TEST REPORT

spencerLAB DIGITAL COLOR LABORATORY

Print Quality Analysis: Modes, Media, and Competitive

Xerox ColorQube™ 9203

The *spencerLAB* DIGITAL COLOR LABORATORY has conducted independent testing and evaluation of print quality attributes of the Xerox ColorQube 9203 color multifunction printer. In order to determine the acceptability and suitability of this novel ColorQube 9200 Series tabloid/A3-size solid ink MFP's output for the office color market, *spencerLAB* conducted comprehensive Print Quality Analyses of Xerox ColorQube 9203 output, evaluating print quality on its different speed modes, on different media types, and in comparison with some key competitors' products. Competitive analysis in respective plain paper default modes on Boise X-9 paper was performed with the Canon imageRUNNER C5180, the Konica Minolta bizhub C650, and the Ricoh Aficio MP C5000 – color laser MFP's that target the office color printing market segment.

spencerLAB concluded that the print quality of the Xerox ColorQube 9203 on its variable speed modes provides an office user with the option to cover a very broad spectrum of office color document printing, ranging all the way from printing a rapid personal to a high quality office document. Leveraging the inherent advantages of solid ink technology, the ColorQube 9203's print quality exhibited negligible change among the four tested media. Competitive print quality evaluation showed that overall the ColorQube 9203 offers comparable or better print quality to the competitive devices tested, maintaining a good balance of quality of various elements on a typical office document such as Text & Lines, Tints & Blends, and Images.

The *spencerLAB* DIGITAL COLOR LABORATORY, a division of Spencer & Associates Publishing, Ltd., is an independent test laboratory with a broad base of industry clients. Although this independent comparative study was commissioned by Xerox Corporation, *spencerLAB* believes these results maintain its reputation for the integrity of its procedures and analyses. Results stated herein are based upon direct testing by *spencerLAB* of actual products believed to be representative.

Executive Summary

The *spencerLAB* DIGITAL COLOR LABORATORY conducted a comprehensive evaluation of print quality of the Xerox ColorQube 9203 looking at many different aspects of print quality. In the first analysis, *spencerLAB* evaluated the print quality attributes of the Xerox ColorQube 9203 "ColorQube 9203" on its four available variable speed modes – High Resolution/Photo, Enhanced, Standard, and Fast Color to determine their suitability to a typical office document printing intent. Secondly, our analysis looked at the dependence of print quality, when printing on a variety of different media types used in an office environment, in comparison with competitive color laser MFP's. Thirdly, we performed a comparative evaluation of ColorQube 9203's print quality with color laser-based MFPs: the Canon imageRUNNER C5180 "Canon C5180", the Konica Minolta bizhub C650 "KM C650" and the Ricoh Aficio MP C5000 "Ricoh C5000".

Key Findings

In mode print quality evaluation on the ColorQube 9203, the High Resolution/Photo and the Enhanced mode (default) output were acceptable overall for office use, with High Resolution/Photo mode providing the highest quality. Standard mode's lower print quality would be suitable for rapid printing of internal draft communication in an office environment, while Fast Color mode may be suitable for quick personal drafts where print quality is less important. Intrinsically, print quality decreases as print speed increases.

In comparative media testing, there was negligible noticeable difference in overall print quality on output from the ColorQube 9203 on different media types. In comparison, Canon C5180, KM C650 and Ricoh C5000 output on the tested media showed some differences in certain attributes of print quality. Differences in print quality on Canon C5180 and KM C650 were mostly saturation-related, where output on high grade media appeared generally more saturated than on other media tested. The Ricoh C5000 exhibited the most differences in print quality on different media types, with color toner splatter causing loss of edge sharpness on standard office plain paper and economy media as well as generally lighter rendition on high grade and recycled media. Some differences were noticed on all printers' output due to differences in brightness and surface smoothness of the variety of different media tested. Output on high grade stock had better contrast due to higher brightness of paper. economy paper has lower brightness and a yellow-green tint, which contributed to comparatively lower contrast and imparted a yellow cast on all printers' output.

Comparative plain paper, default mode print quality of the ColorQube 9203 was mostly comparable or better than other tested printers' print quality. Colors on the ColorQube 9203 output were the most vibrant and saturated, making business graphic elements very eye-catching; however, some graininess limited overall quality. Canon C5180 output had very smooth screening, although Text & Lines appeared comparatively thicker with soft edges limiting sharpness. KM C650 Text & Lines were rendered overall thinner and output appeared soft and muted in comparison. Ricoh C5000 output had good black sharpness, but edge sharpness of secondary colors was poor and coarse screening detracted from overall color print quality.

General Methodology

Key elements of *spencerLAB* methodology included:

- Selection of appropriate test files from the *spencerLAB* PRINTER TEST SUITE
- Determination of acceptable test media (standard office, recycled, high-grade, economy)
- Print quality analysis of ColorQube 9203 output in its variable speed modes on the standard office media
- Print quality analysis of ColorQube 9203 and competitive printers' output in default modes on multiple media types, and
- Comparative print quality analysis of ColorQube 9203 *vs.* competitive printers' output in default modes on the standard office media

Test Parameters

Print quality was analyzed comparatively by a team of experienced *spencerLAB* analysts – within the expected range appropriate to the intended applications in the office printing marketplace – noting the areas of Black Text & Lines, Color Text & Lines, Tints & Blends, and Images.

Test files selected from the *spencerLAB* PRINTER TEST SUITE (Version 4.1) included a range of PDF and PostScript files. One unit for each competitive printer was used in testing and analysis, and assumed to be representative. All devices were serviced before obtaining the test prints. PDF files were printed under Windows XP (SP3) operating system using Acrobat Reader 9.1.0 with the LET PRINTER DETERMINE COLORS option selected in Reader's Advanced print dialog box. Test files were printed using the latest PostScript driver available with the printer or from the respective manufacturer's web site. All test prints were printed by Xerox and provided to *spencerLAB* for analysis.

Print Quality Test Results and Analysis

Xerox ColorQube 9203 Print Quality on its Variable Speed Modes

This analysis was conducted on ColorQube 9203 output on 20# Boise X-9, a standard office paper, comparing the four variable speed modes available in ColorQube 9203 printer's PostScript driver – High Resolution/Photo, Enhanced, Standard and Fast Color.

Xerox ColorQube 9203 Test Print Variable Speed Modes		
Mode	Speed (pages-per-minute)	Addressability (dpi)
High Resolution/Photo	38	2400x600 FinePoint
Enhanced	50	450x567
Standard	70	300x500
Fast Color	85	225x400

These four modes provide progressively better print quality from Fast Color up through High Resolution/Photo mode, with a corresponding trade-off in printing throughput speed. Print resolutions and respective speeds for the four modes are shown in the table above.

High Resolution/Photo and the Enhanced mode (default) output were acceptable overall for office use, with High Resolution/Photo mode providing the highest quality. Standard mode's lower print quality would be suitable for rapid printing of internal draft communication in an office environment, while Fast Color mode's lowest print quality may be suitable for quick personal drafts.

Black Text & Lines

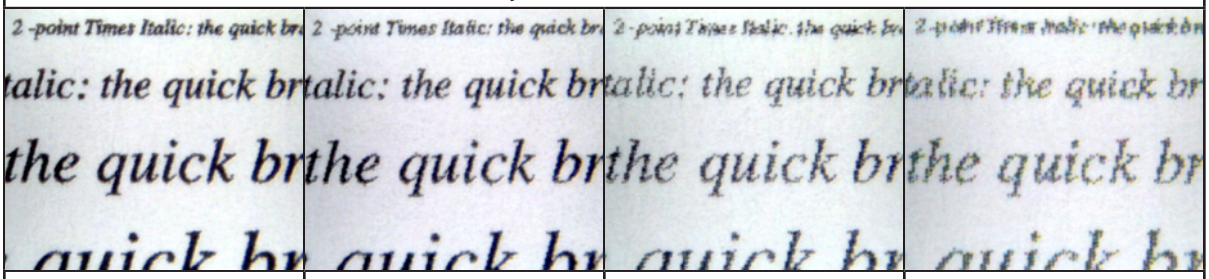
Differences noted between Black and Color and between Text and Lines are discussed in the following paragraphs.

Black Text

Black Text in High Resolution/Photo mode was rendered slightly thicker and appeared more saturated and dense than Black Text on the other three modes – Enhanced, Standard and Fast Color. Under magnification, Black Text characters in High Resolution/Photo mode appeared to be more uniform than on Enhanced, Standard and Fast Color mode output. Text appeared overall smooth at normal viewing distance on High Resolution/Photo and Enhanced modes. Some random jaggedness was noticeable on both High Resolution/Photo and Enhanced mode Black Text; it was more apparent on Enhanced mode where the text was less dense than High Resolution/Photo mode output.

Black Text in Standard mode was rendered with comparatively lower quality and density and appeared muted in comparison to the higher Enhanced and High Resolution/Photo modes. On Standard mode output, individual black dots were visible under magnification. White unfilled spaces were noticeable within characters at normal viewing distance, making the text appear gray instead of black. In Fast Color mode, the lowest print quality available among all four modes, Black Text was rendered fuzzy and grainy. Fast Color pure Black Text was rendered as four-color (CMYK) black and appeared gray rather than black.

Black Text on ColorQube 9203, Mode Comparison on Standard Office Media

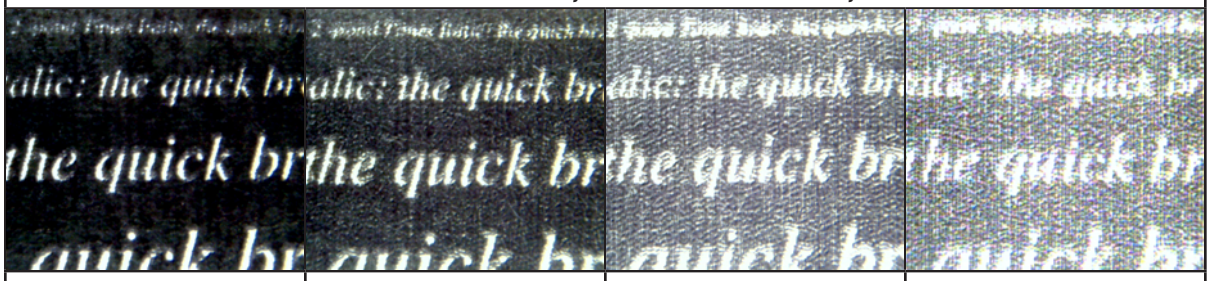


High Res/Photo	Enhanced	Standard	Fast Color

Black Text was legible at normal viewing distance down to 2-point size on High Resolution/Photo and Enhanced, and down to 4-point on Standard and Fast Color mode output. Under magnification, minor random dropouts were noticeable at 8-point size on High Resolution/Photo, Enhanced and Standard, and 10-point size on Fast Color mode output.

On all four output modes, Reverse Black Text was rendered with unsharp edges (irregular edge rendition). Random fill-ins were noticeable even at 14-point size, although text legibility was maintained down to 4-point size, even at normal viewing distance. Fill-ins became progressively more pronounced as modes changed from lower quality Fast Color through to higher quality High Resolution/Photo.

Reverse Black Text: ColorQube 9203, Mode Comparison, Standard Office Media



High Res/Photo	Enhanced	Standard	Fast Color

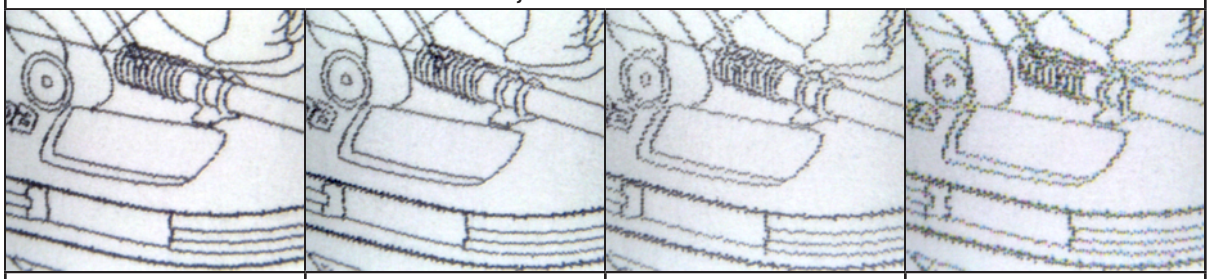
Black Lines

Horizontal and vertical straight Black Lines were rendered cleanly on High Resolution/Photo and Enhanced mode output with acceptable quality. Some stepping was noticeable on curved Black Lines on Enhanced mode output; less apparent on High Resolution/Photo mode output due to higher resolution rendition. Fine lines, as seen on the Mazda car drawing, were rendered soft and slightly uneven on both High Resolution/Photo and Enhanced modes, more noticeable on the Enhanced mode output. As seen below, fine details were marginally maintained on both High Resolution/Photo and Enhanced mode output and very thin lines were rendered broken on Enhanced mode output.

On Standard and Fast Color mode output, Black Lines were rendered fuzzy and broken. Fine Lines were rendered as a sequence of dots, appearing broken and causing loss of fine line details and a blurred appearance even at normal viewing distance. As noticed in Black Text on Fast Color mode output, pure Black Lines were rendered with four-color black and appeared gray rather than black.

Radial Black Lines exhibited jaggedness on all four modes' output and were rendered broken on Enhanced, Standard and Fast Color modes.

Black Lines on ColorQube 9203, Mode Comparison on Standard Office Media



High Res/Photo	Enhanced	Standard	Fast Color

Color Text & Lines

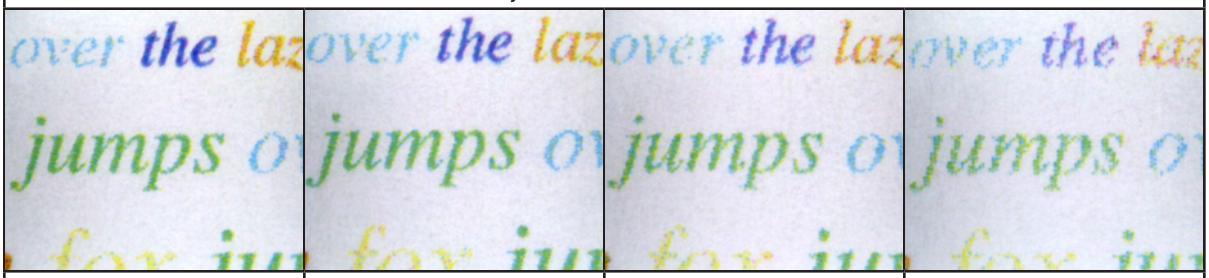
As noted for Black Text & Lines, Color Text & Lines on High Resolution/Photo and Enhanced mode output were acceptable for most office use applications. The Standard mode provided internal draft quality output, and Fast Color mode may be suitable only for very low print quality, quick priority documents such as personal drafts.

Color Text

Color Text on High Resolution/Photo and Enhanced mode output was rendered with good quality. As noticed on Black Text, Color Text appeared smooth at viewing distance on High Resolution/Photo and Enhanced modes. Saturation and thickness of Color Text on High Resolution/Photo mode output was slightly more than on the Enhanced mode output. Under magnification, some screening was noticeable on tertiary colored text on both High Resolution/Photo and Enhanced mode output, although it was not distracting. Color Text was still rendered with soft edges; however, in contrast to the Black Text output, Color Text did not exhibit as much random jaggedness.

Standard mode Color Text output was rendered with lower saturation and less crispness than the High Resolution/Photo and Enhanced mode output. Both Standard and Fast Color mode Color Text were rendered with comparatively lower quality and appeared soft and muted, even at normal viewing distance; Fast Color mode output was lower quality than Standard mode output.

Color Text on ColorQube 9203, Mode Comparison on Standard Office Media



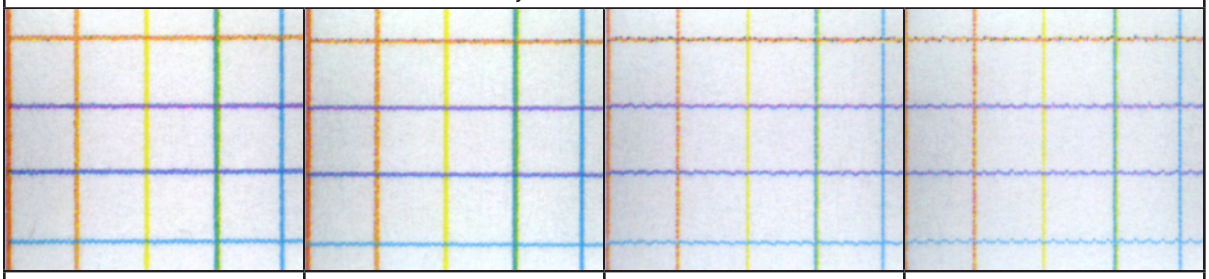
High Res/Photo	Enhanced	Standard	Fast Color

On all four modes' output, regular and reverse Color Text were legible down to 4-point size at normal viewing distance. Reverse Color Text on High Resolution/Photo and Enhanced mode was smoother than on Standard and Fast Color modes. On Standard and Fast Color mode output, Reverse Color Text was rendered soft and desaturated.

Color Lines

Color Lines were smooth with good quality in both High Resolution/Photo and Enhanced mode output, but were not razor-sharp and exhibited soft edges; they were more uniform than Black Line output. High Resolution/Photo mode Color Lines were rendered more saturated and slightly more dense and uniform than on Enhanced mode output. Horizontal and vertical straight Color Lines were rendered smooth and clean on High Resolution/Photo and Enhanced mode output; however, under magnification, angled and curved fine Color Lines were slightly uneven. On Standard and Fast Color mode output, angled, curved and even straight Color Lines appeared jagged and blurred at normal viewing distance.

Color Lines on ColorQube 9203, Mode Comparison on Standard Office Media



High Res/Photo	Enhanced	Standard	Fast Color

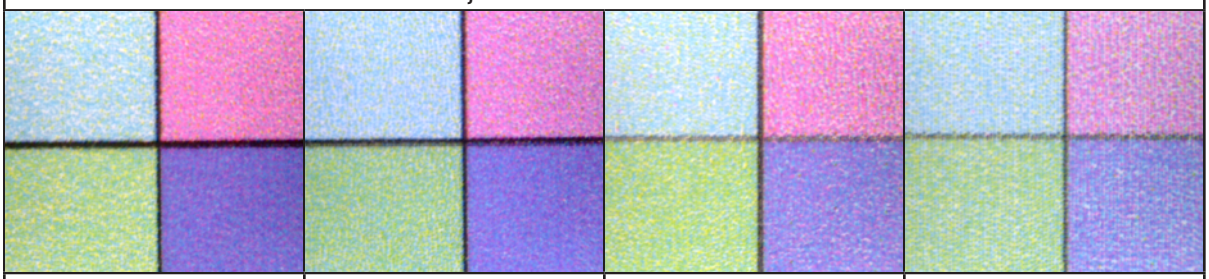
Tints & Blends

High Resolution/Photo and Enhanced mode output exhibited vibrant and saturated colors, whereas Standard and Fast Color mode output appeared muted in comparison. Tints & Blends on High Resolution/Photo and Enhanced modes were acceptable for higher quality office use. Standard mode output was suitable for internal draft quality and Fast Color mode output was very low quality.

Tints

Good saturation was achieved on solid colors in both High Resolution/Photo and Enhanced mode output, exhibiting good vibrance. Lighter tints exhibited some graininess. Tints in Standard mode output had lower saturation, and Fast Color mode Tints appeared muted with some noticeable printhead streaking. Solid blacks were rendered even richer and deeper on High Resolution/Photo mode than on Enhanced mode output, whereas on Standard and Fast Color mode solid blacks appeared noisy with visible streaking. Machine direction streaking was noticeable in Standard and Fast Color mode output through solid color areas. Grays were rendered as four-color grays on all modes.

Tints on ColorQube 9203, Mode Comparison on Standard Office Media



High Res/Photo	Enhanced	Standard	Fast Color

Blends

Blends on High Resolution/Photo and Enhanced mode were rendered smooth and uniform and output looked vibrant, whereas, on Standard and Fast Color mode, the Blends were rendered with overall lower saturation, making the output appear muted and flat in comparison to higher quality modes. Standard and Fast Color mode output appeared grainy with noticeable streaking. Color-to-Color transforms were rendered more linear and smoother going from faster to slower print modes.

Blends on ColorQube 9203, Mode Comparison on Standard Office Media	
	High Resolution/Photo
	Enhanced
	Standard
	Fast Color

Images

High Resolution/Photo mode Images had slightly better sharpness and saturation than Enhanced mode Images. High Resolution/Photo mode Image output was rendered with richer blacks and exhibited better image depth than Enhanced mode. Both High Resolution/Photo and Enhanced mode output were flat with reduced apparent image contrast through the highlight-midtone areas. Solid Image areas appeared slightly grainy on High Resolution/Photo and Enhanced mode output, with the graininess becoming distracting on lower Standard and Fast Color mode output.

On Standard and Fast Color mode output, there was less shadow detail as compared to higher High Resolution/Photo and Enhanced mode Image output. Standard and Fast Color mode Images appeared grainy and desaturated, with Fast Color mode Images more so. Lack of Image details in the lower resolution Standard and Fast Color modes was noticeable. Both Standard and Fast Color mode Image output was lower quality, with visible streaks in dark image areas. Overall colors were quite realistic on all modes' output; however, High Resolution/Photo mode Images were slightly yellow and Standard mode Images appeared to have a slight magenta cast in comparison.

Images on ColorQube 9203, Mode Comparison on Standard Office Media			
			
High Res/Photo	Enhanced	Standard	Fast Color

Print Quality Analysis On Multiple Media Types

This analysis was conducted on the ColorQube 9203 and competitive color laser MFPs using each product's *Default* mode for each media type, respectively. Test prints were compared on four media types: International Paper Hammermill Color Copy Cover 60# (high grade), Boise X-9 20# (standard office), Boise ASPEN 100 20# (recycled), and Xerox High Yield Business Paper 17.7# (economy).

Print Media Matrix		
Paper Category	**Brand**	**Weight**
High Grade	Hammermill Color Copy Cover	60#, 100 brightness
Standard Office	Boise X-9	20#, 92 brightness
Recycled	Boise ASPEN 100	20#, 92 brightness
Economy	Xerox High Yield Business Paper	17.7#, 84 brightness

Some differences were noticeable on all printers' output due to differences in brightness and surface smoothness of the media tested. Output on high grade stock had better contrast due to the higher media brightness. Lower brightness and a yellow-green tint of the economy paper contributed to comparatively lower contrast, and imparted a yellow cast on all printers' Image output.

There was negligible difference noticeable in overall print quality attributes on output from the ColorQube 9203 on different media types. Although no significant differences in print quality were noted on Canon C5180 and KM C650 output, minor color rendition and saturation differences were observed. Ricoh C5000 output on the tested media showed the most noticeable differences in overall print quality, such as toner splatter and lighter rendition.

Black Text & Lines

Negligible differences were noticeable in Black Text & Line print quality on output from the ColorQube 9203, the Canon C5180, and the Ricoh C5000 among the tested media types. Black Text & Line quality appeared marginally smoother on high grade paper compared to the other media types, due to better surface smoothness of the high grade paper.

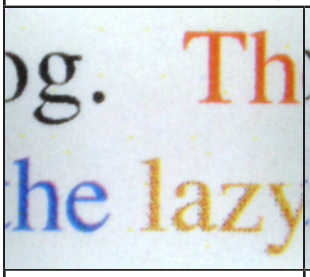
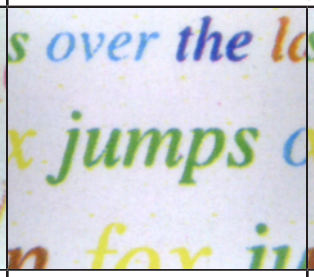
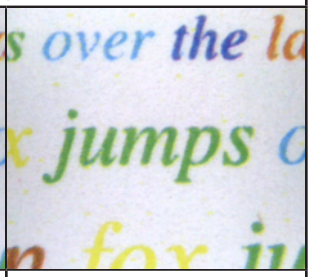
Black Text & Lines were rendered slightly darker and hence appeared marginally sharper on KM C650 output on high grade media than on economy, recycled, and standard office paper.

Color Text & Lines

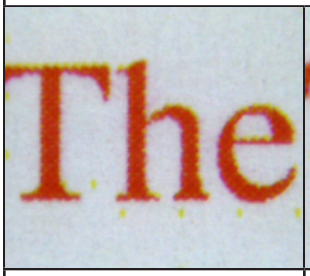
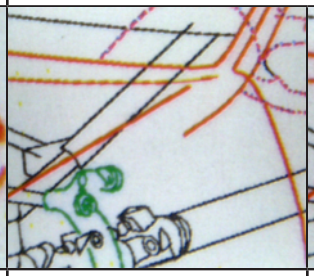
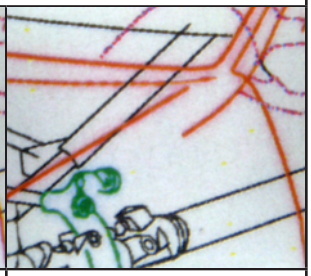
As noted for Black Text on the ColorQube 9203 output, there were negligible differences in Color Text & Line print quality among the different media types tested. Output on high grade paper appeared slightly smoother than other media output due to its smoother surface and higher brightness.

On Canon C5180 output, Color Text was rendered marginally thicker on high grade and economy media compared to the output on standard office and recycled media. However, there was no significant difference in Color Lines print quality among the tested media types.

Color Text & Lines on KM C650 output was rendered with overall comparable quality on all media tested, though on standard office, recycled, and economy media Color Text was rendered with slightly lower saturation than on the high grade media.

KM C650 Text, Media Comparison		Canon C5180 Text, Media Comparison	
			
High Grade	Standard Office	High Grade	Recycled

Color Text & Lines on Ricoh C5000 output was rendered slightly sharper on high grade media as compared to other tested media. Under magnification, standard office, recycled, and economy paper output exhibited some toner splatter, especially on secondary colors, making the Text & Lines appear blurred. Toner splatter was less noticeable on recycled media output.

Ricoh C5000 Color Text, Media Comparison		Ricoh C5000 Color Lines, Media Comparison	
			
High Grade	Economy	High Grade	Standard Office

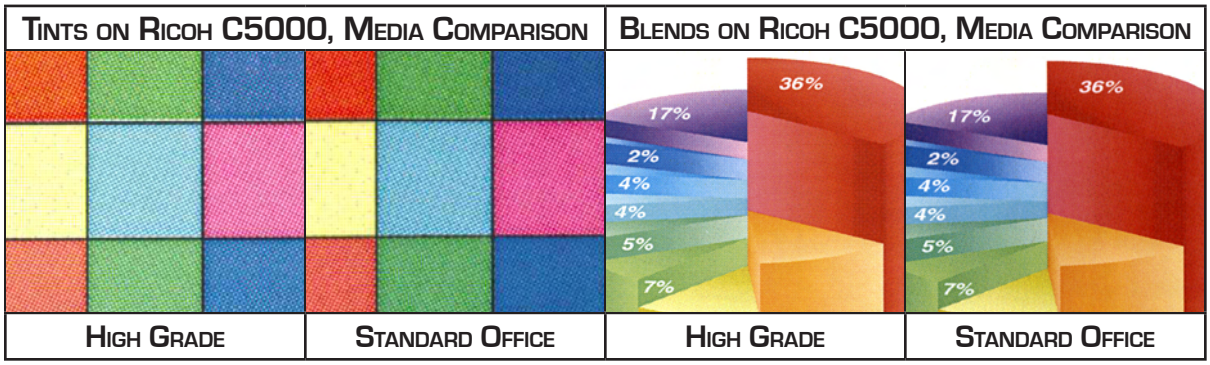
Tints & Blends

There was negligible difference noticeable in Tints & Blends print quality on output from the ColorQube 9203 among the different media types tested.

Canon C5180 Tints & Blends exhibited mottling on the standard office, economy and recycled media output. Mottling was not noticed on high grade media output.

KM C650 Tints & Blends on standard office, recycled, and economy media showed mottling, more noticeably on the Blends. Tints & Blends were rendered with slightly higher saturation on the high grade media.

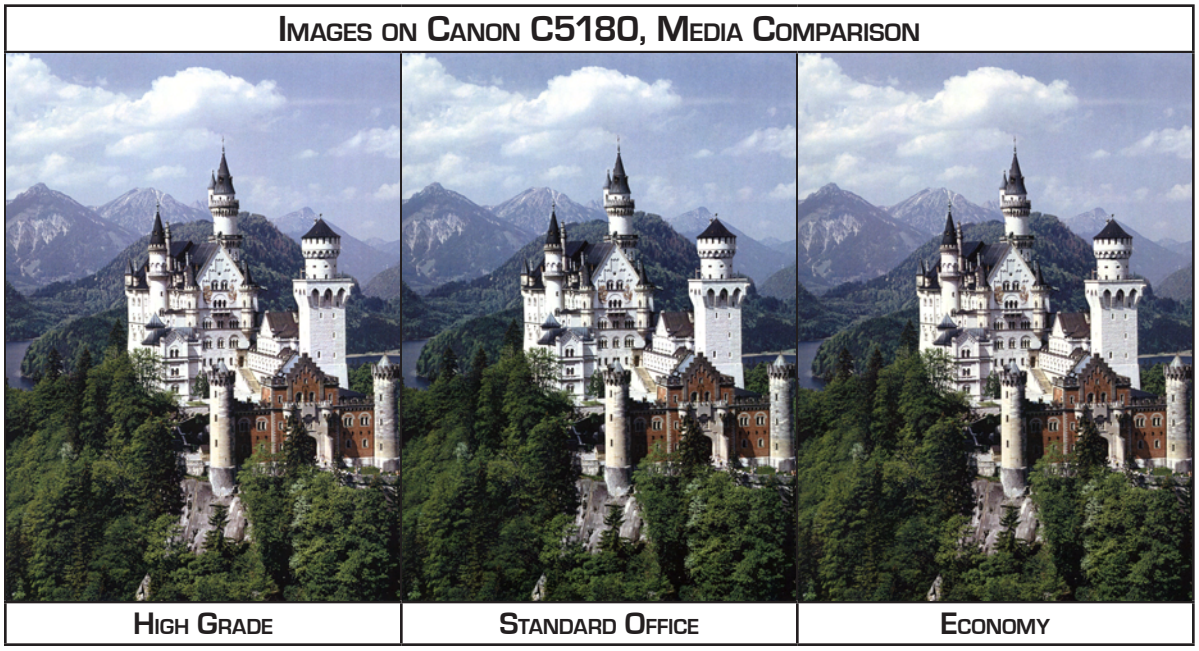
Ricoh C5000 Tints & Blends appeared smoother on standard office, economy and recycled media compared to high grade media. Screening was more noticeable and distracting on high grade media. Tints were rendered with higher saturation on standard office and economy media than on high grade and recycled media.



Images

The overall quality of ColorQube 9203 output was comparable on all four media types tested. However, the Images rendered on economy paper had a slightly yellow tinge due to the paper color.

Canon C5180 Images on high grade paper exhibited a magenta cast and some banding was noticeable on solid image areas. Images rendered on high grade paper were smoother



than Images on other tested papers. The higher contrast of the Canon C5180 output lost both highlight and shadow detail; on the lower brightness economy paper the images looked darker, losing more shadow details. Severe mottling was noticeable on standard office, economy and recycled media output.

KM C650 Images on high grade media had more image depth due to richer blacks, and were slightly sharper than Images on standard office, recycled, and economy media. Images on economy media appeared yellow due to yellow-green paper color. Severe mottling was noticeable on standard office, economy and recycled media output that detracted from overall image quality; it was more severe on economy media.

Ricoh C5000 Images on high grade and recycled media were rendered lighter than Images on standard office and economy media, which displayed comparatively higher saturation. Images on standard office media had a slight magenta cast and Images on economy media had a magenta-yellow cast.

KM C650 Images, Media Comparison		Ricoh C5000 Images, Media Comparison	
			
High Grade	Economy	High Grade	Standard Office

Competitive Print Quality Analysis On Default Print Modes

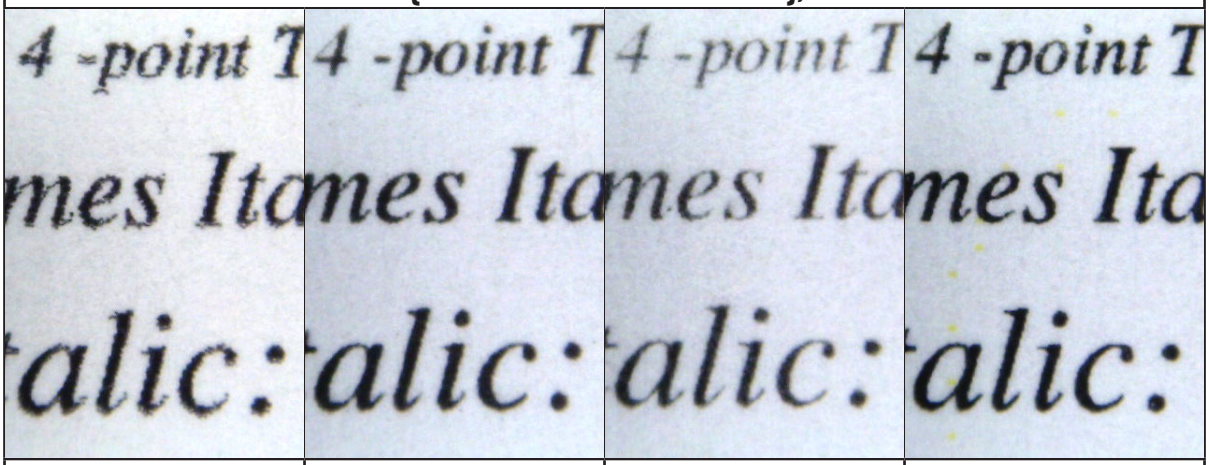
This analysis was conducted on Boise X-9, 20# paper in each MFP's respective *Default* mode available in respective PostScript print drivers of the machines tested.

Competitive Test Print Systems		
Printer	**Speed (pages-per-minute)**	**Driver Setting**
Xerox ColorQube 9203	Color: 50, B&W: 50	Enhanced
Canon imageRUNNER C5180	Color: 51, B&W: 51	600 dpi
Konica Minolta bizhub C650	Color: 50, B&W: 65	Document
Ricoh Aficio MP C5000	Color: 50, B&W: 50	600 dpi

Black Text & Lines

Black Text and horizontal and vertical Black Lines on ColorQube 9203 output were rendered smoothly with acceptable quality; however, angled and curved Black Lines were jagged and broken, and appeared uneven, while small Black Text looked slightly jagged and non-uniform. Random dropouts were noticeable, more on 6-point and smaller Black Text and on angled and curved Lines.

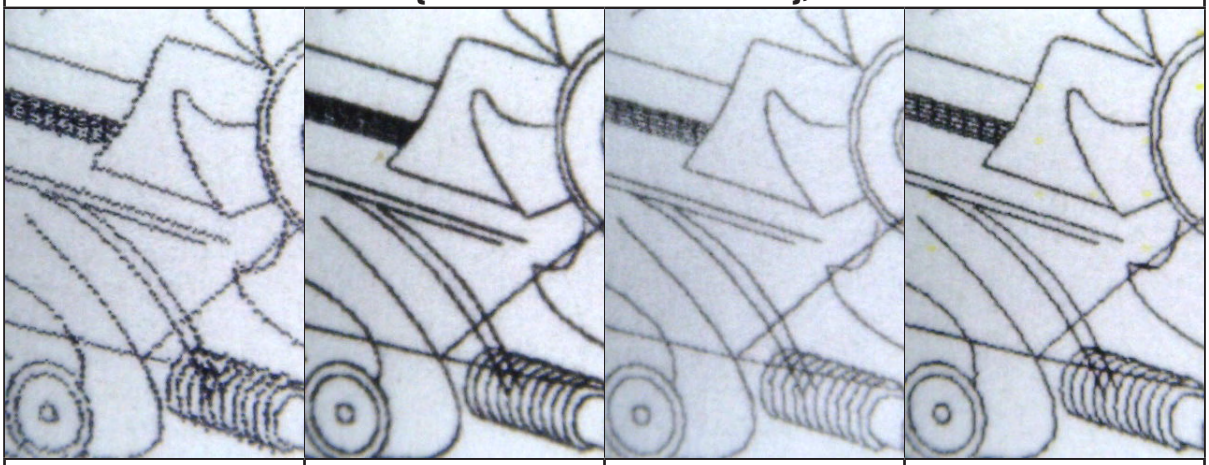
Black Text Comparison (*Enhanced Black* extracts), Standard Office Media



ColorQube 9203	Canon C5180	KM C650	Ricoh C5000

Black Text & Lines on the Canon C5180 and KM C650 Black Text were rendered smoothly and had comparably softer edge rendition. However, Canon C5180 Black Text & Lines were rendered thicker in comparison and lost fine line details, whereas those of the KM C650 were rendered thin and appeared muted and only marginally maintaining fine line detail. Ricoh C5000 Black Text & Lines were the sharpest, with minor jaggedness and stepping on curved Lines noticeable under magnification.

Black Lines Comparison (*Enhanced Black* extracts), Standard Office Media



ColorQube 9203	Canon C5180	KM C650	Ricoh C5000

ColorQube 9203, Canon C5180 and Ricoh C5000 Black Text was legible down to 2-point, but only to 4-point on the KM C650. Dropouts on fine serifs started at 6-point on Canon C5180, 8-point on KM C650, and 4-point on Ricoh C5000 output.

Reverse Black Text on ColorQube 9203 output exhibited non-uniformities within the characters making the text appear less sharp than on Ricoh C5000 output. Minor fill-ins on fine serifs starting at 8-point Reverse Text were noted on Canon C5180 and Ricoh C5000 output, and at 10-point on KM C650 output.

Radial Lines on all printers' output displayed similar characteristics as noted above and exhibited some jaggedness under magnification.

Color Text & Lines

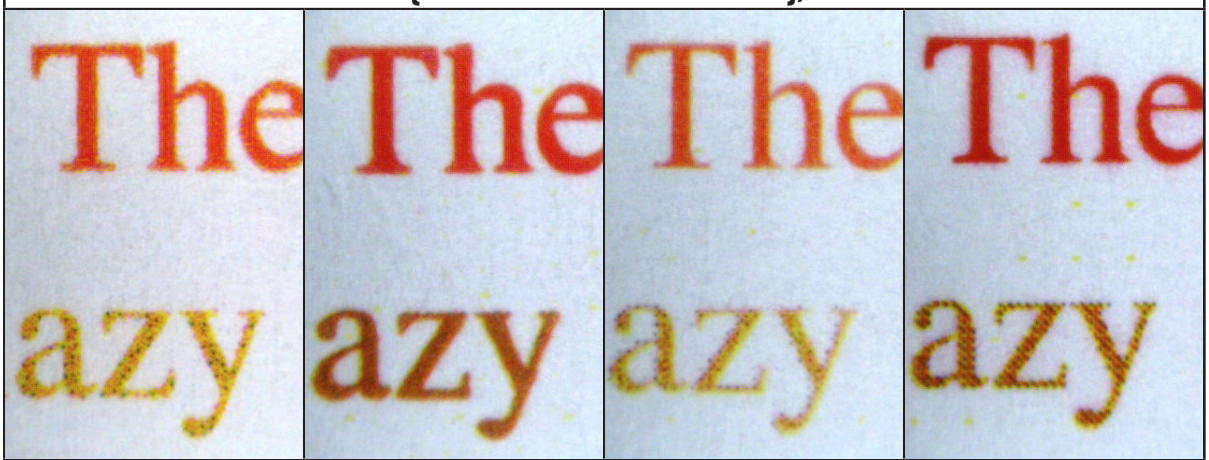
ColorQube 9203 Color Text was rendered generally superior to all other printers' output and also better than its Black Text output. Color Lines were rendered smoothly, and ColorQube 9203 output had good saturation. Although not razor-sharp, Color Text was rendered relatively cleanly with no evident defects such as splatter. Some screening/graininess was noticeable on ColorQube 9203 tertiary Color Text, although not distracting.

Canon C5180 Color Text had soft edges and appeared thick in comparison, which in turn made the Color Text appear less sharp and lose some fine line detail. Screening of Canon C5180 Color Text and Lines was very smooth.

As noted on KM C650 Black Text & Lines, Color Text & Lines were rendered thinner in comparison to other MFPs' output and appeared soft and muted.

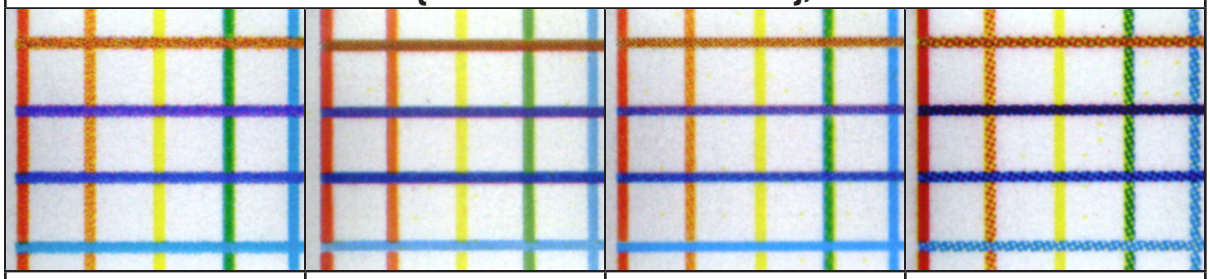
Color Text & Lines on the Ricoh C5000 were rendered with poor quality, exhibiting distracting coarse screening patterns with tertiary Color Text appearing very jagged. Toner splatter was noticeable, causing the Color Text & Lines to look blurred, especially on secondary colors.

Color Text Comparison (*Color Spectrum* extracts), Standard Office Media



ColorQube 9203	Canon C5180	KM C650	Ricoh C5000

Color Lines Comparison (*Color Spectrum* extracts), Standard Office Media



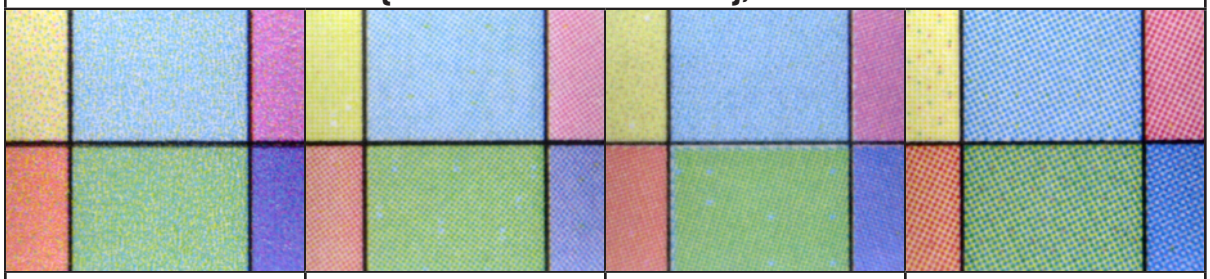
ColorQube 9203	Canon C5180	KM C650	Ricoh C5000

Misregistration was noticed on the Canon C5180, especially on tertiary Color Text such as Brown, and on some KM C650 Color Lines; the Ricoh C5000 showed darkening of screened colors adjacent to solid black, an apparent edge effect.

Tints & Blends

ColorQube 9203 Tints & Blends were rendered smoothly; some graininess was noticeable; however, overall quality was good. Colors were most vibrant and exceptional saturation was achieved on the output. Grays were rendered in four colors and solid Blacks were rendered richer than other MFPs' output. Highlight-Shadow and Color-to-Color Blends were generally rendered smoothly on ColorQube 9203 output. Blue Blends appeared to shift towards purple on the ColorQube 9203 and showed some harsh transitions on the Highlight-Shadow transform.

Tints Comparison (*Color Graphic* extracts), Standard Office Media



ColorQube 9203	Canon C5180	KM C650	Ricoh C5000

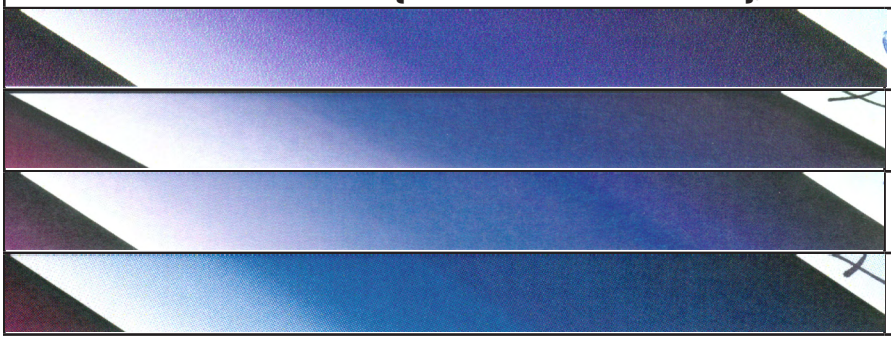
Canon C5180 Tints & Blends were rendered smoothly overall; however, some mottling was visible and the output appeared muted in comparison with the ColorQube 9203. The Canon C5180 Blue Highlight-Shadow Blend exhibited some harsh transitions. Highlights seemed extended, reducing midtone range, and colors appeared to be comparatively dark.

KM C650 Tints & Blends were also rendered quite smoothly; however, some non-uniform transitions were also noticeable on the Blue Highlight-Shadow Blend, and the output similarly appeared muted in comparison with the ColorQube 9203. Severe mottling was noticeable on the KM C650 output.

Ricoh C5000 Tints & Blends were rendered least well among all printers as they exhibited coarse, distracting screening that detracted from overall quality, and mottling was

noticeable on output. Blues had a slight Cyan cast on the Ricoh C5000 output, while harsh transitions were noticeable on Blue, Magenta and Green Blends.

Blends Comparison (*Color Graphic* extracts), Standard Office Media



ColorQube 9203
Canon C5180
KM C650
Ricoh C5000

Images

ColorQube 9203 Images were rendered with better depth due to rich Blacks, although some shadow details were lost. Sharpness of the ColorQube 9203 Images was average. Canon C5180 Images were rendered with excessive contrast. Highlights were blown out and shadows were plugged, losing some highlight and shadow details; these Images also appeared comparatively dull. KM C650 Images were rendered light and soft, exhibiting overall lower apparent sharpness and saturation than ColorQube 9203 output; these Images also exhibited a slight magenta cast. Ricoh C5000 Images exhibited good sharpness, but coarse screening detracted from overall Image quality. Ricoh C5000 Images exhibited a slight yellow cast.

Images Comparison (*Color Spectrum* extracts), Standard Office Media

ColorQube 9203	Canon C5180	KM C650	Ricoh C5000

The *spencerLAB* Digital Color Laboratory

The *spencerLAB* DIGITAL COLOR LABORATORY is an independent printing device evaluation firm that provides services to vendors and corporations for whom digital color printing is mission-critical. The Laboratory follows strict guidelines in the integrity of both its methodology and reporting; vendor-sponsored studies do not guarantee favorable results. *spencerLAB* has developed industry-standard test software, and performs print quality, cost-per-page/yield, throughput speed, and ease-of-use analyses in all technology classes, from desktop printers to digital color presses.

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