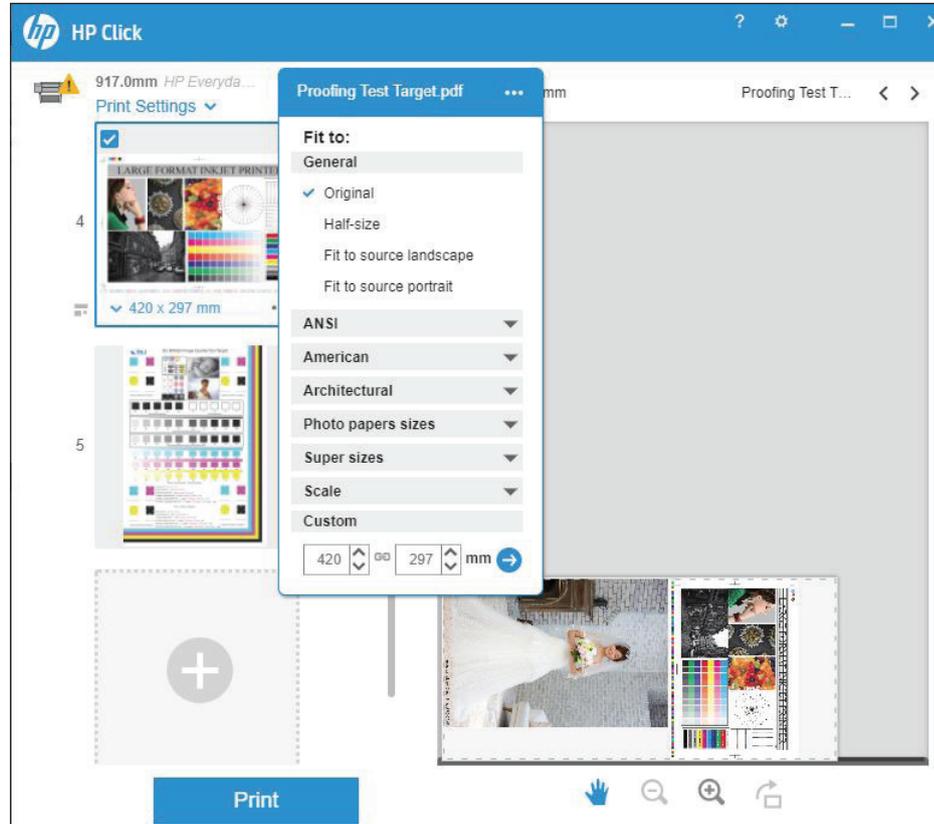
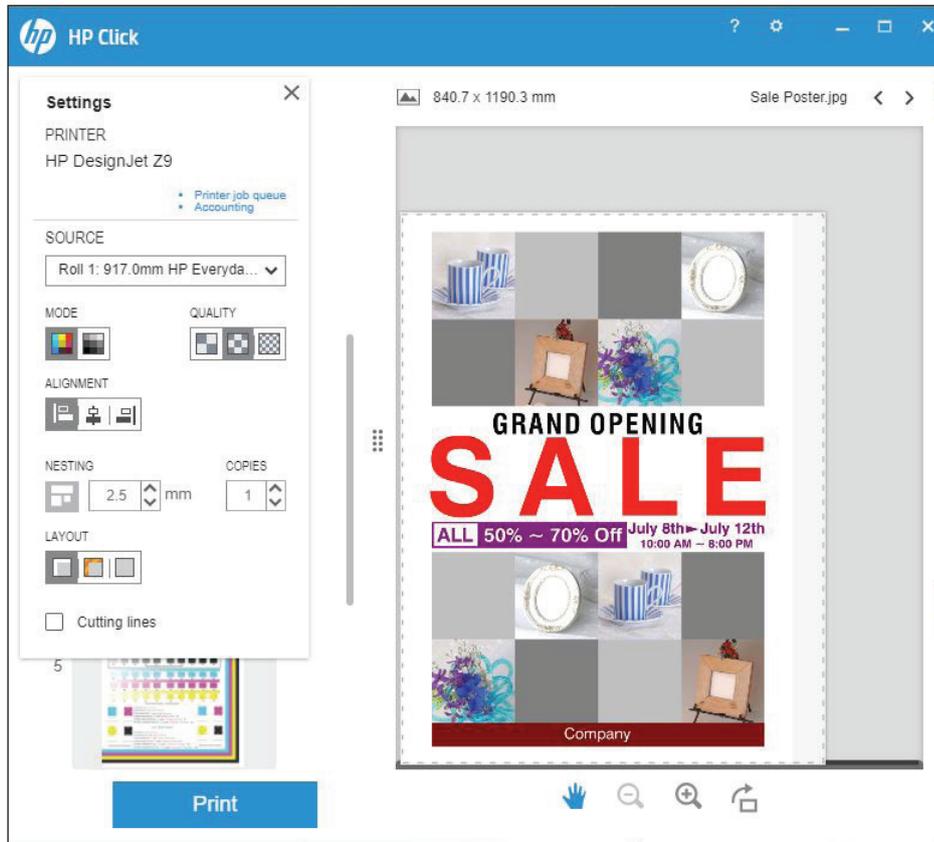
**Conveniently, users can view device and consumables status via the utility before sending jobs to print.**

- Users can download stored files from Google Drive and AutoCAD 360 cloud storage services for printing via the Canon imagePROGRAF Direct Print & Share utility. Files can be uploaded directly to cloud storage as well. For added convenience and collaboration, the utility offers the option to share files simultaneously with one or more users (via Google Drive only), who will receive an email notification with a link to download the shared file without the need to log in.
- Additional benefits provided by imagePROGRAF Direct Print & Share include quick and easy printing of jobs selected from the print history log using the same settings as when last printed; the ability to view device and consumables status via a link to Status Monitor; and the option to insert a divider sheet in between jobs when outputting multiple files simultaneously for easier identification.
- The free Canon Print Service (CPS) mobile print plugin lets Android users print wirelessly to the PRO-4000 as well as other compatible Canon printers on the same WiFi network. Conveniently, the service automatically detects compatible Canon printers, offers a broad range of print settings, and is very straightforward to use. For iPad users, PRO Gallery Print is a free dedicated mobile app for Canon's PRO series, that lets users print JPEG files stored on their iPads, or via photographers' web services such as SmugMug and Zenfolio.



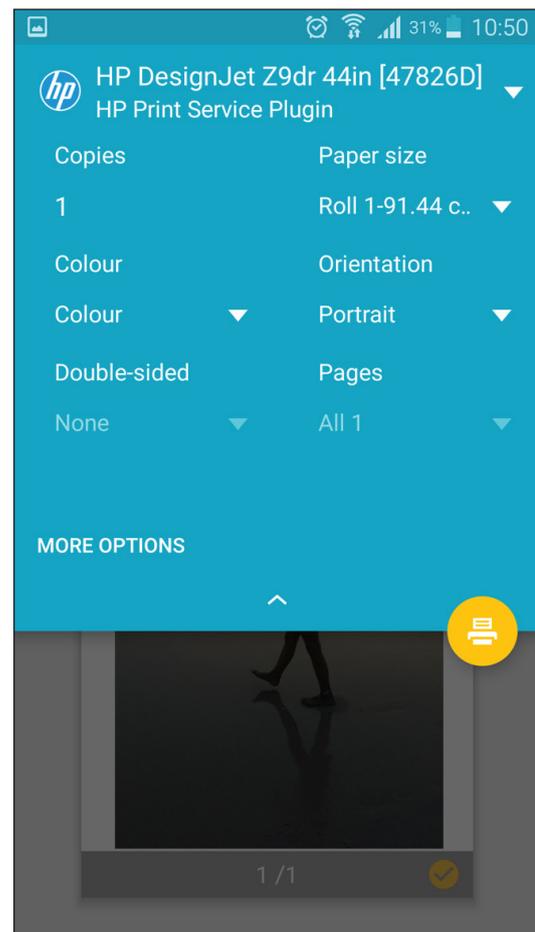
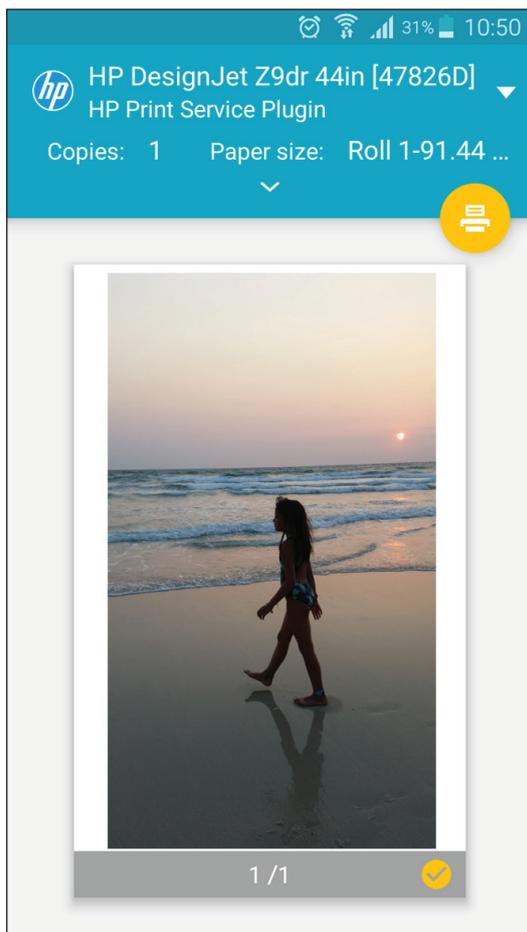
**The Canon Print Service mobile print plugin is an easy way for Android users print to the PRO-4000 and other compatible Canon large-format printers, and offers a broad range of print settings, including colour, orientation, and borderless printing.**

- Similar to Canon’s utility, HP Click printing software, which is also available as a free download, enables direct printing of PDF, JPEG, TIFF and HPGL/2 files from the PC desktop, without the need for native applications or print drivers. Here, users can preview, resize and align images without the need to open up the driver properties. The utility also has an automatic nesting feature to reduce waste, and with select printers (including the HP DesignJet Z9), users can access printer and print job status information via a link to the printer’s embedded web server.



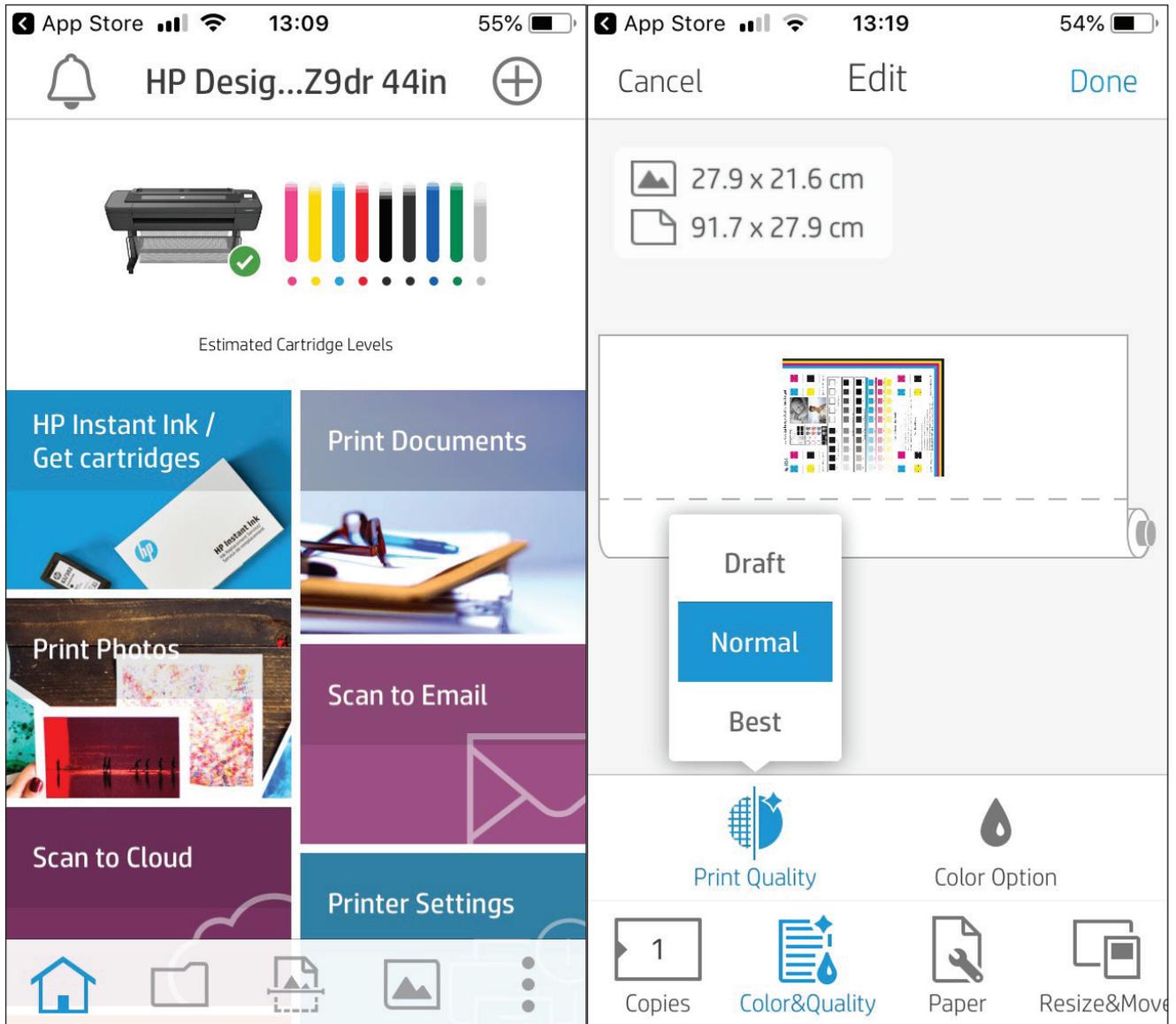
**Via HP Click, users can select basic print settings, preview images, manipulate images as well as utilize the automatic nesting feature to reduce paper waste.**

- The HP Mobile Printing service allows users to print directly from an iOS or Android smart device to a compatible HP large-format device. Unlike the previous version (ePrint & Share), users do not need to create an account in order to access direct print functionality, instead, the mobile device quickly pairs with the printer via a wireless network connection or by Wi-Fi Direct for direct job submission. Android users have an added step, however, of downloading and enabling the free HP Print Service Plugin app, which is available from Google Play, before being able to access the HP Printing service. Users can print a wide selection of file formats such as Microsoft Office documents, as well as PDF, JPEG and TIFF files. Whether a file is stored locally on the device, in a cloud service account, or sent as an email attachment, the user just needs to open the file and select the Share option, which then allows them to send the job to their preferred HP printer.



**The HP Mobile Printing service enables Android (shown above) and iOS mobile devices to pair with the HP Z9 and other compatible HP devices easily. Users can retrieve files from cloud storage, preview images and perform image adjustments.**

- Users also have the option of printing from their Apple iOS and Android smartphones and tablets via the HP Smart mobile app (formerly known as HP All-in-One Printer Remote app). This free mobile printing app lets users scan documents directly to their mobile device; retrieve, print, or upload files to a variety of cloud storage services such as Dropbox, Box, Google Drive and Evernote; and monitor printer status. A broad range of document editing options are available through the Preview function, as are a multitude of print settings.



**The HP Smart App (formerly known as HP All-in-One Printer Remote app) is a free mobile printing app that allows users to print, scan, share and store documents from their device to compatible HP output devices.**

- In addition, the HP Z9 supports HP ePrint functionality, whereby users are able to send print jobs remotely by email either via a workstation PC or a mobile device; PDF, TIFF and JPEG files (up to 10 MB) are supported.

## Device Feature Set

- + The HP DesignJet Z9+dr employs ten inks, which include Chromatic Red, Chromatic Blue, Chromatic Green, and (optional) Gloss Enhancer, while the Canon PRO-4000 employs 12 inks, including two black and two grey inks. The fact that the Canon inks are replaceable during operation helps to reduce downtime for Canon users. HP's cartridges cannot be replaced during operation.

- + The Canon PRO-4000 offers three replacement ink cartridge capacity options—130 ml, 300 ml and 700 ml—for all colours, whilst the HP Z9+dr only offers 300 ml for all colours.
- + The Canon unit's ink delivery system dispenses a 4-picoliter drop size for all colours, while the HP DesignJet Z9+dr model dispenses two drop sizes: 7/3-picoliter dual drop weight (M, C, PBk, CB, and G) and a 6-picoliter drop size for yellow, chromatic red, chromatic green, and matte black.
- + The Canon model offers easy user-friendly media loading options at the top front of the device. For the HP DesignJet Z9+dr, however, media rolls are loaded at the rear, which, if the basket is open, makes it a more cumbersome process as the operator may need to lean further over the device. If it is positioned against a wall, the operator will have to move it in order to load the second roll, which is located directly underneath the first roll at the rear of the device.
- The Canon PRO-4000 supports borderless printing regardless of what roll media is being used, whilst the HP Z9+dr supports this feature only with select media. However, when the V-Trimmer feature is enabled, the HP model supports borderless output on all sizes and media.
- The Canon device includes a media mismatch option, which holds jobs that can't be printed due to incorrect media being loaded, while jobs that can be completed are printed; the queued jobs are printed once the required paper is loaded. In the event of a media mismatch on the HP device, users are provided with a warning directly in the print driver before the job is submitted, and a control panel warning appears after it is submitted. The control panel's "Paper mismatch action" allows users either to put the job on hold or print it; all jobs that are slated for the paper types that are already loaded will be printed without delay.
- Both units utilize user-replaceable printheads, which take less than five minutes to replace on both models.
- + Both models support Gigabit Ethernet connectivity, but the Canon PRO-4000 also offers a wireless interface (not matched by the HP Z9+dr with V-Trimmer).
- Both devices have USB ports, enabling walk-up users to print from USB flash drives (PDF and JPEG files supported, with TIFF files also supported on HP model) and helps aid document portability.
- The HP Z9+dr 44 inch with V-Trimmer model comes with an inline XRite i1 Spectrophotometer as standard, for automated colour management and verification—an option that's not offered with the Canon model.
- However, the Canon PRO-4000's standard calibration feature enables users to calibrate Canon media, as well as other media brands. Moreover, administrators can control colour and monitor the calibration status across the whole PRO-1000/2000/4000 series via Canon's free Device Management Console utility to ensure colour consistency among all Canon devices. HP users can also track and control colour consistency across multiple devices via HP PrintOS Color Beat functionality, which is part of HP PrintOS a cloud-based print production management system that includes multiple online and mobile apps to help HP customers better manage their operational environment.
- The Canon model offers a standard, non-upgradable RAM capacity of 3 GB, while the HP unit has a standard non-upgradable RAM capacity of 4 GB (includes virtual memory).
- The HP Z9+dr comes with a standard built-in 500-GB hard drive, which allows for the storage of commonly used documents and aids spooling workflow. The Canon PRO-4000 comes with a standard 320-GB hard drive.
- For maximum convenience and minimum downtime, the both models offer the advantage of a dual-roll design as an option, giving users the added flexibility of switching between different media types or sizes without having to reload the media each time.
- + The PRO-4000's optional Multifunction Roll System can also act as an auto Take-up-Roll unit with bi-directional rewind, which could be an extremely valuable feature in high-volume production environments, enabling large numbers of prints to be conveniently stored on a single roll. This is also available but as an extra cost option for the HP device.

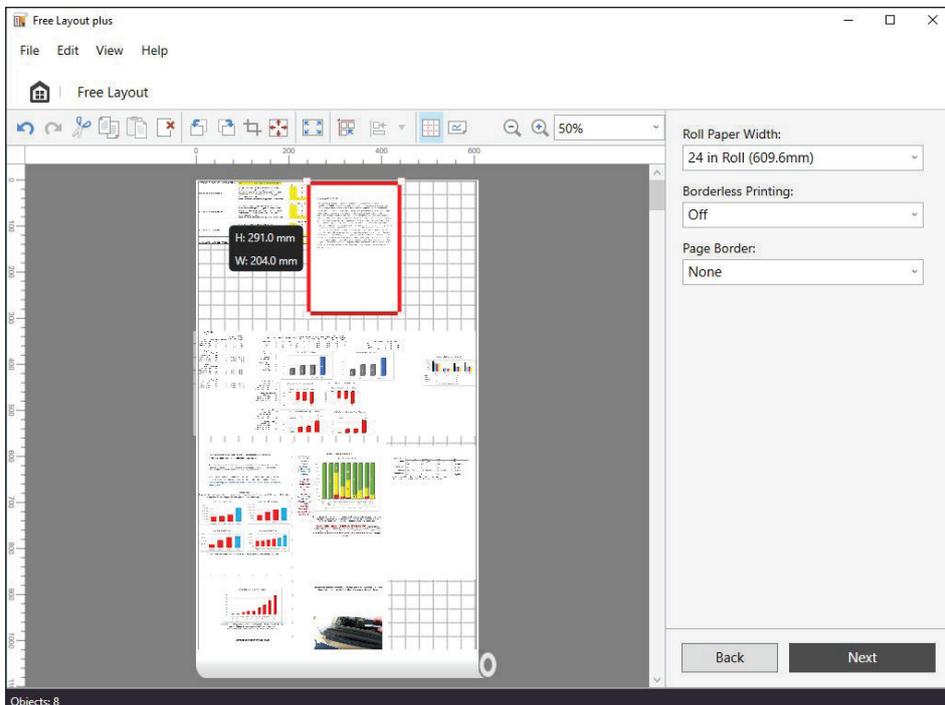
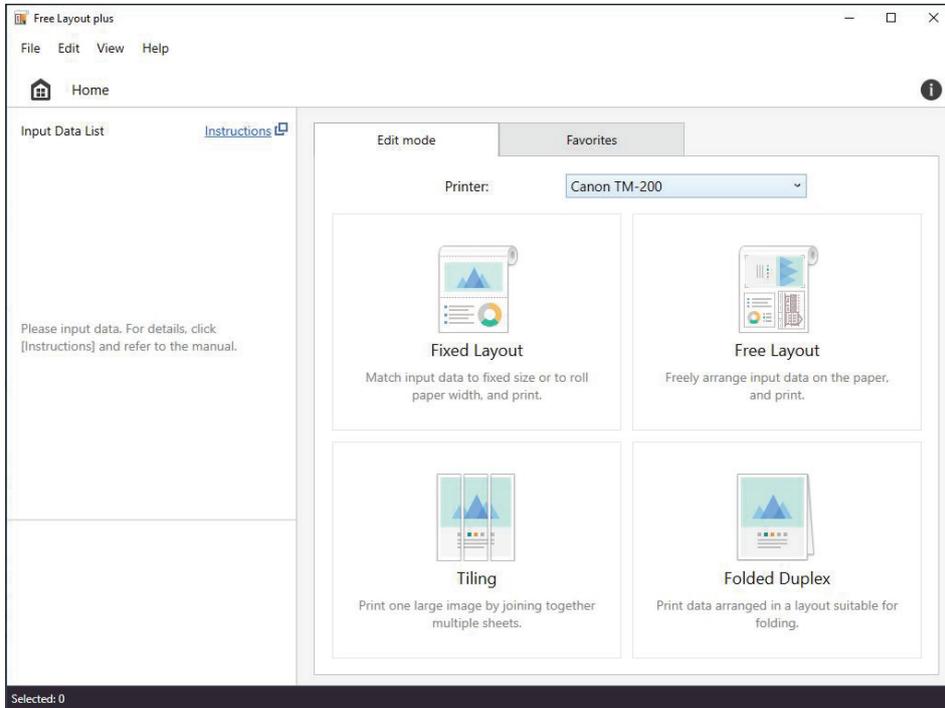
- The output catch baskets of both models are very simple designs which collect output from media rolls in a random order.
- While the Canon model is slightly heavier (123 kg versus 98 kg) than the HP Z9+dr unit, it is more compact with a width of 1,593 mm versus 1,802 mm for the HP Z9+dr.
- Both models offer a colour touchscreen user interface; while the PRO-4000 offers a much smaller screen, both operations panels are similarly responsive and intuitive to navigate.
- The Canon PRO-4000's power consumption while active is higher—123 watts versus 100 watts—than that of the HP model.
- + However, in standby mode (where it may spend more of its time) the Canon model's power consumption is lower (1.8 watts versus HP Z9+dr's <32 watts).
- Rated noise emissions while the devices are printing are 48 db for the Canon model and slightly lower for the HP Z9+dr (42-45 db).

## Print Driver Feature Set

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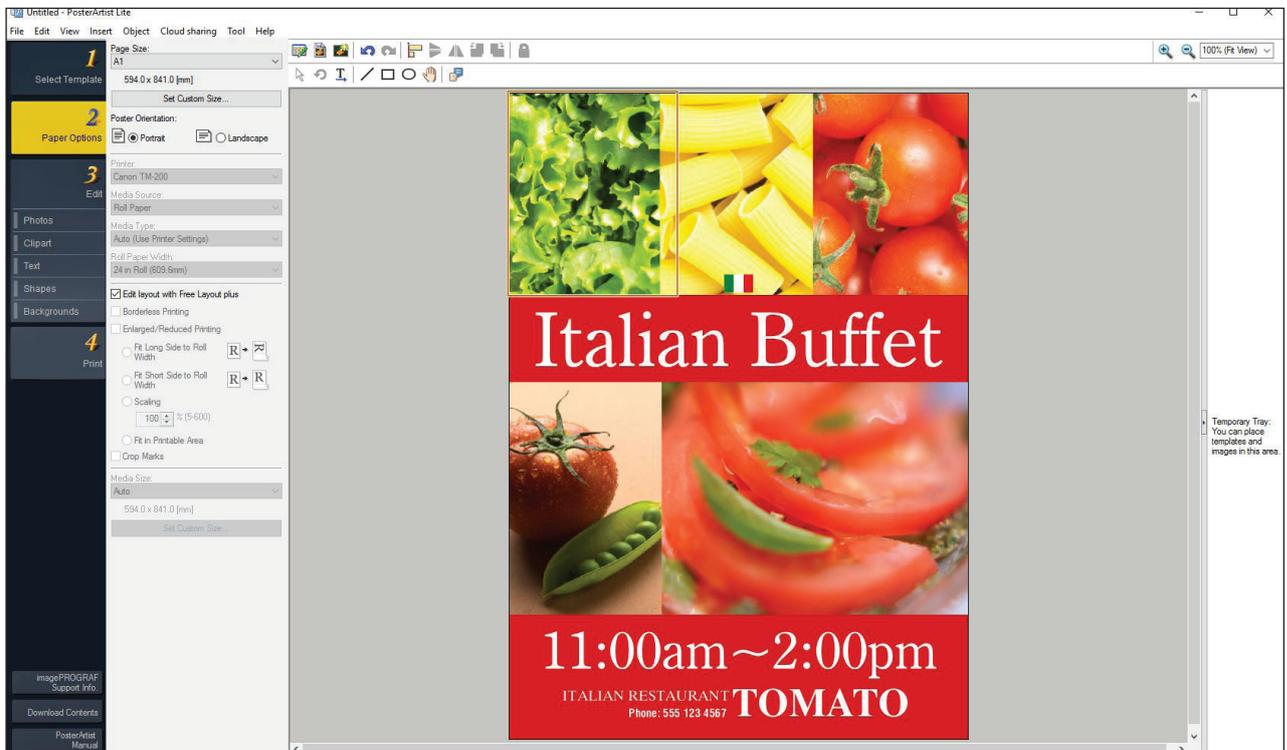
- + The Canon PRO-4000 has five speed settings, although not all speed settings are available with all media types. In contrast, the HP device has three settings (Fast, Normal and Best).
- + The Canon driver includes 51 media profiles, versus 35 for the HP driver.
- + The Canon driver includes a watermark capability; the HP driver does not.
- + The Canon driver offers N-up printing (up to 16), which is not supported by the HP unit.
- + Poster printing capability (2 x 2) is offered only by the Canon model, as is page-stamping (date, time, user-name and page number); neither feature is available with the HP driver.
- + The Canon driver offers unidirectional printing, even in Fast mode, which helps to eliminate banding across output because the printhead travels in only one direction to create the desired image. The HP driver does not offer this feature.
- The Canon driver contains advanced colour-matching capabilities, including the ability to match ICC profiles and select the rendering intent based on different elements in the document. The HP Color Center Utility offers the HP Easy Profiling feature, which enables users to build custom ICC colour profiles and embed them in the HP Z9 printer. Users can also re-profile existing media as well as new, third-party media.
- HP Professional PANTONE Emulation is a noteworthy feature that allows users to create and print a swatchbook of multiple PANTONE colours and see how accurately the printer will reproduce them on selected media. Canon does not offer such a feature.
- The Canon driver includes a utility, Colour imageRUNNER Enlargement Copy Mode, which allows users to integrate a Canon MFP or other scanner with the PRO-4000. Documents scanned by the Canon MFP are automatically routed to a hot folder, which is monitored by the PRO-4000 driver. Users can also set up other scanners to route files directly to the hot folder. The image is then resized and printed, offering a fast, easy-to-use poster creation tool for office users.
- + Canon's Free Layout plus software enables files—even those created with different applications—to be scaled, resized, or grouped together as a single job from the printer driver. Images can be dragged and dropped to the desired locations and printed together on a single page, helping to save on paper. The HP unit offers a

similar nesting feature, which can be activated directly on the control panel or from the print driver utility, or when using HP Click. However, unlike the Canon tool, it does not allow users to have precise control over the positioning of jobs, rather it will randomly position jobs to print across the width of a page, either in the order they were submitted or in 'optimized' layout order.



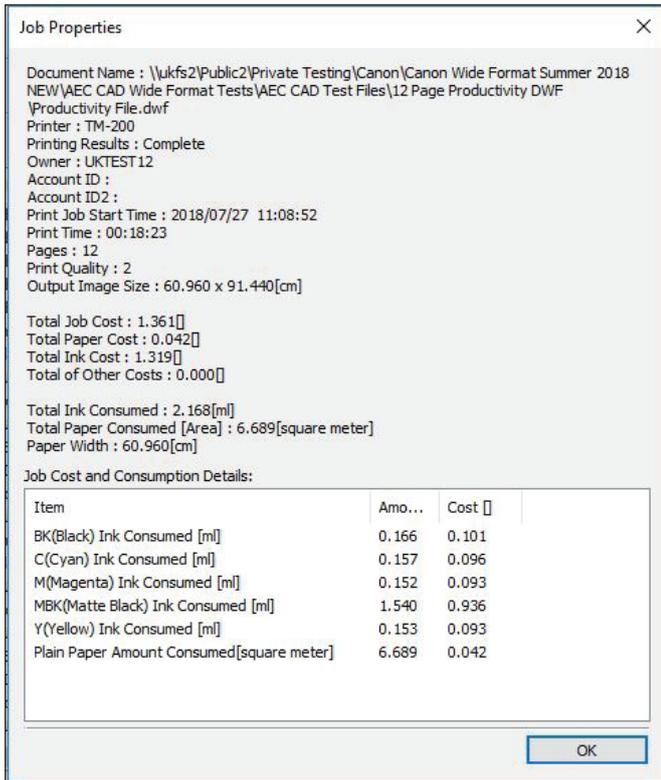
**Canon's Free Layout plus allows users to arrange documents from different applications on a page to use paper more efficiently. Within the utility, any two pages can be arranged for double sided printing so that they are oriented correctly when folded after printing.**

- + The Canon model also offers a plug-in for printing from Microsoft Office applications, which includes useful tools for automatic media resizing, nesting and borderless printing. No such plug-in is available to HP users.
- Canon offers a Print Studio PRO plug-in which offers support for a variety of software options designed to appeal to specific segments of the Graphic Arts market such as photography and fine art display. These include a print plug-in for Photoshop, which, according to Canon, allows users to print 16-bit files directly from Adobe RGB with a wide gamut and clear tonal gradation, and a plug-in for DPP (Digital Photo Professional) that includes a 'Digital Lens Optimizer' to improve photographic image quality and enhance depth of field; Adobe Lightroom is also supported. Print Studio Pro has additional functions allowing users to add text to the photos; choose black and white photo mode, and save favourite settings among others.
- The Canon model includes PosterArtist Lite, Canon's software for creating posters and signage in simple steps. The full version of Canon PosterArtist, available as an option, offers more advanced features such as auto design, variable data printing, in-application editing features, plus additional templates, photos and clip art. HP users can create posters via a redesigned poster application in the HP Applications Center (which also includes creative tools such as Adobe Stock, Unsplash, Vecteezy, and Pattern Design) and print them via HP Click.



**Canon's PosterArtist Lite is an easy-to-use poster creation tool; newly-enhanced, it provides additional templates to create multi-language versions of a poster, 900 common expressions in 10 languages and a wide range of pictographic icons.**

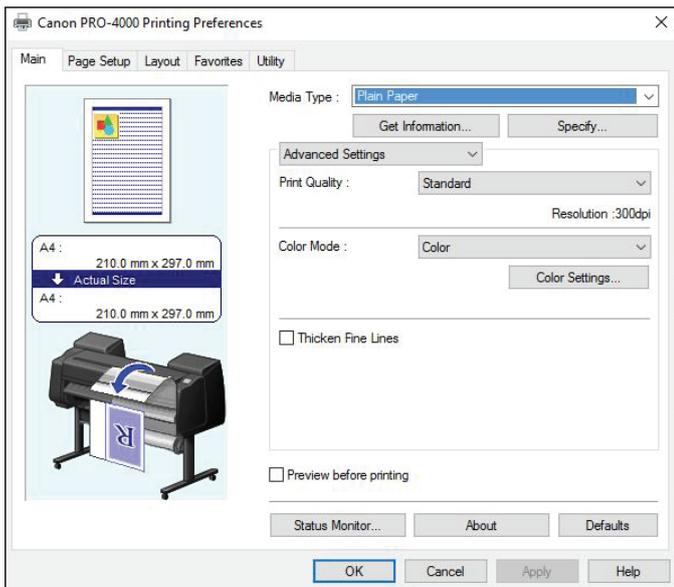
- + Available for the PRO series, Canon's Accounting Manager can be downloaded for free from Canon's website and offers comprehensive accounting management for all print jobs. Users enter the actual costs for individual inks and media types, and the cost per job is calculated automatically and displayed. For each job, the media type, area, ink used and total print time are listed, and more detailed cost and consumption information can be obtained by double-clicking on an individual job name or by highlighting a range of different jobs. Job cost information can then be saved in .CSV format and opened in Excel. There is no equivalent tool for the HP Z9.



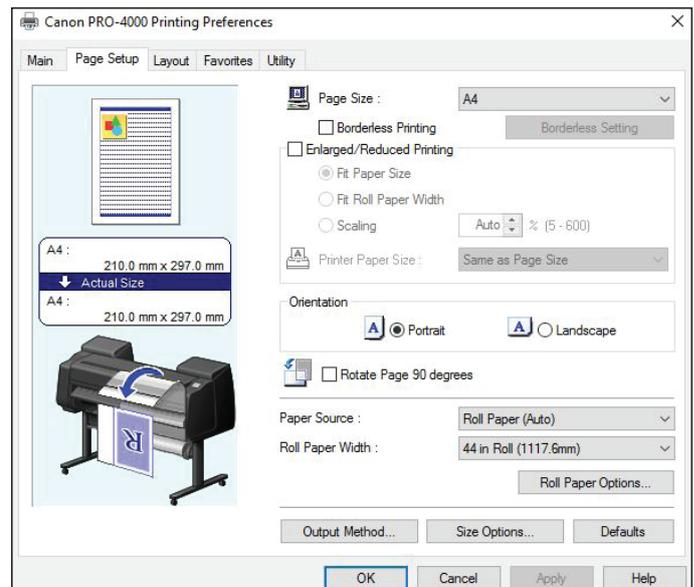
Canon Accounting Manager; users can double click on a job to view a breakdown of the individual costs.

## Test Models' Print Driver Screenshots

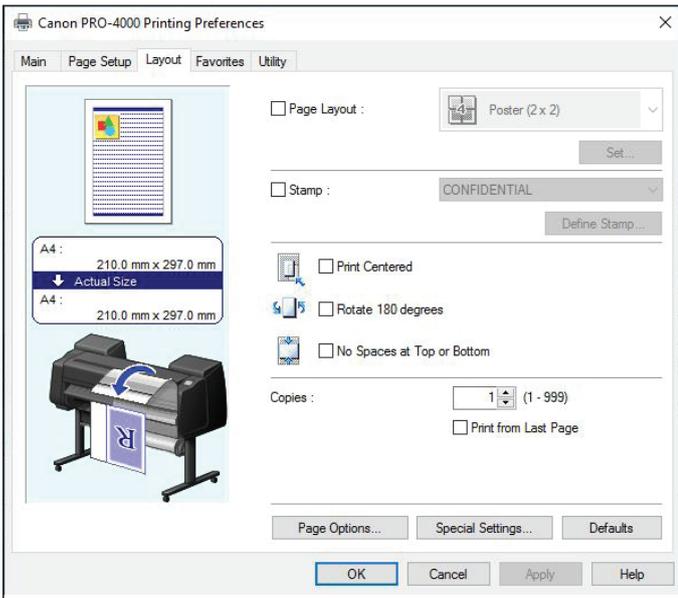
Note: Due to performance issues related to the HP model's HPLG/2 driver (version available at the time of testing), the PCL 3 for Windows with Modern Apps driver was recommended as the replacement.



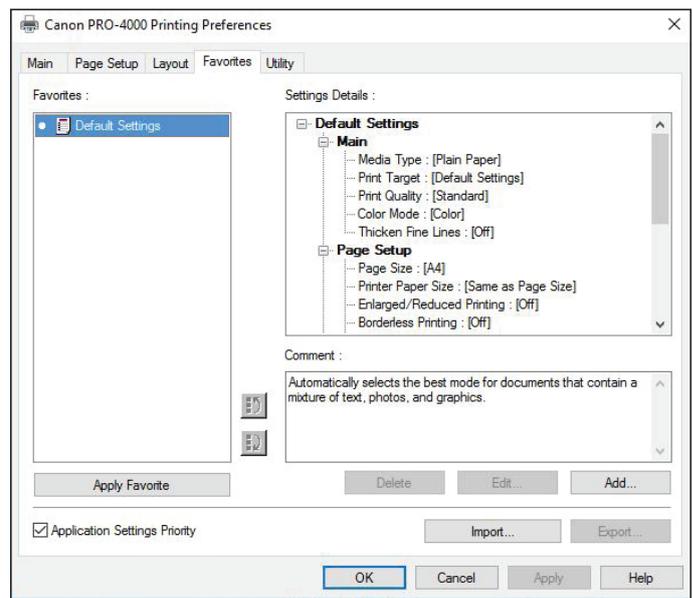
Canon imagePROGRAF PRO-4000 Main Tab



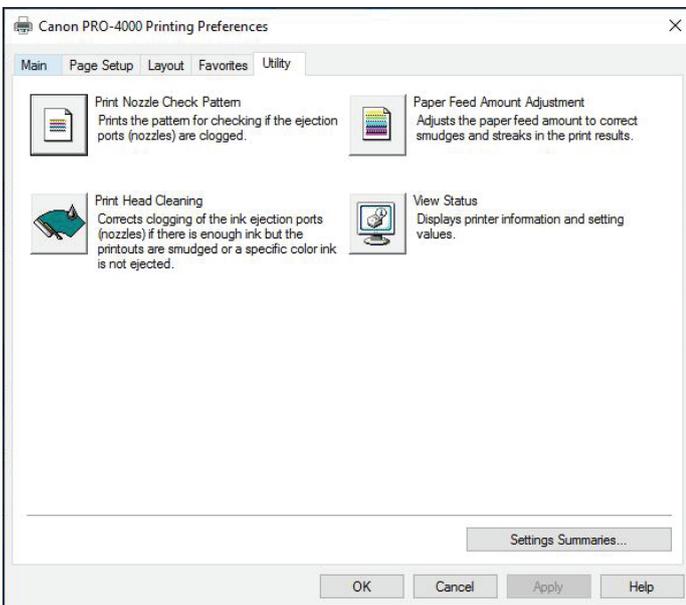
Canon imagePROGRAF PRO-4000 Page Setup Tab



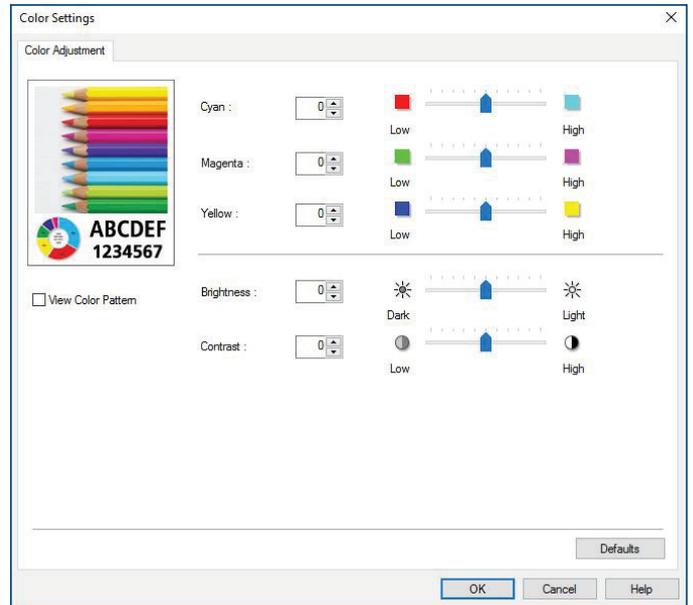
Canon imagePROGRAF PRO-4000 Layout Tab



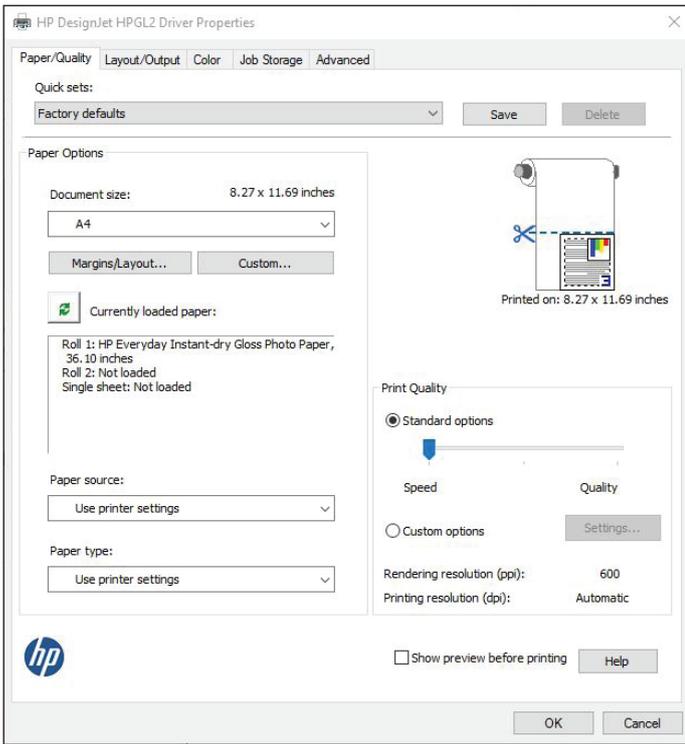
Canon imagePROGRAF PRO-4000 Favourites Tab



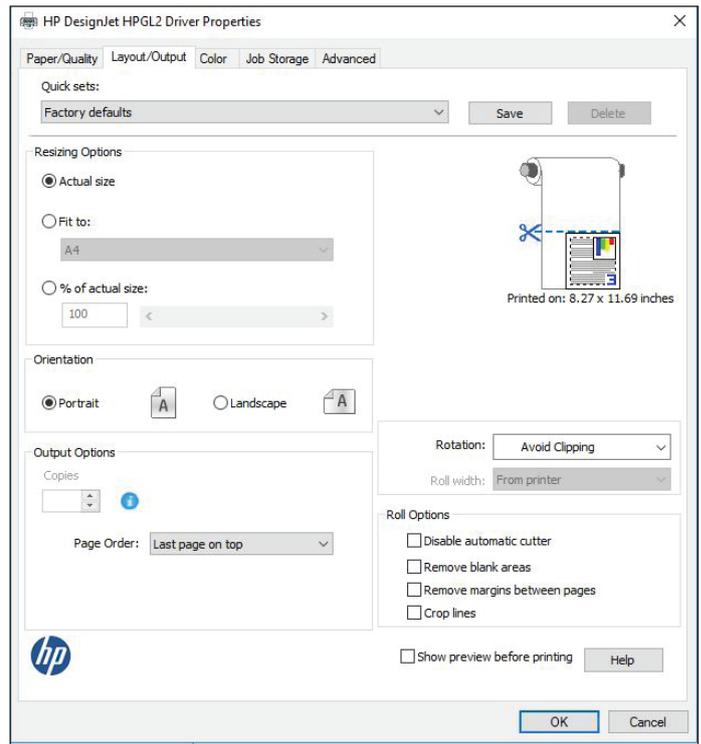
Canon imagePROGRAF PRO-4000 Utility Tab



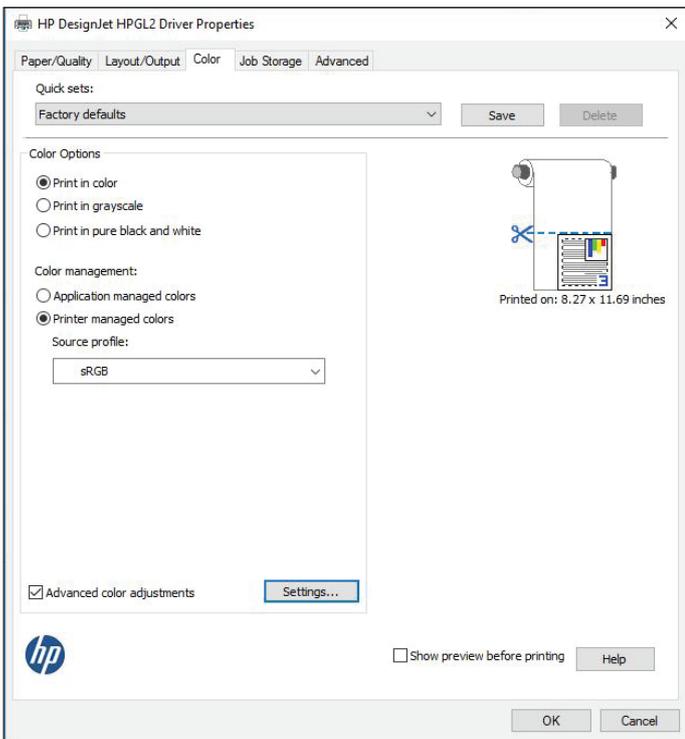
Canon imagePROGRAF PRO-4000 Colour Adjustment Settings



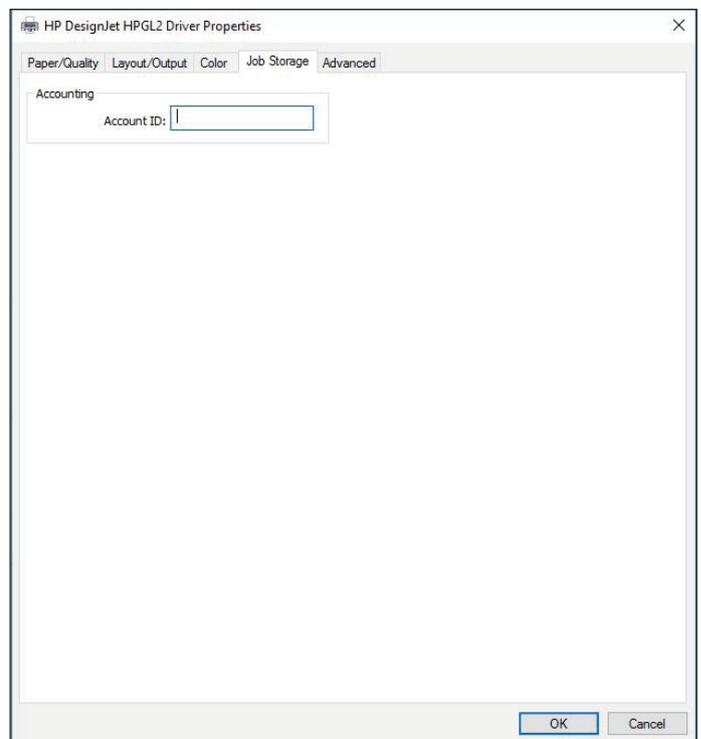
HP DesignJet Z9+dr Paper/Quality Tab (HPGL/2)



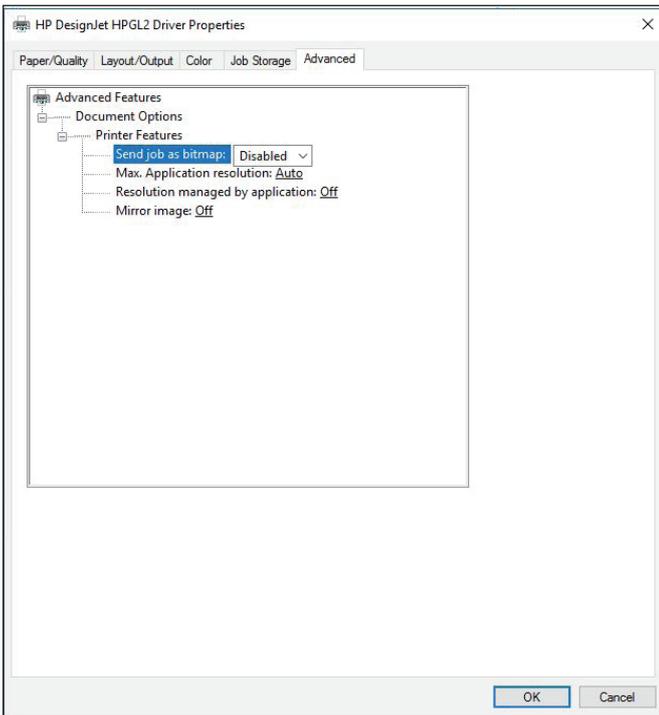
HP DesignJet Z9+dr Layout/Output Tab (HPGL/2)



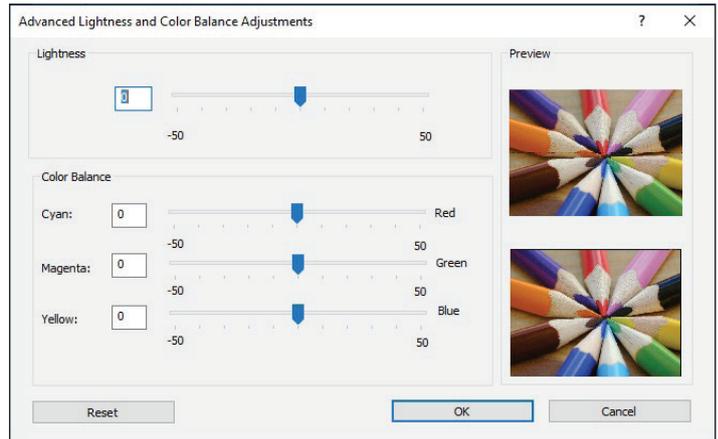
HP DesignJet Z9+dr Colour Tab (HPGL/2)



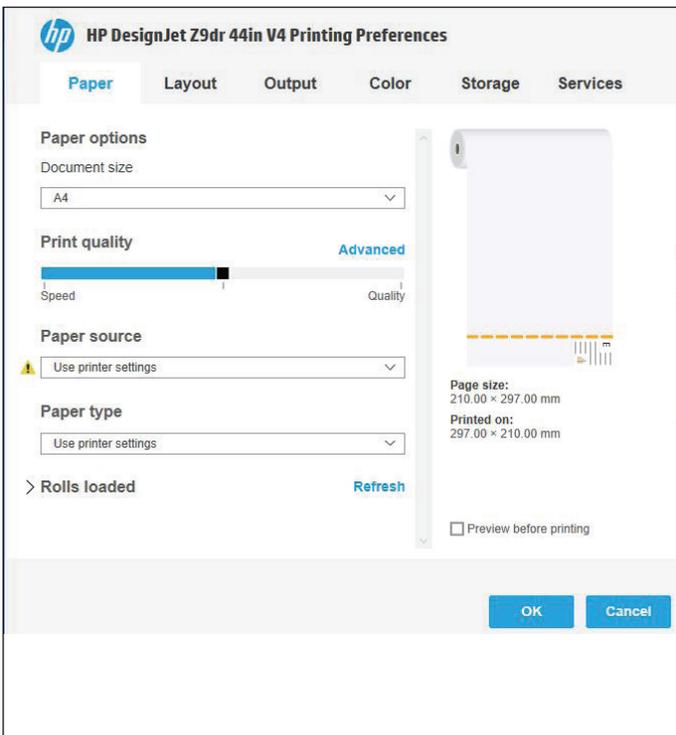
HP DesignJet Z9+dr Job Storage Tab (HPGL/2)



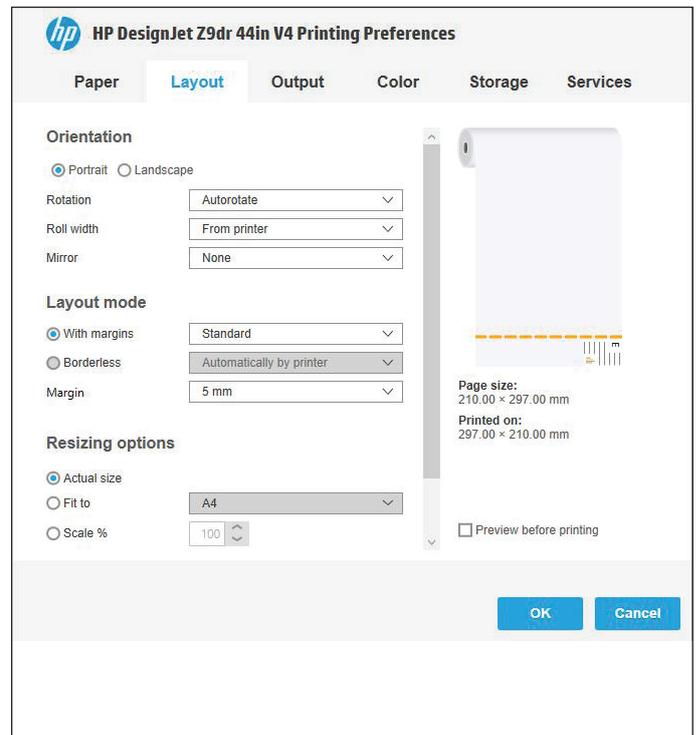
HP DesignJet Z9+dr Advanced Tab (HPGL/2)



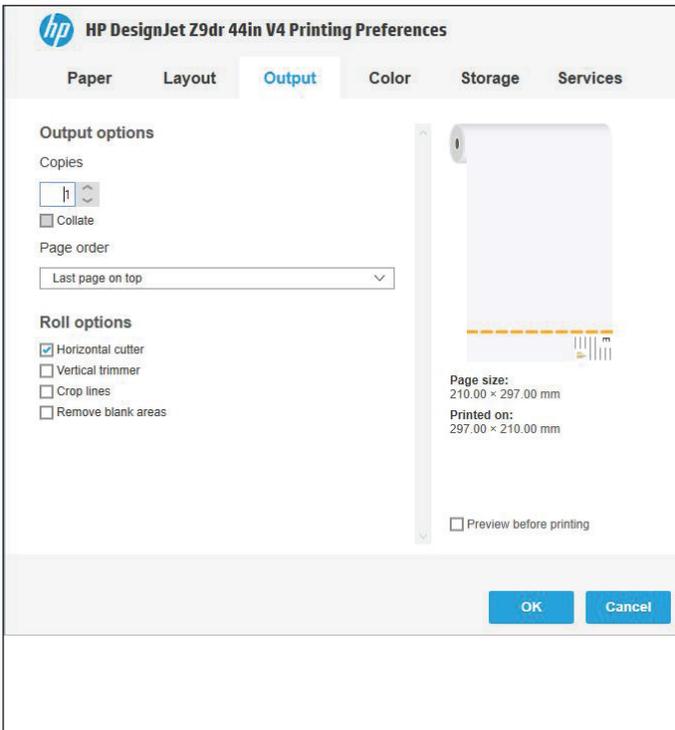
HP DesignJet Z9+dr Advanced Colour Adjustment Settings (HPGL/2)



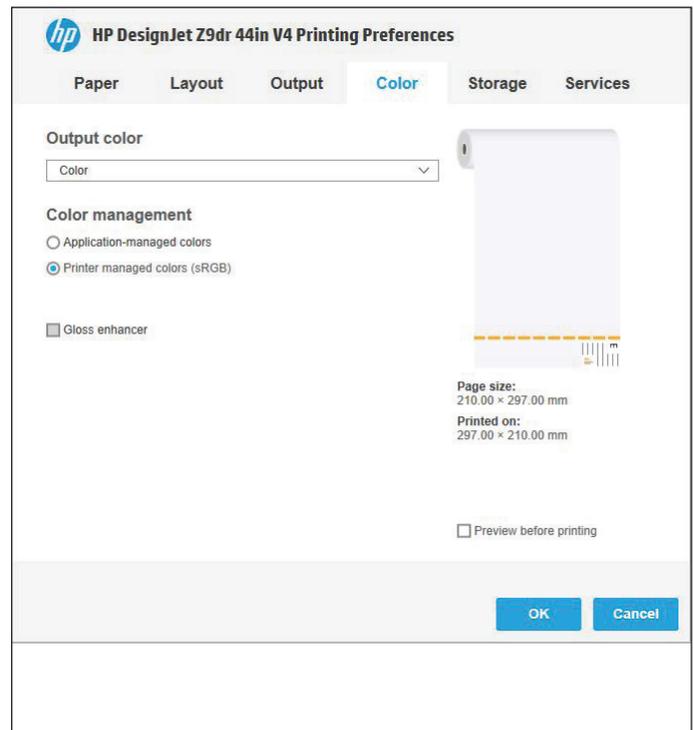
HP DesignJet Z9+dr Paper Tab (PCL 3)



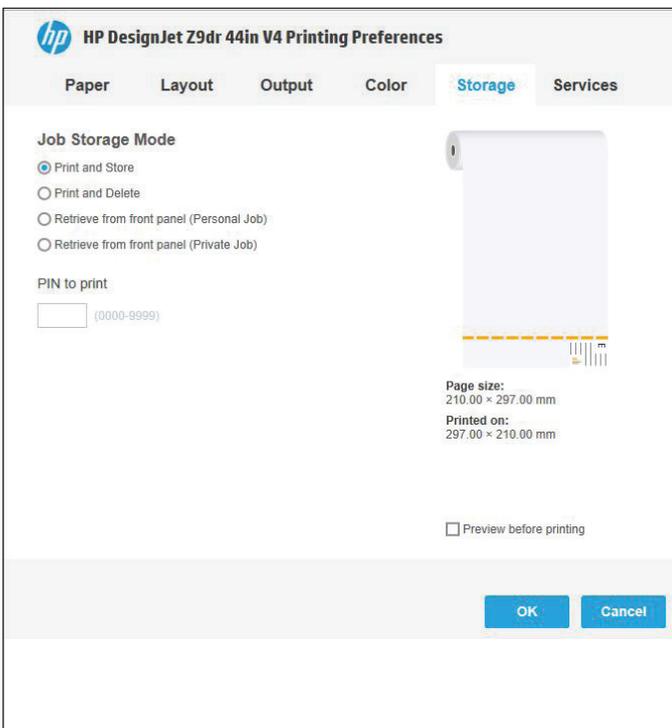
HP DesignJet Z9+dr Layout Tab (PCL 3)



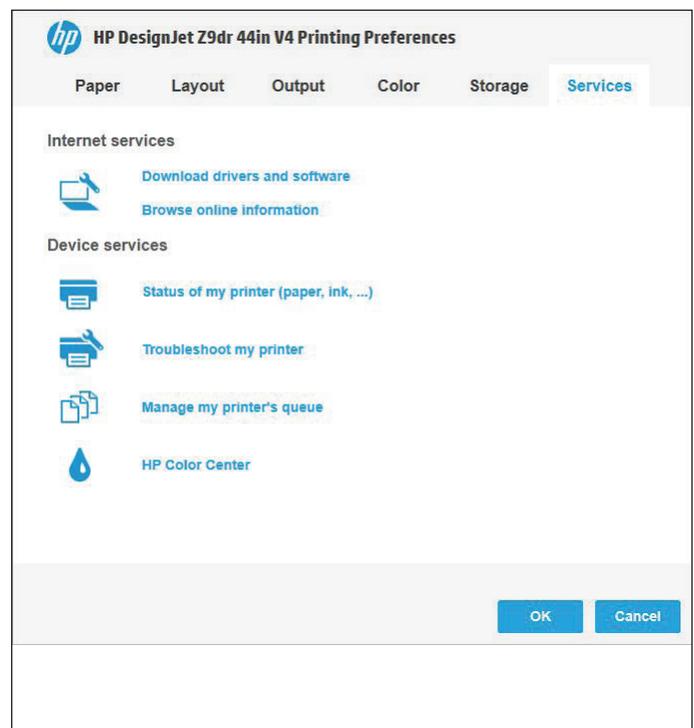
HP DesignJet Z9+dr Output Tab (PCL 3)



HP DesignJet Z9+dr Colour Tab (PCL 3)



HP DesignJet Z9+dr Storage Tab (PCL 3)



HP DesignJet Z9+dr Services Tab (PCL 3)

## Printhead Reliability / Cleaning Routines

- The Canon PRO-4000 enables users to run a printhead nozzle check pattern at the control panel. The default setting is an Auto nozzle check, while additional settings include 'after one page', 'after 10 pages' or 'disable'. The HP DesignJet Z9 offers only one option to run a nozzle check pattern – 'Print Diagnostic Image', which can be found in the main Settings menu under the Optimize Print Quality option.
- When a clogged nozzle is detected on the Canon unit, it pauses during operation and automatically runs a cleaning cycle to maintain image quality and consistency; it resumes printing once the cleaning cycle is completed, with no user intervention required. The HP model does not offer any indication that it conducts automatic printhead maintenance other than when the machine is initializing after being switched on. However, users can initiate a clean printhead maintenance process at the control panel for one or more printheads. The control panel indicates an estimate of both time and the amount of ink consumed, which differs depending on how many printheads are selected.
- + After both devices were turned off over the course of a weekend, upon restarting the following Monday, the Canon model had no problems with clogged nozzles and printed the pattern perfectly after a performing a cleaning. In contrast, the nozzles of the HP unit became clogged over the weekend and required at least one cleaning cycle to resolve the issue, leading to operator downtime.
- + A standard cleaning cycle performed on the Canon model takes approximately four minutes, 30 seconds on average to complete, whilst on the HP model, a cleaning cycle lasts twice as long – nine minutes, 25 seconds.

## SUPPORTING TEST DATA

### Productivity

#### Colour Throughput Time – A1 High-Resolution Portrait Printing (in Seconds)

Canon imagePROGRAF PRO-4000		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer (Enabled)
Standard	High	Normal	Best	Normal
271.36	420.00	379.19	566.17	402.56

A single-page high-resolution A1 portrait was printed as a five-page job using the device driver set to the semi-gloss photo/colour setting. Both devices were loaded with 36" rolls, with each job set to auto-rotate to save media. The time indicated is the average number of seconds (based on timing from the cutting of the first page to the cutting of the final page and dividing by four to exclude the initial processing time).

**Colour Throughput Time – A1 Medium-Resolution Retail Poster Printing (in Seconds)**

Canon imagePROGRAF PRO-4000		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer (Enabled)
Standard	High	Normal	Best	Normal
125.70	238.73	164.29	285.74	174.47

A single-page medium-resolution A1 retail sales poster was printed as a five-page job using the device driver set to the matte coated/colour setting. Both devices were loaded with 36" rolls, with each job set to auto-rotate to save media. The time indicated is the average number of seconds (based on timing the cutting of the first page to the cutting of the final page and dividing by four to exclude the initial processing time).

**Colour Throughput Time – A0 High-Resolution Portrait Printing (in Seconds)**

Canon imagePROGRAF PRO-4000		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer	
Standard	High	Normal	Best
583.46	786.29	642.87	1,030.88

A single-page high-resolution A0 portrait was printed as a five-page job using the device driver set to the semi-gloss photo/colour setting. Both devices were loaded with 36" rolls, with each job set to auto-rotate to save media. The time indicated is the average number of seconds (based on timing from the cutting of the first page to the cutting of the final page and dividing by four to exclude the initial processing time).

**Colour Throughput Time – A0 Medium-Resolution Retail Poster Printing (in Seconds)**

Canon imagePROGRAF PRO-4000		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer	
Standard	High	Normal	Best
229.79	432.99	305.48	573.26

A single-page medium-resolution A0 retail sales poster was printed as a five-page job using the device driver set to the matte coated/colour setting. Both devices were loaded with 36" rolls, with each job set to auto-rotate to save media. The time indicated is the average number of seconds (based on timing the cutting of the first page to the cutting of the final page and dividing by four to exclude the initial processing time).

**First-Print-Out Time from Ready State – High-Resolution Portrait Printing (in Seconds)**

	Canon imagePROGRAF PRO-4000		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer (Enabled)
	Standard	High	Normal	Best	Normal
Time Before Printing Commences	26.82	28.97	74.47	81.16	106.97
First Print Out Time	269.24	415.47	417.77	607.16	452.66

First-page-out times are determined by sending an A1 high-resolution portrait PDF file to print, timed from job release to page out, with both Canon and HP drivers set to semi-gloss photo media. Both devices were loaded with 36" rolls.

First-Print-Out Time from Ready State – Medium-Resolution Retail Poster Printing (in Seconds)

	Canon imagePROGRAF PRO-4000		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer (Enabled)
	Standard	High	Normal	Best	Normal
Time Before Printing Commences	24.54	22.84	20.81	26.85	46.97
First Print Out Time	129.72	230.26	141.39	261.85	144.25

First-print-out times are achieved by sending an A1 medium-resolution retail sales poster PDF file to print, timed from job release to page out with both Canon and HP drivers set to matte coated media. Both devices were loaded with 36" rolls.

## Colour Print Quality

### Colour Optical Density Evaluation

Canon imagePROGRAF PRO-4000 Semi-Glossy Photo Paper						
	Highest					
	1	2	3	4	Max.	Min.
Cyan	1.78	1.79	1.70	1.71	1.79	1.70
Magenta	1.69	1.71	1.69	1.70	1.71	1.69
Yellow	1.32	1.32	1.31	1.31	1.32	1.31
Black	2.70	2.69	2.69	2.66	2.70	2.66

HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer Semi-Glossy Photo Paper						
	Best					
	1	2	3	4	Max.	Min.
Cyan	2.33	2.31	2.23	2.34	2.34	2.23
Magenta	1.76	1.75	1.76	1.74	1.76	1.74
Yellow	1.25	1.24	1.24	1.24	1.25	1.24
Black	2.24	2.28	2.26	2.25	2.28	2.24

Note: Colour density readings were assessed by printing a Buyers Lab test file on proofing paper in high-quality colour settings and measuring the density of 100% dot fill using an XRite 508 densitometer and an XRite exact<sup>SP</sup> densitometer

Skin Tone and Neutral Grey Consistency

Skin Tone 1 (Formula: C=6, M=15,Y=16,K=0)		
	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Colour block		
2	0.2	0.6
3	0.3	0.5
4	0.5	0.6
5	0.3	0.6
6	0.4	1.0
7	0.1	0.8
8	0.4	0.6
9	0.9	0.7
Max. Delta E Variance	0.8	0.5

Skin Tone 2 (Formula: C=30, M=63,Y=75,K=0)		
	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Colour block		
2	0.3	1.0
3	0.5	1.1
4	0.3	0.5
5	0.7	0.3
6	0.3	0.3
7	0.8	0.6
8	0.7	0.4
9	0.7	0.4
Max. Delta E Variance	0.5	0.8

Skin Tone 3 (Formula: C=19, M=33,Y=50,K=0)		
	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Colour block		
2	0.4	1.0
3	0.7	1.0
4	0.9	0.8
5	0.7	0.4
6	0.5	0.7
7	0.4	0.2
8	0.5	0.1
9	0.5	0.5
Max. Delta E Variance	0.5	0.9

Neutral Grey		
	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Colour block		
2	0.8	0.8
3	0.3	0.4
4	0.4	0.4
5	0.3	0.3
6	0.6	0.6
7	0.3	0.4
8	0.4	0.2
9	0.3	0.6
Max. Delta E Variance	0.5	0.6

Note: Skin tone and neutral grey consistency measurements are based on nine readings taken from a Buyers Lab proprietary PDF test target file comprising four A1-sized solid coverage documents of three skin tones and a neutral grey with the High/Best quality setting selected in the driver and the target printed on the manufacturer's own brand of proofing semi-gloss media. Colour differences across the A1 image were measured comparing eight locations to that of the colour measured at the top left of the page, using an EFI ES1000 colour spectrophotometer and Gretag MacBeth EyeOne Share colour comparison software.

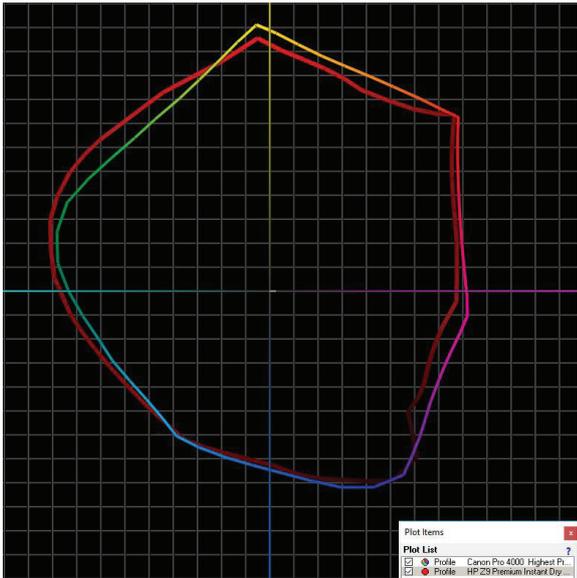
**FOGRA 39 DRIFT TEST:**

Comparison of FOGRA39 colour patches before and after ink consumption test

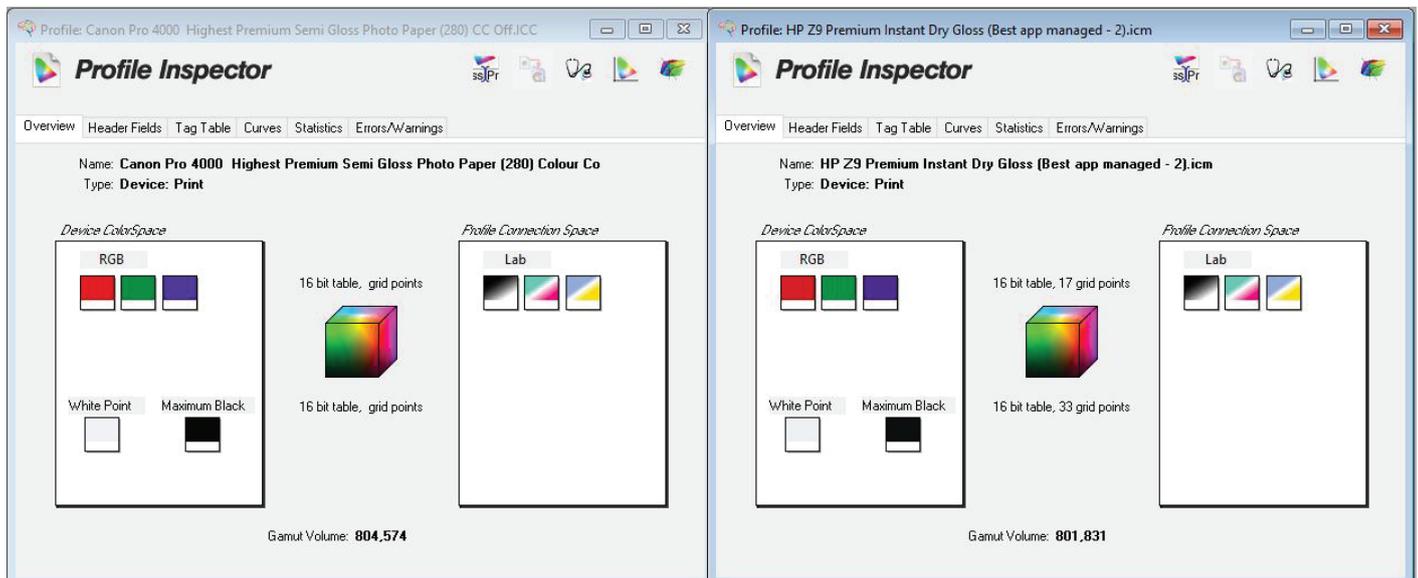
	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Delta E Drift	2.9	2.9

## Colour Gamut Comparison

Media Type/Settings	Canon imagePROGRAF PRO-4000	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer	Canon % larger/smaller (-) than HP
Photo Paper High/Best	804,574	801,831	0.3



Canon imagePROGRAF PRO-4000 colour gamut (shown chromatically) on semi-gloss photo paper in High mode with colour correction disabled versus HP DesignJet Z9+dr 44 inch with V-Trimmer colour gamut (red) on semi-gloss photo paper in Best quality mode with Colour Adjustment disabled.



Colour gamut profile for Canon imagePROGRAF PRO-4000 (left) and HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer (right) on gloss photo paper in highest-quality mode.

## Device Feature Set

	Canon imagePROGRAF PRO-4000	Advantage		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Max. print resolution	2400 x 1200 dpi			2400 x 1200 dpi
Number of inks	12	✓		10 (unit was tested with optional Gloss Enhancer ink)
Ink tanks replaceable during operation	Yes	✓		No
Ink-drop size	4 picoliter	✓		7/3 pl dual-drop weight (M, C, PBk, CB, G); 6 pl (Y, CR, MBk, CG)
Starter cartridge ink capacity	2,280 ml total (12 x 190 ml)			INA
Ink cartridge capacity	160 ml, 330 ml and 700 ml (all colours)	✓		300 ml (all colours)
Number of nozzles	18,432 nozzles in total (1,536 per colour)			2,400 nozzle-per-inch HDNA printheads
Number of printheads	1 (User-replaceable)			5 Universal (User-replaceable)
Line accuracy	+/-0.1% or less			+/-0.1%
Minimum line width	INA			0.02 mm (PDF addressable at 1200 dpi)
Minimum print margins	Roll paper: Borderless or 3 mm (all sides); Cut sheet: 3 mm (Top, Side), 20 mm (Bottom)			Roll paper: Borderless (all media when using V-Trimmer) or 5 mm (all sides); Cut sheet: 5 mm (Top, Side), 17 mm (Bottom)
Borderless (0 mm) printing	Yes (Roll paper)			Yes (with select media); V-Trimmer enables borderless output on all sizes and media supported
Maximum outside diameter of roll paper	170 mm	✓		136 mm
Maximum printable paper roll length	18 m (varies according to the OS and application)			INA
Maximum cut-sheet media length	1.6 m			INA
Maximum media thickness	0.8 mm			0.8 mm
Maximum media width	44 inches			44 inches
Media loading	Front/Top	✓		Rear
Roll paper	Optional Multifunction Roll System (with auto take up)			Dual roll
Optional media handling	Roll holder set (supports 2" and 3" media cores)			Roll holder adapter (supports 3" media core)
Standard RAM	3 GB		✓	128 GB with 4 GB physical memory
Maximum RAM	3 GB		✓	128 GB with 4 GB physical memory
Hard drive	Standard 320-GB		✓	Standard 500-GB

	Canon imagePROGRAF PRO-4000	Advantage		HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer
Interface	10/100/1000Base-T/TX Ethernet, USB 2.0 High Speed, Wireless 802.11b/g/n			10/100/1000Base-T Ethernet (802.3, 802.3u, 802.3ab), USB Type-A host port
PDL	SG Raster (Swift Graphic Raster), HPGL/2, HP RTL, JPEG (Ver. JFIF 1.02)			Adobe PostScript 3, Adobe PDF 1.7, TIFF, JPEG, CALS G4, HPGL/2, HP-RTL
Net weight (unpacked) and size	123 kg / 1,593mm			98 kg / 1,802mm
Power consumption when in standby	1.8 W	✓		< 32 W
Power consumption when active	112 W		✓	< 100 W
Acoustic pressure	Operation: 48 dB (A) or less; Standby: 35 dB (A) or less		✓	Operation: 42-45 dB (A) or less; Standby: 33 dB (A) or less
Acoustic power	Operation: 6.4 Bels or less; Standby: INA			Operation: 6.0-6.3 Bels or less; Standby: 5.1 Bels
Standard/Option to integrate with a spectrophotometer?	No		✓	Standard embedded X-Rite i1 spectrophotometer On-line

INA – Information not available

## Driver Feature Set

	Canon imagePROGRAF PRO-4000	Advantage (compared with HP's HPGL/2)		HP DesignJet Z9+dr 44 inch with V-Trimmer (HPGL/2)**	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer (PCL 3 for Windows Modern Apps)**
Speed settings	Up to five depending on media settings	✓		3 (Fast, Normal, Best)	3 (Fast, Normal, Best)
Economy mode	Yes (Fast setting)			Yes (Fast setting)	Yes (Fast setting)
Predefined profiles	4 (under Easy Settings)		✓	5 (Default, CAD, GIS, Photo, and Black and White Photo)	None
Overview of profile settings provided	Yes			Yes	No
Media profiles	51	✓		35	44
IQ optimized for various types of output	Yes			Yes	Yes
Watermark	Yes	✓		No	No
Sharpen text	No		✓	Yes (called Max Detail)	Yes (called Max Detail)
Thicken fine lines	Yes			Yes (called Max Detail)	Yes (called Max Detail)

	Canon imagePROGRAF PRO-4000	Advantage (compared with HP's HPGL/2)		HP DesignJet Z9+dr 44 inch with V-Trimmer (HPGL/2)**	HP DesignJet Z9+dr 44 inch PostScript with V-Trimmer (PCL 3 for Windows Modern Apps)**
Mirror image	Yes			Yes	No
Multi-up printing	Yes, 2 to 16	✓		No	No
Poster print mode	Yes (2 by 2)	✓		No	No
Page stamping	Yes (Date, Time, Name, Page Number)	✓		No	No
Image rotation	Yes, auto 180 degrees			Yes, auto, 90 degrees	Yes, auto, 90, 180 and 270 degrees
Option to preview before print	Yes			Yes	Yes
Link to device web server from driver	No (there is a link to Status Monitor)			No	No (there is a link to HP DesignJet Utility)
CMYK balance adjustment	Yes (CMY only)			Yes (CMY only)	No
Brightness adjustment	Yes			Yes	No
Contrast adjustment	Yes	✓		No	No
Saturation adjustment	No			No	No
Advanced colour management options	Yes			Yes	No
Enlargement Copy Mode	Yes			INA	INA
Free Layout Capability	Yes (flexible placement)	✓		Yes (automatic nesting via HP Click)	Yes (automatic nesting via HP Click)
MS Office Plug-in	Yes	✓		No	No
Adobe Photoshop Plug-in	Yes*			INA	INA
Accounting Capability	Yes	✓		No	No
Disable automatic cutter	Yes			Yes	Yes
Unidirectional printing selection option	Yes	✓		No	No
Integration with MFP	Yes			INA	INA

\* Canon's imagePROGRAF PRO-4000 supports Canon's Print Studio PRO plug-in which lets users print from industry-standard editing and graphics software such as Adobe Lightroom, Adobe Photoshop, and Canon Digital Photo Professional. It also comes bundled with PosterArtist Lite.

\*Note KPI usually tests HP large-format models using the HPGL/2 driver, however due to the model not performing as expected, Buyers Lab technicians were advised by an HP reseller to use the PCL 3 for Windows Modern Apps driver. The issues previously encountered were eliminated once the driver was switched, and so the faults are attributed to the HPGL/2 driver. For the purposes of the report, the driver feature set section includes both the HPGL/2 and the (more limited) PCL 3 for Windows Modern Apps features, while the Canon PRO 4000's driver is compared and rated against the HPGL/2 driver in the understanding that the HPGL/2's bugs will be rectified in future versions.

## Ink Consumption

Table 1: Amount of Ink in each Canon imagePROGRAF PRO-4000 700-ml Cartridge (in Grams)

	PM	R	C	PG	MK	PK	B	CO	GY	Y	M	PC
Weight of cartridge prior to installation	945.9	944.4	941.2	931.0	956.3	935.5	937.5	937.1	937.2	944.4	951.6	938.7
Weight of cartridge at end of life	201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3
Net weight of ink	744.6	743.1	739.9	729.7	755.0	734.2	736.2	735.8	735.9	743.1	750.3	737.4
Total ink weight across 12 cartridges												8,885.2

Table 2: Amount of Ink in each HP DesignJet Z9+dr 44-inch PostScript with V-Trimmer 300-ml Cartridge (in Grams)

	M	Y	C	CR	PK	MK	CB	CG	GY	GE
Weight of cartridge prior to installation	416.1	416.7	413.6	418.2	418.7	420.0	414.3	424.2	413.8	413.8
Weight of cartridge at end of life	111.3	111.3	111.3	111.3	111.3	111.3	111.3	111.3	111.3	111.3
Net weight of ink	304.8	305.4	302.3	306.9	307.4	308.7	303.0	312.9	302.5	302.5
Total ink weight across ten cartridges										3,056.4

Table 3: Ink Used in Three 50-Page Runs of Packaging Proof Test Document (Standard Mode) on the Canon PRO-4000 (in Grams)

	PM	R	C	PG	MK	PK	B	CO	GY	Y	M	PC
Test Run 1 Net weight of ink used	9.25	7.0	11.4	7.3	7.7	36.9	6.5	9.3	33.2	11.6	11.8	8.2
Test Run 2 Net weight of ink used	11.1	9.8	11.4	4.8	4.0	37.8	8.9	3.8	33.2	10.9	11.8	4.2
Test Run 3 Net weight of ink used	10.8	4.4	3.7	7.1	6.9	30.2	5.5	6.7	27.7	9.6	8.2	5.3
Average amount of ink used across three runs	10.4	7.1	8.8	6.4	6.2	35.0	7.0	6.6	31.4	10.7	10.6	5.9
Total ink weight across 12 cartridges for 50-page run (based on averages)												146.1

Table 4: Ink Used in Three 50-Page Runs of Packaging Proof Test Document (Normal Mode) on the HP DesignJet Z9+dr 44-inch PostScript with V-Trimmer (in Grams)

	M	Y	C	CR	PK	MK	CB	CG	GY	GE
Test Run 1 Net weight of ink used	15.0	19.4	7.5	11.0	42.1	3.7	5.5	7.3	16.3	91.1
Test Run 2 Net weight of ink used	15.8	20.2	7.7	11.8	43.1	3.7	5.8	7.1	16.5	92.6
Test Run 3 Net weight of ink used	15.7	20.0	8.2	11.3	43.9	4.1	5.8	7.6	17.0	92.3
Average amount of ink used across three runs	15.5	19.9	7.8	11.4	43.0	3.8	5.7	7.3	16.6	92.0
Total ink weight across ten cartridges for 50-page run (based on averages)										223.0

Table 5: Ink Used in Three 50-Page Runs of Retail Sales Poster Test Document (Standard mode) on the Canon PRO-4000 (in Grams)

	PM	R	C	PG	MK	PK	B	CO	GY	Y	M	PC
Test Run 1 Net weight of ink used	13.2	23.6	4.0	21.6	10.2	3.8	4.6	3.6	15.1	8.8	7.5	4.8
Test Run 2 Net weight of ink used	13.5	22.3	3.6	23.4	9.5	3.5	0	3.6	14.6	7.4	7.3	6.1
Test Run 3 Net weight of ink used	16.9	23.5	3.7	24.5	10.3	3.1	6.2	3.7	17.8	8.4	8.8	6.5
Average amount of ink used across three runs	14.5	23.1	3.8	23.2	10.0	3.5	3.6	3.6	15.8	8.2	7.9	5.8
Total ink weight across 12 cartridges for 50-page run (based on averages)												123.0

Table 6: Ink Used in Three 50-Page Runs of Retail Sales Poster Test Document (Normal Mode) on the HP DesignJet Z9+dr 44-inch PostScript with V-Trimmer (in Grams)

	M	Y	C	CR	PK	MK	CB	CG	GY	GE
Test Run 1 Net weight of ink used	8.3	3.9	4.7	26.2	13.6	4.8	2.1	1.6	20.4	1.3
Test Run 2 Net weight of ink used	8.4	4.4	5.2	26.3	14.0	4.9	2.4	1.8	20.3	1.7
Test Run 3 Net weight of ink used	8.3	3.7	4.7	25.4	13.3	4.6	2.1	1.5	19.8	1.4
Average amount of ink used across three runs	8.3	4.0	4.9	26.0	13.6	4.8	2.2	1.6	20.2	1.5
Total ink weight across ten cartridges for 50-page run (based on averages)										87.1

Table 7: Ink Used in Three 50-Page Runs of Studio Portrait Test Document (Standard mode) on the Canon PRO-4000 (in Grams)

	PM	R	C	PG	MK	PK	B	CO	GY	Y	M	PC
Test Run 1 Net weight of ink used	10.8	3.8	4.0	35.1	5.0	15.3	4.4	4.0	36.2	5.2	3.9	7.1
Test Run 2 Net weight of ink used	15.3	4.8	4.2	37.1	4.7	13.7	5.4	4.8	39.2	9.9	4.7	9.8
Test Run 3 Net weight of ink used	10.3	3.7	3.6	36.0	3.7	14.1	2.2	3.1	34.7	8.1	2.7	8.2
Average amount of ink used across three runs	12.1	4.1	3.9	36.1	4.5	14.4	4.0	4.0	36.7	7.7	3.8	8.4
Total ink weight across 12 cartridges for 50-page run (based on averages)												139.7

Table 8: Ink Used in Three 50-Page Runs of Studio Portrait Test Document (Normal mode) on the HP DesignJet Z9+dr 44-inch PostScript with V-Trimmer (in Grams)

	M	Y	C	CR	PK	MK	CB	CG	GY	GE
Test Run 1 Net weight of ink used	7.9	12.9	6.7	9.0	18.6	3.6	3.9	5.7	46.7	60.2
Test Run 2 Net weight of ink used	8.0	12.7	6.6	9.2	18.6	3.9	4.2	5.7	45.4	86.9
Test Run 3 Net weight of ink used	7.6	12.3	6.2	8.5	17.9	3.3	3.9	2.7	44.7	86.1
Average amount of ink used across three runs	7.8	12.6	6.5	8.9	18.4	3.6	4.0	4.7	45.6	77.7
Total ink weight across ten cartridges for 50-page run (based on averages)										189.8

## Ink Consumption Test Methodology Overview

Buyers Lab’s ink consumption analysis was conducted using three document types (Packaging Proof, Retail Sales Poster and Studio Portrait). The Packaging Proof document was formatted as a PDF, the Retail Sales Poster as a JPG, and the Studio Portrait was formatted as a TIFF file; all documents were sized at ISO A1.

The Canon imagePROGRAF PRO-4000 was installed in Buyers Lab’s lab with the latest level of firmware (as of April 2016) and connected to a Windows 7 workstation using a 1000BaseT TCP/IP connection. The device was left in default configuration throughout testing. The Canon GARO driver was used for all testing and was left in default colour setting configuration. The Packaging Proof document was printed on 255gsm semi glossy proofing media in Standard mode. The Retail Poster was printed on matte coated media in Standard mode, and the Studio Portrait photo was printed on semi-gloss photo media in Standard mode.

The HP DesignJet Z9+dr 44-inch PostScript with V-Trimmer was installed in Buyers Lab's lab with the latest "JGR6\_03\_18\_26.7" level of firmware (as of August 2018) and connected to a Windows 10 workstation using a 1000BaseT TCP/IP connection. The device was left in default configuration throughout testing. The PCL 3 driver for Windows Modern Apps was used for all testing and was left in default colour setting. The Packaging Proof document was printed on HP glossy proofing media in Normal mode. The Retail Poster was printed on matte coated media in Normal mode, and the Studio Portrait photo was printed on HP gloss photo media in Normal Mode.

Before installing the ink cartridges, Buyers Lab technicians weighed and recorded the weight of each with all packaging removed. At the end of each 50-print test run, the cartridges were weighed again and the resulting weight of ink used for the test run calculated for each colour. To ensure that the sub-tank on the Canon model did not affect results, a procedure was followed to ensure that the sub-tank level was at its maximum before the print run commenced and again after the print run was completed, thereby ensuring that ink replenishment of the sub-tanks was taken into account for each print run.

For both models, one cartridge was then run to exhaustion and the weight of the empty cartridge was recorded and used as the empty weight for each colour.

## Test Environment

Products were tested in Buyers Lab's environmentally controlled UK test lab, which replicates typical office conditions.

## Test Equipment

Buyers Lab's dedicated test network in Europe, consisting of Windows 2012 servers and Windows 10 Professional workstations, 10/100/1000BaseTX network switches and CAT5e/6 cabling.

## Test Procedures

The test methods and procedures employed by Buyers Lab in its lab testing include Buyers Lab's proprietary procedures and industry-standard test procedures. In addition to a number of proprietary test documents, Buyers Lab uses industry standard files including a Buyers Lab test file and an ASTM monochrome test document for evaluating black image quality. In addition to a visual observation, colour print quality and gamut size are evaluated using XRite i1 profile software and an i1 Pro colour spectrophotometer, and analysed using XRite i1i0 Advanced Scanning Table. Density of black and colour output was measured using XRite 508 and XRite exact<sup>XP</sup> densitometers.

## About Keypoint Intelligence - Buyers Lab

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Keypoint Intelligence is a one-stop shop for the digital imaging industry. With our unparalleled tools and unmatched depth of knowledge, we cut through the noise of data to offer clients the unbiased insights and responsive tools they need in those mission-critical moments that define their products and empower their sales.

For over 50 years, Buyers Lab has been the global document imaging industry's resource for unbiased and reliable information, test data, and competitive selling tools. What started out as a consumer-based publication about office equipment has become an all-encompassing industry resource. Buyers Lab evolves in tandem with the ever-changing landscape of document imaging solutions, constantly updating our methods, expanding our offerings, and tracking cutting-edge developments.

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