

Canon imagePROGRAF PRO-4000S vs. HP DesignJet Z5400PS



Canon imagePROGRAF PRO-4000S



HP DesignJet Z5400PS

	Canon imagePROGRAF PRO-4000S	HP DesignJet Z5400PS
Advantage ✓		
Image Quality	✓	
Print Productivity	✓	
Ink Consumption		✓
Device Feature Set	✓	
Print Driver Feature Set	✓	
Printhead Reliability/Cleaning Routines	✓	

TEST OBJECTIVE

Buyers Laboratory LLC (BLI) was commissioned by Canon Europe to conduct confidential document imaging device performance testing on the Canon imagePROGRAF PRO-4000S and the HP DesignJet Z5400PS, and produce a report comparing the relative strengths and weaknesses of the two products in terms of image quality, productivity (including dual-roll productivity), ink consumption, device feature set, driver functionality, and print-head stability and cleaning routines. All testing was performed in BLI's test facility in Wokingham, UK.

Executive Summary

The Canon imagePROGRAF PRO-4000S outshone the HP DesignJet Z5400PS in the majority of categories evaluated, with its superior productivity performance, better image quality overall and richer device and driver feature sets. The PRO-4000S's productivity performance, in particular, was outstanding, with a clear speed advantage in all tested modes. It also features a significant 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 Z5400PS runs out of ink, printing has to stop for the cartridge to be replaced, which leads to operator downtime. For maximum convenience and minimum downtime, both models offer a dual-roll design, which gives users the added flexibility of switching between different media types or sizes without the need to reload the media each time. While the time taken to switch rolls was largely comparable between the two models, the Canon PRO-4000S delivered the faster (by 24.3%) dual roll productivity performance in Fast mode.

Both models delivered a very high standard of colour output appropriate for their Graphic Arts (GA) target market; yet, the Canon PRO-4000S had the overall edge with crisper text, more distinct fine lines and smoother circles. It also delivered higher optical densities for all colours, a larger colour gamut when printing on photo media and, in the photographic image evaluation, and more vibrant colours and finer detailing in light and dark contrast areas when compared to output from the HP device; the Canon model also exhibited less colour drift when FOGRA39 colour patches were compared before and after the ink consumption test, with a mean Delta E of 2.8 compared with 11.5 for the HP unit. Business graphics output was of a comparable quality.

One key area for the HP Z5400PS was its more efficient use of ink in two of the three ink consumption tests. It used significantly less ink in terms of net weight than the Canon PRO-4000S when printing 50-page runs of two different test documents in Standard/Normal mode using matte coated and glossy photo media. A contributory factor for the HP model's much lower ink consumption is that it does not support lighter colour inks, such as light cyan and light magenta, which are available with the Canon device. While the Canon model's printhead performed reliably throughout the evaluation, and did not experience nozzle clogging issues when powered off over a weekend, the HP model's printhead did suffer from clogged nozzles when powered off over a weekend and required more than one clean cycle to rectify.

In terms of device and driver feature sets, the Canon PRO-4000S has a robust offering, which includes its aforementioned hot-swap ink tanks, Wi-Fi connectivity, a unidirectional printing feature which can help to eliminate banding issues, a higher-capacity cartridges than those available with the HP unit (700 ml versus 300 ml) and a lower rated power consumption in both operating and standby modes. In addition, loading media with the Canon device is far easier than with the HP model, which only offers media loading access from the back.

The HP Z5400PS has a higher (virtual) memory capacity, while other noteworthy features include its ColorCenter utility that offers third-party media and colour calibration management, while the Professional PANTONE Emulation feature enables the creation of swatchbooks containing virtually any user-specified PANTONE colours to see how accurately they can be reproduced on the chosen media. Both models come with a 320-GB hard drive, which conveniently allows the storage of commonly use documents and aids spooling workflow.

In summary, with its superior productivity, excellent overall image quality and stronger feature sets, the Canon imagePROGRAF PRO-4000S is judged to be the stronger performer in BLI’s evaluation.

Image Quality

	Canon imagePROGRAF PRO-4000S	HP DesignJet Z5400PS
Advantage ✓		
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	=	=
Business Graphics	=	=
Photographic Images	✓	
Colour Gamut (photo media)	✓	

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

○ Image quality testing was done with Canon’s Semi-gloss Photo 280-gsm media and HP’s proofing Semi-gloss Satin media, with quality set to Highest (2400 x 1200 dpi) on the Canon model and the HP model set to Best (2400 x 1200 dpi).

+ The Canon model produced clearly formed sans serif fonts down to the smallest 3-pt. type size, while its serif fonts were distinct down to the 4-pt. level (in black) and 5-pt. level (in colour). Text produced by the HP model was legible down to the 3-pt. level in colour, and down to the 5-pt. level (serif) and 3-pt. level (sans serif) in black. However, characters were not as crisp as those produced by the Canon unit as they were affected by some overspray, which was visible when viewed under magnification even at the larger type sizes.

- Both models produced the 1x1 pixel grid in CMY with no quality issues. The Canon PRO-4000S delivered a consistent dot laydown in the 1x1 black-on-white pixel grid, as did the HP Z5400PS, but its pixels were judged slightly less distinct than those of the Canon device. However, the HP unit produced the better 1x1 white-on-black pixel grid, whereas the Canon device's 1x1 white-on-black grid was less distinct.
- + Fine lines delivered by the Canon unit were crisp and distinct down to the 0.1-pt size; fine lines produced by the HP Z5400PS were distinct at the 0.1-pt. size but displayed some fuzziness in the feed direction.
- + Whilst there was some slight stair-stepping evident in diagonal lines produced by the Canon model, the HP model's diagonal lines suffered from slight fuzziness. Circles produced by the Canon PRO-4000S were smooth and well formed at the 0.1-pt. size, whilst the HP unit delivered fully formed circles only at the 0.25-pt. size.
- 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 colour halftone fills, with no banding issues, but the HP model's colour halftone fills at the 10% and 20% levels were slightly grainy. Neutral greyscale halftone coverage was smooth from the Canon model. Greyscale halftone coverage produced by the HP device displayed a slight magenta bias at the lower percentage fill levels.
- + The Canon device produced higher optical densities for cyan, magenta and black colours compared with those from the HP Z5400PS, with yellow being largely comparable between both models.
- + Skin tones produced by the Canon unit were very good, smooth and natural-looking; although skin tones were also natural-looking with the HP device, they were slightly grainier by comparison.
- The three skin tone tests yielded fairly consistent results for each model when compared with the original target. Output produced by the Canon model displayed greater variance with all three skin shades when compared with HP model, however, overall there's no meaningful real-world difference that would be discernible to the naked eye.
- Neutral grey consistency was comparable for both models, with a Delta E variance of 0.4 registered by the Canon PRO-4000S versus 0.3 for the HP Z5400PS.
- + During BLI'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 Colour Verifier software, the Canon device delivered a far lower mean Delta E drift of 2.8 than the HP unit's mean Delta E, which was 11.5.
- + When printing on photo media in highest quality settings, the Canon PRO-4000S delivered a larger (by 27.2%) colour gamut than the HP model, with a CIE volume of 679,092 versus 533,758.
- + BLI analysed a wide range of colour and greyscale output in photographic images produced by both devices and found the Canon PRO-4000S had a clear advantage, with more vibrant colours and excellent fine detailing in light and dark contrast areas. Photographic images produced by the HP device suffered from a loss of definition in light and dark contrast areas and colours were rather flat.
- Both models delivered a very high level of quality in business graphics, which would perfectly satisfy customer requirements.

Print Productivity

	Canon imagePROGRAF PRO-4000S	HP DesignJet Z5400PS
Advantage ✓		
First Print Out From Ready State (Fast and Standard/Normal modes)	✓	
Throughput Speed Portrait (Fast and Standard/Normal modes)	✓	
Throughput Speed Retail Poster (Fast and Standard/Normal modes)	✓	
Job Stream (multiple jobs submitted to device in fast succession simulating busy network environment)	✓	
Dual Roll Job Stream	✓	

- + When printing a single high-resolution portrait, the Canon model easily surpassed the HP model in terms of speed of the first-print-out from ready state across two tested modes; in Fast and Standard/Normal settings, the PRO-4000S was 49.6% and 38.8% faster, respectively, compared with the HP Z5400PS.
- + When printing a single medium-resolution retail poster on matte coated media, the Canon PRO-4000S delivered first-print-out speeds that were 55.4% (Fast) and 71.1% (Standard/Normal) faster than the HP device.
- + When printing BLI’s job stream, designed to simulate a typical mixed workflow for a large-format unit, the Canon PRO-4000S delivered a superior performance in Fast mode, running 28.5% faster than the HP model. It was also faster when tested in Standard/Normal mode with a time of 2,185.54 seconds—33.8% faster than the 3,301.12 seconds taken by the HP device.
- + As both models offer a dual-roll design, BLI conducted a second job stream test, sending the same files as alternate jobs to different rolls to test both models’ efficiency when switching between rolls. The Canon PRO-4000S completed the dual-roll job stream in Fast mode in 1,711.13 seconds—24.3% faster than the 2,260.03 seconds taken by the HP Z5400PS in Fast mode.
- BLI analysts observed that, although Canon’s faster speed gave it the advantage when printing to dual rolls, the actual time taken to switch between rolls (between 51 and 56 seconds) was similar for both models.
- + In BLI’s throughput speed evaluation, the Canon PRO-4000S displayed a clear advantage over the HP model when printing five pages of a single-page A1-size high-resolution portrait test document in the tested modes; its per-page speed was 36.5% faster in Fast mode and 21.2% faster in Standard/Normal mode.
- + When printing five copies of a single-page A1-size medium-resolution retail poster test document, the Canon model again outperformed the HP device, with per-page speeds that were 43.7% (in Fast) and 37.9% (in Standard/Normal) faster compared with the HP DesignJet Z5400PS.
- + Similar results were seen with the A0-size high-resolution portrait test run. The Canon unit produced five copies of a single-page test document with per-page speeds that were 43.5% (in Fast) and 23.1% faster (in Standard/Normal), compared with the HP model.
- + The Canon model completed its superior performance by delivering the A0-size medium-resolution retail poster test in per-page times that were faster than the HP device in the two tested modes; it was 38.8% faster in Fast mode and 43.2% faster in Standard/Normal mode.

Ink Consumption

BLI analysts 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 BLI 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.

Results averaged across three tests of 50-set A1 printing in Standard/Quality mode

RESULTS		
Average weight of ink used (grams)	Canon imagePROGRAF PRO-4000S	HP DesignJet Z5400PS
PACKAGING PROOF	133.1	152.5
RETAIL POSTER	100.3	85.5
STUDIO PORTRAIT	129.2	89.2

- + When printing BLI's Packaging Proof test target using Standard/Normal mode on semi-gloss proofing media, the Canon PRO-4000S used less (12.7%) ink in terms of net weight than the HP DesignJet Z5400PS.
- In the BLI Retail Poster print run evaluation using Standard/Normal mode on matte coated media, the Canon PRO-4000S used 17.3% more ink in terms of net weight than the HP DesignJet Z5400PS.
- When printing BLI's Studio Portrait ink consumption test target using Standard/Quality mode on glossy photo media, the Canon PRO-4000S used 44.8% more ink in terms of net weight than the HP DesignJet Z5400PS.

Device Feature Set

- + The Canon PRO-4000S uses eight inks, including two black inks and one grey, whilst the HP Z5400PS employs six inks, which also include two black inks and one grey.
- + Ink cartridges can be replaced during operation on the Canon model (but not on the HP device), which helps to reduce downtime.
- + The PRO-4000S's single printhead contains more nozzles per colour—1,536—than the HP unit's single printhead, which contains 720 nozzles per colour.
- + The Canon unit's ink delivery system dispenses a 4-picoliter drop size for all colours, while HP device dispenses two drop sizes: 4-picoliter (light grey and photo black) and a slightly larger 6-picoliter drop size for cyan, magenta, yellow and matte black.
- + Canon's higher-capacity cartridges have a larger capacity than those available with the HP unit—700 ml versus 300 ml.

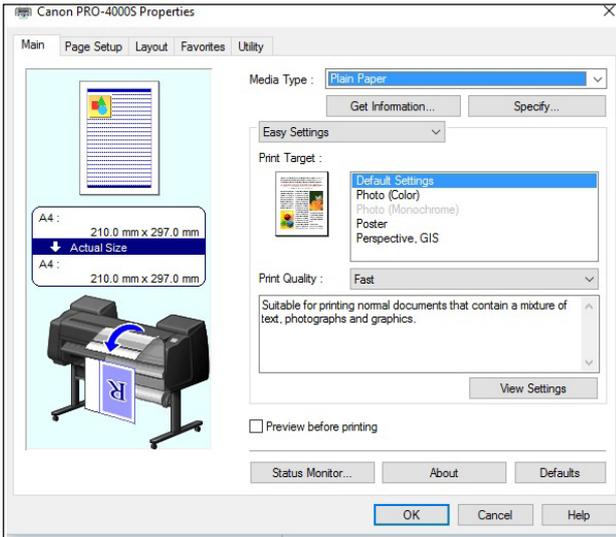
- Both models offer borderless printing.
- + The Canon unit supports a larger diameter of roll paper (170 mm as opposed to 150 mm with the HP device).
- The Canon device has a standard memory capacity of 3 GB, while the HP unit offers 64-GB virtual capacity, based on 768 RAM.
- Both devices come with a standard 320-GB hard drive, which allows for the storage of commonly used documents and aids spooling workflow.
- The HP Z5400PS is a lighter model, with a weight of 86 kg versus 121 kg for the Canon unit.
- + The Canon PRO-4000S offers user-friendly media loading options (at the front) while media rolls must be loaded from the rear with the HP unit, which makes it more cumbersome process if the device is positioned against a wall.
- Rated noise emissions while active are slightly lower for the HP model compared with the Canon unit (45 dB versus 49 dB).
- + The Canon model has a lower advertised operational peak energy value (107 W) than the HP device (120 W). In standby mode (the operating mode most in use), the Canon PRO-4000S's energy consumption is just 1.8 W compared with 27 W for the HP device.
- Both models offer 2" and 3" core adapters. The 3" cores especially help to avoid paper curling towards the end of a roll.
- Both models can support an optional dual-roll unit, giving users the added flexibility of switching between different media types or sizes without having to reload the media each time, or allowing the automatic take-up of printed output.
- Both models offer USB 2.0 and Gigabit Ethernet connectivity.
- + The Canon device offers direct Wi-Fi connectivity, which is not available with the HP model.
- The Canon device includes a media mismatch option, which places jobs that can't be printed due to incorrect media being loaded on hold, while those without a mismatch are printed. The held jobs are printed once the required paper is loaded, all of which minimizes the risk of ink and paper being wasted. The HP driver, which shows the currently loaded media, will display an error alert should the media selected be different to that loaded on the device; and while the print job is sent to the machine, it is held and will not be printed until the operator changes the media on the device or opts to resume printing on the incorrect media.
- The Canon model includes a plug-in for Microsoft Office, which provides a wizard that walks users through the process of creating posters from Word, Excel or PowerPoint, avoiding the need for complex resizing. A similar poster creation feature is offered with the HP device; its Instant Printing Pro utility (available as a free download) enables users to click on a file name and, without opening the application, set individual options such as print size, rotation, print quality and number of copies before printing. Supported file formats include PDF, TIFF, JPEG and PPT. A free download plug-in provides compatibility with other MS Office applications.
- + 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 offers Serif PosterDesigner Pro as an extra-cost option, which enables poster and banner creation on HP large-format printers.
- + 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 their photos; choose black and white photo mode, and save favourite settings, among others.

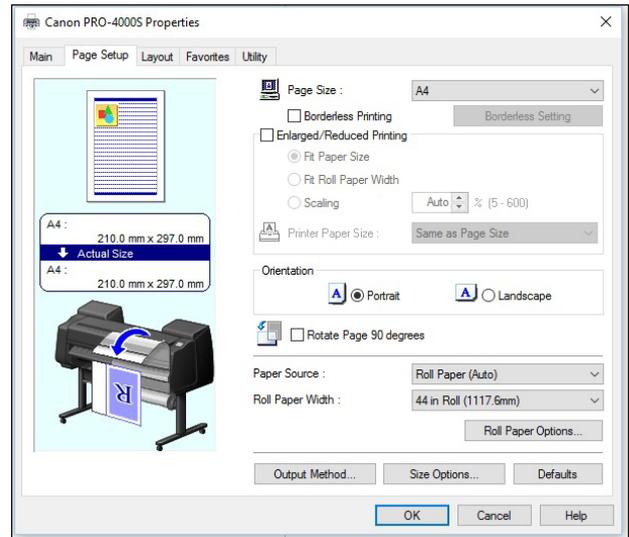
- Canon's Accounting Manager, accessed via the Status Monitor, offers comprehensive accounting management for all print jobs. Users enter the actual costs for individual inks and media types, and the cost per job is calculated automatically and displayed. For each job, the media type, area, ink used 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. HP offers similar accounting management and tracking capabilities via the Accounting tab on its embedded web server page, or via the HP DesignJet Accounting tool, which is available as a free download.

Print Driver Feature Set

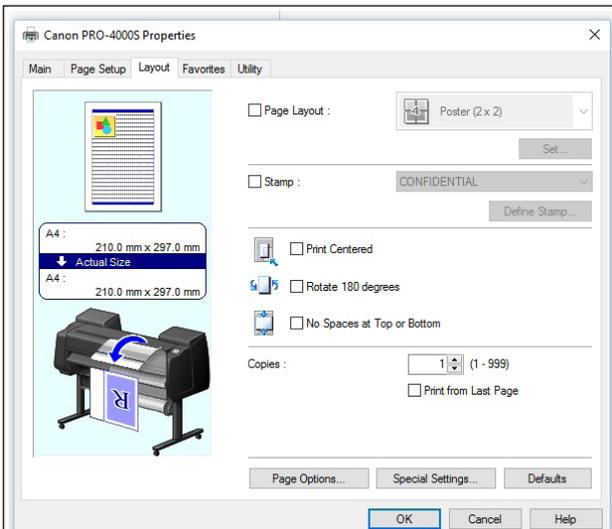
- + The Canon driver includes 49 media profiles versus 20 for the HP driver, although both units enable users to build a library of custom media profiles.
- + The Canon driver includes a watermark capability; the HP driver does not.
- + The Canon driver includes a Thicken Fine Lines image enhancement option, which is not available with the HP model.
- The HP driver has a Sharpen Text option, which is not offered with the Canon device.
- + The Canon driver offers N-up printing (up to 16), which is not available with the HP driver.
- + Poster printing capability (2 x 2) is offered by the Canon model, as well as page-stamping (date, time, user-name and page number); neither feature is supported by the HP device.
- + The Canon model's device status monitor can be accessed directly from the first tab of the driver, but HP users are required to perform an extra click to access device status via an icon on the Services tab.
- + The Canon driver features a wide selection of simple colour adjustment options, which include brightness and contrast, as well as sliding scale adjustments for cyan, magenta, yellow and black. The HP driver has similar adjustment options for cyan, magenta and yellow, but not black, along with brightness.
- The driver for the HP model provides a handy thumbnail preview for users to check the effects on their image as they make colour adjustments.
- The Canon driver includes 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 Utility Color Center offers 'Paper Preset Management', which offers third-party media and colour calibration management.
- HP Professional PANTONE Emulation is a noteworthy feature that allows users to create and print a swatchbook of multiple PANTONE colours to see how accurately they can be reproduced on the chosen media.
- + The Canon driver includes a unidirectional print selection that helps to avoid any banding across output, whereas the HP driver does not.



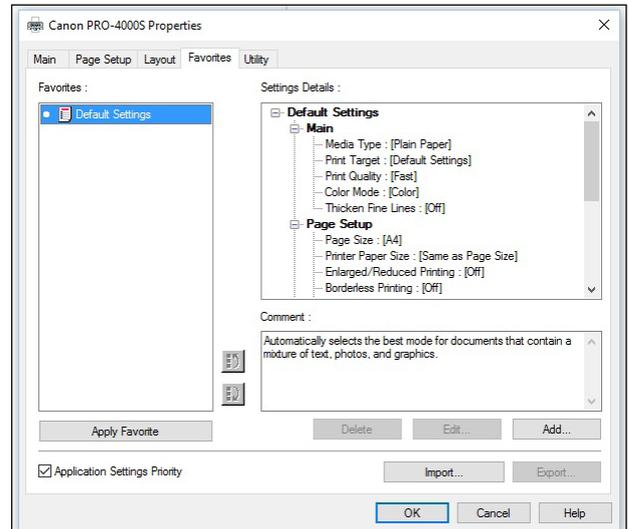
Canon imagePROGRAF PRO-4000S Print Driver Main Tab



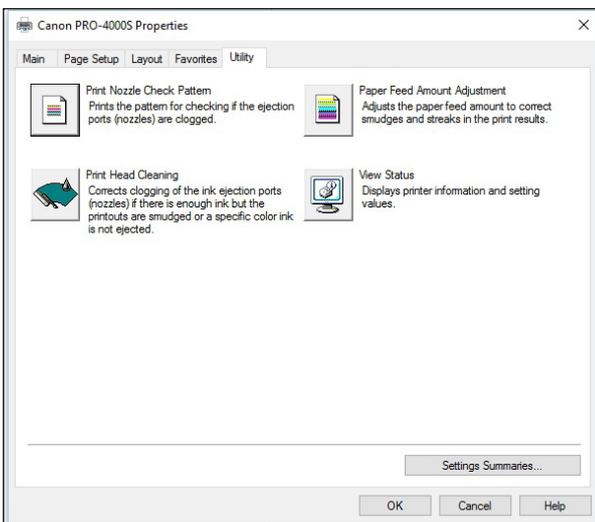
Canon imagePROGRAF PRO-4000S Print Driver Page Setup Tab



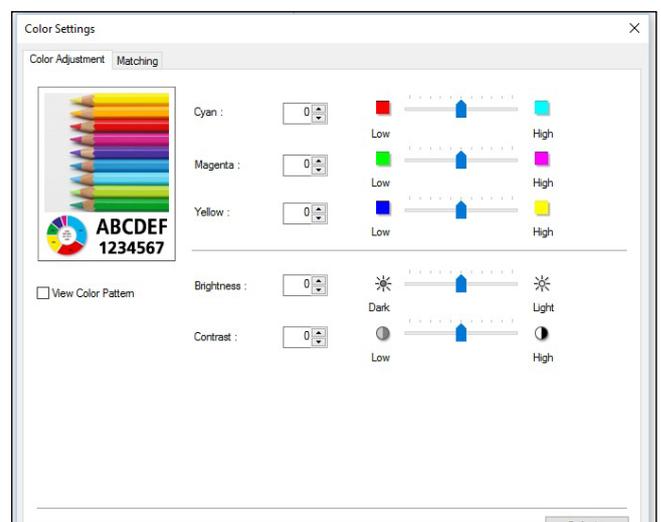
Canon imagePROGRAF PRO-4000S Print Driver Layout Tab



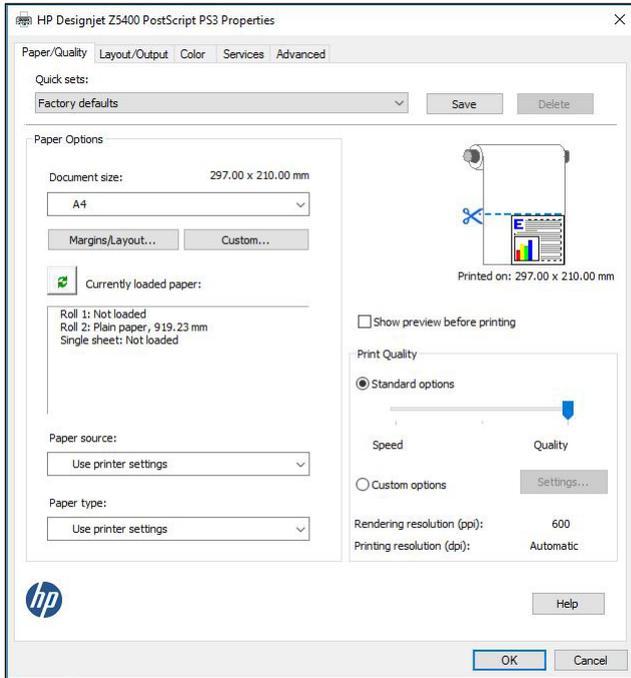
Canon imagePROGRAF PRO-4000S Print Driver Favourites Tab



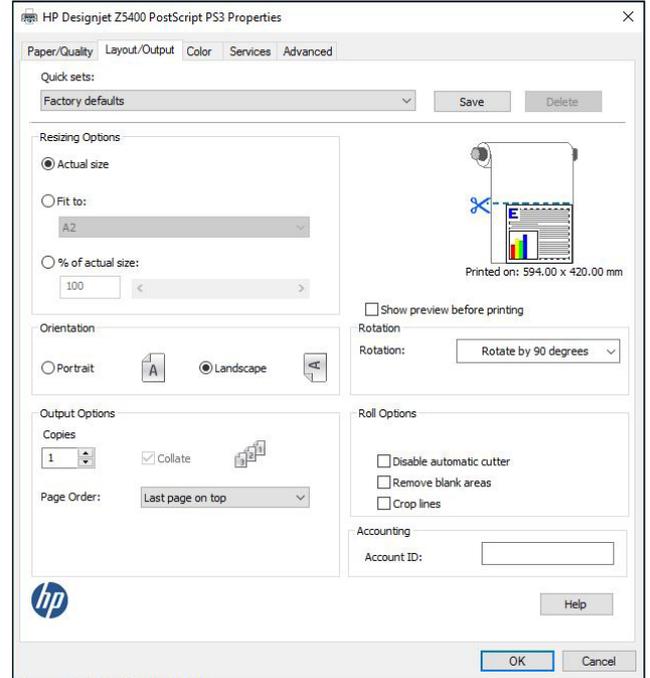
Canon imagePROGRAF PRO-4000S Utility Tab



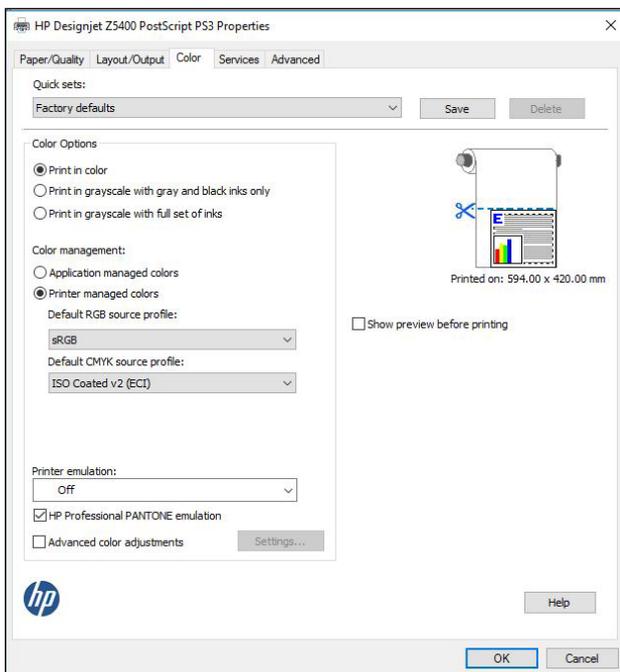
Canon imagePROGRAF PRO-4000S Colour Adjustment Settings



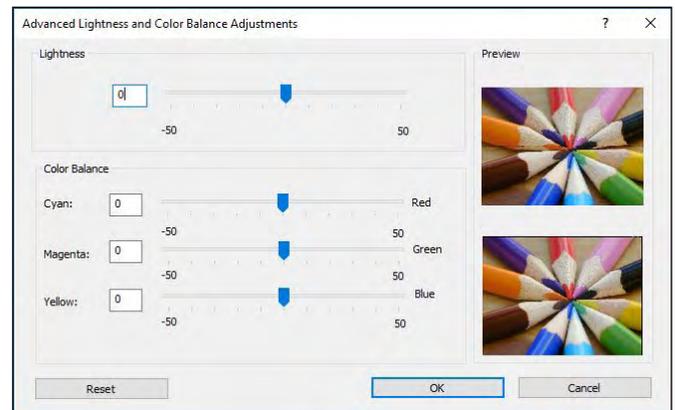
HP DesignJet Z5400PS Print Driver Paper/Quality Tab



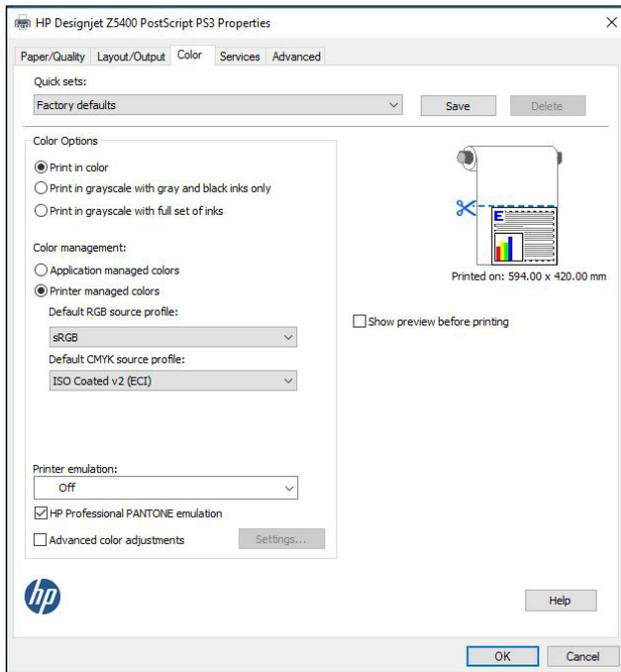
HP DesignJet Z5400PS Print Driver Layout/Output Tab



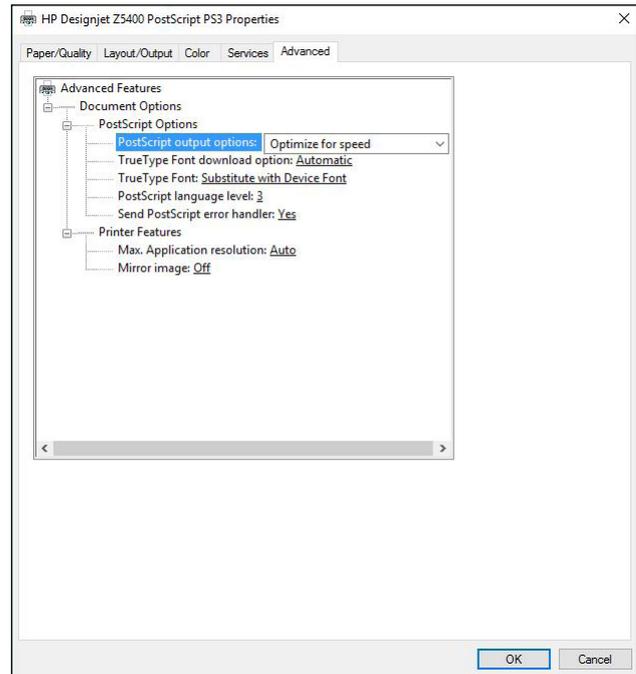
HP DesignJet Z5400PS Print Driver Colour Tab



HP DesignJet Z5400PS Colour Adjustment Settings



HP DesignJet Z5400PS Print Driver Services Tab



HP DesignJet Z5400PS Print Driver Advanced Tab

Printhead Reliability / Cleaning Routines

- The Canon PRO-4000S offers various nozzle check settings at the control panel. The default setting is “Auto Nozzle Check”. Additional settings include “after one page”, “after 10 pages” or “disabled”. The HP DesignJet Z5400PS does not offer this capability on its control panel.
- When it comes to replacing the printhead, both models offer flexibility with their user-friendly replacement procedure.
- + 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 print-head maintenance.
- + After both devices were shut down completely over the course of a weekend, the Canon model had no problems with nozzles clogging and when a nozzle check pattern was registered by BLI analysts, it printed with perfect accuracy. In contrast, the nozzles of the HP unit became clogged and required at least two cleaning cycles 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 takes approximately nine minutes.

SUPPORTING TEST DATA

Productivity

Job Stream

Mixed File Types, Same Size, Single Roll

Canon imagePROGRAF PRO-4000S (time in seconds)		HP DesignJet Z5400PS (time in seconds)	
Fast	Standard	Fast	Normal
1,252.28	2,185.54	1,752.08	3,301.12

BLI's job stream consists of nine files, including PDF, TIFF and DWF files totalling 19 pages, all at Arch D-size, ensuring that DWF and PLT files are set to fit to page. This test replicates the type of traffic a typical wide-format device might experience in a real-world, multi-user environment. All of the files are submitted to the controller in a specific order and sent to the printer as a group, at which time the stopwatch begins; timing ends when the last page of the last file exits the device. Both devices were loaded with 36-inch rolls, with each file set to auto-rotate to save media.

Mixed File Types, Same Size, Dual-Roll

Canon imagePROGRAF PRO-4000S (time in seconds)	HP DesignJet Z5400PS (time in seconds)
Fast	Fast
1,711.13	2,260.03

BLI's dual-roll job stream consists of nine files, including PDF, TIFF and DWF files totalling 19 pages, all at Arch D-size, ensuring that DWF and PLT files are set to fit to page. This test replicates the type of traffic a typical wide-format device might experience in a real-world, multi-user environment. All of the files are submitted to the controller in a specific order and sent to the printer as a group, sending alternate jobs to different rolls, at which time the stopwatch begins; timing ends when the last page of the last file exits the device. Both devices were loaded with 36-inch rolls, with each file set to auto-rotate to save media.

Colour Throughput Time - A1 High-Resolution Portrait Printing

Canon imagePROGRAF PRO-4000S (time in seconds)		HP DesignJet Z5400PS (time in seconds)	
Fast	Standard	Fast	Normal
124.90	186.74	196.69	237.06

A single-page high-resolution A1 portrait was printed as a 5-page job using the device driver set to the semi-gloss photo paper/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

Canon imagePROGRAF PRO-4000S (time in seconds)		HP DesignJet Z5400PS (time in seconds)	
Fast	Standard	Fast	Normal
69.02	108.52	122.51	174.62

A single-page medium-resolution A1 portrait was printed as a 5-page job using the device driver set to the matte coated paper/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

Canon imagePROGRAF PRO-4000S (time in seconds)		HP DesignJet Z5400PS (time in seconds)	
Fast	Standard	Fast	Normal
232.05	369.30	410.96	480.40

A single-page high-resolution A0 portrait poster was printed as a 5-page job using the device driver set to the semi-gloss photo paper/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 per page (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 Medium-Resolution Retail Poster Printing

Canon imagePROGRAF PRO-4000S (time in seconds)		HP DesignJet Z5400PS (time in seconds)	
Fast	Standard	Fast	Normal
131.24	218.50	214.45	384.72

A single-page medium-resolution A0 retail poster was printed as a 5-page job using the device driver set to the matte coated paper/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-Page-Out Time from Ready State – High-Resolution Portrait Printing

	Canon imagePROGRAF PRO-4000S (time in seconds)		HP DesignJet Z5400PS (time in seconds)	
	Fast	Standard	Fast	Normal
Time Before Printing Commences	23.79	23.23	81.10	98.21
First Page Out Time	129.15	190.73	256.35	311.81

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 paper. Both devices were loaded with 36" rolls, with each job set to auto-rotate to save media.

First-Page-Out Time from Ready State – Medium-Resolution Retail Poster Printing

	Canon imagePROGRAF PRO-4000S (time in seconds)		HP DesignJet Z5400PS (time in seconds)	
	Fast	Standard	Fast	Normal
Time Before Printing Commences	23.41	22.03	70.90	69.96
First Page Out Time	70.49	114.10	157.90	394.83

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

Colour Print Quality

Colour Optical Density Evaluation

Canon imagePROGRAF PRO-4000S						
Semi-Glossy Photo Paper						
Highest (2400 x 1200 dpi)						
	1	2	3	4	Max.	Min.
Cyan	1.61	1.61	1.64	1.63	1.64	1.61
Magenta	1.34	1.33	1.36	1.35	1.36	1.33
Yellow	1.29	1.28	1.29	1.29	1.29	1.28
Black	2.45	2.46	2.43	2.42	2.46	2.42

HP DesignJet Z5400PS						
HP Proofing semi-gloss satin paper						
Best (2400 x 1200 dpi)						
	1	2	3	4	Max.	Min.
Cyan	0.79	0.80	0.79	0.79	0.80	0.79
Magenta	1.15	1.16	1.15	1.15	1.16	1.15
Yellow	1.26	1.23	1.24	1.24	1.26	1.23
Black	1.83	1.84	1.83	1.84	1.84	1.83

Note: Colour density readings were assessed by printing a BLI test file on proofing paper in high-quality colour settings (with Colour Correction disabled on both devices) and measuring the density of 100% dot fill using an XRite 508 densitometer.

Skin Tone and Neutral Grey Consistency

Skin Tone 1 (C=6, M=15, Y=16, K=0)		
	Canon imagePROGRAF PRO-4000S	HP DesignJet Z5400PS
Colour block		
2	0.5	0.1
3	0.5	0.1
4	0.4	0.2
5	0.5	0.3
6	0.6	0.2
7	0.7	0.2
8	0.7	0.2
9	0.8	0.1
Max. Delta E Variance	0.4	0.2

Skin Tone 2 (C=30, M=63, Y=75, K=0)		
	Canon imagePROGRAF PRO-4000S	HP DesignJet Z5400PS
Colour block		
2	0.6	0.5
3	0.6	0.3
4	0.2	0.4
5	0.9	0.4
6	0.8	0.2
7	0.7	0.3
8	0.9	0.1
9	1.4	0.3
Max. Delta E Variance	1.2	0.4

Skin Tone 3 (C=19, M=33, Y=50, K=0)		
	Canon imagePROGRAF PRO-4000S	HP DesignJet Z5400PS
Colour block		
2	0.8	0.3
3	1.2	0.4
4	0.1	0.6
5	0.7	0.3
6	0.9	0.2
7	1.2	0.7
8	0.9	0.8
9	1.3	0.6
Max. Delta E Variance	1.2	0.6

Neutral Grey		
	Canon imagePROGRAF PRO-4000S	HP DesignJet Z5400PS
Colour block		
2	0.3	0.2
3	0.4	0.3
4	0.3	0.3
5	0.6	0.3
6	0.2	0.3
7	0.3	0.4
8	0.4	0.3
9	0.3	0.1
Max. Delta E Variance	0.4	0.3

Note: Skin tone and neutral grey consistency measurements are based on nine readings taken from a BLI proprietary PDF test target file comprising four A1-sized solid coverage documents of three skin tones and a neutral grey with the Highest/Best print 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.

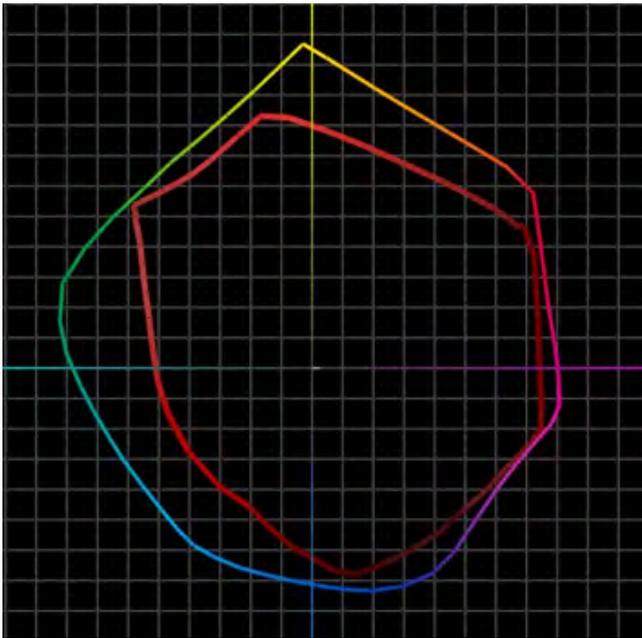
FOGRA 39 DRIFT TEST: Comparison of FOGRA39 colour patches before and after ink consumption test

	Canon imagePROGRAF PRO-4000S	HP DesignJet Z5400PS
Delta E Drift	2.8	11.5

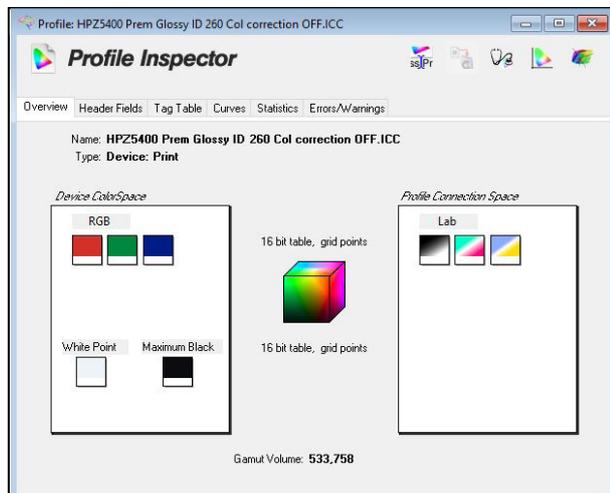
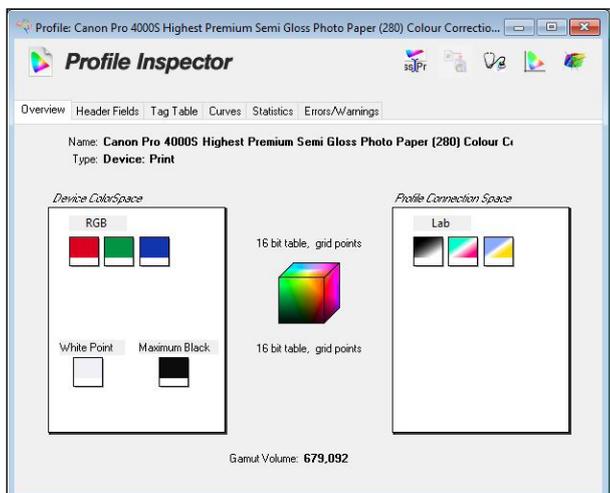
Colour Gamut Comparisons

Media Type/Settings	Canon imagePROGRAF PRO-4000S	HP DesignJet Z5400PS	Canon % larger/smaller (-) than HP
Photo Paper Highest/Max Quality	679,092	533,758	+ 27.2%

Colour Gamut Comparison



Canon imagePROGRAF PRO-4000S colour gamut (shown chromatically) on Semi-Gloss 280gsm photo paper in Highest setting and with colour correction disabled versus HP DesignJet Z5400PS colour gamut (red) on 260gsm glossy photo paper in Best setting with colour correction disabled.



Colour gamut profiles for the Canon imagePROGRAF PRO-4000S (left) and HP DesignJet Z5400PS (right) on semi-gloss photo paper in highest quality settings.

Device Feature Set

	Canon imagePROGRAF PRO-4000S	Advantage		HP DesignJet Z5400PS
Max. print resolution	2400 x 1200 dpi			2400 x 1200 dpi
Number of inks	8	✓		6
Ink tanks replaceable during operation	Yes	✓		No
Ink-drop size	4 picoliter	✓		4 picoliter (light grey and photo black); 6 picoliter (C, M, Y and MBk)
Ink cartridge capacity	160 ml, 330 ml and 700 ml (all colours)	✓		130 ml and 300 ml (all colours)
Starter ink capacity	2,080 ml total (330 ml x C, M, Y, MBk; 190 ml x PC, PM, Bk, GY)	✓		414 ml total (69 ml bundled starter ink)
Number of nozzles	18,432 (1,536 per colour)	✓		3,600 (720 per colour)
Number of printheads	1			1
Line accuracy	+/-0.1% or less			+/-0.1%
Minimum line width	INA			0.04 mm
Minimum print margins	Roll paper: Borderless or 3 mm (all sides); Cut sheet: 3 mm (Top, Side); 20 mm (Bottom)			3 mm
Borderless (0 mm) printing	Yes			Yes (with photo paper)
Maximum outside diameter of roll paper	170 mm	✓		150 mm
Maximum printable paper roll length	18 m (varies according to the OS and application)			INA
Maximum cut-sheet media length	1.6 m		✓	1.676 m
Maximum media thickness	Roll/cut: 0.07-0.8 mm			0.8 mm
Maximum media width	44 inches			44 inches
Media loading	Front			Front
Optional media handling	Roll holder set (supports 2" and 3" media cores)			Roll media adapter (supports 2" and 3" media cores)
Standard RAM	3 GB			64 GB (including virtual memory), based on 768 MB standard RAM
Hard drive	Standard 320-GB			Standard 320-GB
Interface	10/100/1000Base-T Ethernet, USB 2.0 High Speed, USB Memory Direct, Wireless LAN	✓		10Base-T/100Base-TX/1000Base-T Ethernet, USB 2.0
PDL	SG Raster			Adobe PS 3, CALS G4, HP PCL 3 GUI, HP-GL/2, HP RTL
Net weight (unpacked)	121 kg		✓	86 kg
Power consumption when in standby	1.8 W	✓		27 W
Power consumption when active	107 W	✓		120 W
Acoustic pressure	Operation: 49 dB (A) or less; Standby: 35 dB (A) or less		✓	Operation: 45 dB (A); Standby: 23 dB (A)
Acoustic power	Operation: 6.6 Bels or less			Operation: 6.7 Bels

Driver Feature Set

	Canon imagePROGRAF PRO-4000S	Advantage		HP DesignJet Z5400PS
Speed settings	Up to five, depending on media settings	✓		3 (Fast, Normal and Best Quality), depending on paper chosen
Economy mode	Yes (Fast setting)			Yes
Predefined profiles	5 (Under Easy Settings)		✓	6
Overview of profile settings provided	Yes			Yes
Media profiles	49	✓		20
IQ optimized for various types of output	Yes			Yes
Watermark	Yes	✓		No
Sharpen text	No		✓	Yes
Thicken fine lines	Yes	✓		No
Mirror image	Yes			Yes
Multi-up printing	Yes, 2 to 16	✓		No
Poster print mode	Yes (2 by 2)	✓		No
Page stamping	Yes (Date, Time, Name, Page Number)	✓		Not supported
Image rotation	Yes, auto 180 degrees			Yes, auto 180 degrees
Option to preview before print	Yes			Yes
Link to device web server from driver	No (there is a link to Status Monitor)			No
CMYK balance adjustment	Yes			Yes
Brightness adjustment	Yes			Yes
Contrast adjustment	Yes			Yes
Saturation adjustment	No		✓	Yes
PANTONE Emulation	No		✓	Yes
Advanced colour management options	Yes			Yes
Enlargement Copy Mode	Yes			Yes
Free Layout Capability	Yes			Yes
MS Office Plug-in	Yes			Yes
Adobe Photoshop Plug-in	Yes*	✓		No
Accounting Capability	Yes			Yes
Disable automatic cutter	Yes			Yes
Unidirectional printing selection option	Yes	✓		No

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

Ink Consumption

Table 1: Amount of ink in each Canon imagePROGRAF PRO-4000S Cartridge (in grams)

	GY	PM	M	MBK	PBK	PC	Y	C
Weight of cartridge prior to installation	737.9	743.1	661.1	658.1	736.9	765.8	635.6	641.4
Weight of cartridge at end of life	201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3
Net weight of ink	536.6	541.8	459.8	456.8	535.6	564.5	434.3	440.1
Total ink weight across eight cartridges								3,969.5

Table 2: Amount of ink in each HP DesignJet Z5400PS Cartridge (in grams)

	M	Y	PK	LG	MK	C
Weight of cartridge prior to installation	418.3	425	415.3	419.5	424.1	424.5
Weight of cartridge at end of life	103.3	103.3	103.3	103.3	103.3	103.3
Net weight of ink	315.0	321.7	312	316.2	320.8	321.2
Total ink weight across six cartridges						1,906.9

Table 3: Ink Used in Three 50-Page Runs of Packaging Proof Test Document on the Canon imagePROGRAF PRO-4000S (grams)

	GY	PM	M	MBK	PBK	PC	Y	C
Test Run 1 Net weight of ink used	31.5	19.4	15.6	4.4	31.0	10.7	12.6	8.9
Test Run 2 Net weight of ink used	31.2	19.0	15.4	3.7	32.6	11.9	13.6	9.2
Test Run 3 Net weight of ink used	29.2	19.0	14.5	7.1	28.3	9.7	12.2	8.6
Average amount of ink used across three runs	30.6	19.1	15.2	5.1	30.6	10.8	12.8	8.9
Total average ink weight across eight cartridges								133.1

Table 4: Ink Used in Three 50-Page Runs of Packaging Proof Test Document on the HP DesignJet Z5400PS (grams)

	M	Y	PK	LG	MK	C
Test Run 1 Net weight of ink used	30.2	32.3	33.0	50.5	6.5	11.9
Test Run 2 Net weight of ink used	21.8	22.9	22.9	37.9	56.6	12.5
Test Run 3 Net weight of ink used	21.8	22.7	22.3	37.2	2.1	12.3
Average amount of ink used across three runs	24.6	26.0	26.1	41.9	21.7	12.2
Total ink weight across six cartridges						152.5

Table 5: Ink Used in Three 50-Page Runs of Retail Poster Test Document on the Canon imagePROGRAF PRO-4000S (grams)

	GY	PM	M	MBK	PBK	PC	Y	C
Test Run 1 Net weight of ink used	1.5	2.8	51.2	9.1	0.8	4.3	23.5	19.4
Test Run 2 Net weight of ink used	3.7	3.3	44.5	6.7	2.5	2.2	19.8	14.5
Test Run 3 Net weight of ink used	1.3	1.9	50.8	9.9	0.9	2.0	23.4	1.0
Average amount of ink used across three runs	2.2	2.7	48.8	8.6	1.4	2.8	22.2	11.6
Total average ink weight across eight cartridges								100.3

Table 6: Ink Used in Three 50-Page Runs of Retail Poster Test Document on the HP DesignJet Z5400PS (grams)

	M	Y	PK	LG	MK	C
Test Run 1 Net weight of ink used	37.0	14.4	5.3	53.0	3.9	9.4
Test Run 2 Net weight of ink used	19.3	9.2	14.7	15.7	5.1	7.9
Test Run 3 Net weight of ink used	7.4	9.0	9.4	12.6	12.6	10.7
Average amount of ink used across three runs	21.2	10.9	9.8	27.1	7.2	9.3
Total ink weight across six cartridges						85.5

Table 7: Ink Used in Three 50-Page Runs of Studio Portrait Test Document on the Canon imagePROGRAF PRO-4000S (grams)

	GY	PM	M	MBK	PBK	PC	Y	C	
Test Run 1 Net weight of ink used	25.9	18.2	20.1	9.6	11.2	12.9	7.3	6.8	
Test Run 2 Net weight of ink used	31.7	34.5	19.1	9.6	13.4	21.9	12.5	6.2	
Test Run 3 Net weight of ink used	17.6	25.5	13.6	11.8	14.3	21.4	12.9	9.6	
Average amount of ink used across three runs	25.1	26.1	17.6	10.3	13.0	18.7	10.9	7.5	
Total average ink weight across eight cartridges									129.2

Table 8: Ink Used in Three 50-Page Runs of Studio Portrait Test Document on the HP DesignJet Z5400PS (grams)

	M	Y	PK	LG	MK	C	
Test Run 1 Net weight of ink used	16.0	14.1	7.7	54.8	2.6	12.2	
Test Run 2 Net weight of ink used	14.4	13.1	7.7	48.9	2.5	11.9	
Test Run 3 Net weight of ink used	9.2	8.1	4.8	30.0	1.7	7.6	
Average amount of ink used across three runs	13.2	11.8	6.7	44.6	2.3	10.6	
Total ink weight across six cartridges							89.2

Ink Consumption Test Methodology Overview

Buyers Lab's ink consumption analysis was conducted using three document types (proof, retail poster and photo). The packaging proof document was formatted as a PDF, the retail poster as a JPG file and the studio portrait was formatted as a TIFF file and all were sized at ISO A1.

The Canon imagePROGRAF PRO-4000S was installed in BLI's lab with the latest level of firmware (as of July 2016) and connected to a Windows 10 workstation using a 1000BaseT TCP/IP connection. The device was left in default configuration throughout testing. The Canon driver was used for all testing and was left in default colour setting configuration. The packaging proof document was printed on 255gsm semi-gloss 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 250gsm glossy photo media in Standard mode.

The HP DesignJet Z5400PS was installed in BLI's lab with the latest level of firmware (as of July 2016) and connected to a Windows 10 workstation using a 1000BaseT TCP/IP connection. The HP Adobe PS3 driver was used for all testing and was left in default colour setting, with media selection set to plain paper and the image set to print

at actual size. The packaging proof document was printed on 195gsm gloss 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 250gsm gloss photo media in Normal mode.

Before installing the ink cartridges, BLI 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. Then, for each model, one cartridge was run to exhaustion and the weight of the empty cartridge was recorded.

Test Environment

Testing was conducted in BLI's European test lab, in an atmospherically controlled environment monitored by a 24/7 ExTech RH520 Temperature/RH chart recorder, ensuring that typical office conditions were maintained. All paper used in testing was allowed to acclimatize inside the facility for a minimum of 12 hours before being used.

Test Equipment

Test equipment: BLI's dedicated test network in Europe, consisting of Windows 2008 servers, Windows 10 workstations, 10/100/1000BaseTX network switches and CAT5e/6 cabling.

Test Procedures

The test methods and procedures employed by BLI in its lab testing include BLI's proprietary procedures and industry-standard test procedures. In addition to a number of proprietary test documents, BLI uses industry standard files including a BLI 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 a profile software tool from Colour Confidence that was read using an EFI ES-1000 colour spectrophotometer and analysed using Chromix ColorThink Pro 3.0 software. Density of black and colour output was measured using an X-Rite 508 densitometer.

About Buyers Laboratory LLC

Buyers Laboratory LLC (BLI) is the world's leading independent provider of analytical information and services to the digital imaging and document management industry. For more than 50 years, buyers have relied on BLI to help them differentiate products' strengths and weaknesses and make the best purchasing decisions, while industry sales, marketing and product professionals have turned to BLI for insightful competitive intelligence and valued guidance on product development, competitive positioning and sales channel and marketing support. Using BLI's web-based bliQ and Solutions Center services, 40,000 professionals worldwide create extensive side-by-side comparisons of hardware and software solutions for more than 15,000 products globally, including comprehensive specifications and the performance results and ratings from BLI's unparalleled Lab, Solutions and Environmental Test Reports, the result of months of hands-on evaluation in its US and UK labs. The services, also available via mobile devices, include a comprehensive library of BLI's test reports, an image gallery, hard to find manufacturers' literature and valuable tools for configuring products, calculating total cost of ownership (TCO) and annual power usage. BLI also offers consulting and private, for-hire testing services that help manufacturers develop and market better products and consumables.

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