spencerLAB
DIGITAL COLOR LABORATORY

Summary Report

PRINT QUALITY COMPARISON: *Xerox DocuColor 2240*
vs. **Ricoh Aficio AP3800C**

This report summarizes an independent test and evaluation of the Print Quality of the Xerox DocuColor 2240 and Ricoh Aficio AP3800C color laser printers. *SpencerLab* Digital Color Laboratory, a division of Spencer & Associates Publishing, Ltd., was commissioned[1] to perform comparative testing and analysis utilizing representative real-world documents, including professional office and graphic arts applications from the *SpencerLab* Printer Test Suite[2].

Print Quality of the **Xerox DocuColor 2240** exceeds that of the **Ricoh AP3800C** in the areas of Registration, Text (including Black, Color, and Reverse Text), Tints, and Skin tones. Text is rendered smoothly and with good "typographic color" on the DocuColor 2240; Tints are vivid, smooth and uniform; skin tones are produced more naturally; and Blends within individual colors are well rendered, although some harsh transitions are noted between colors. The AP3800C produces slightly more uniform thin lines, though at the expense of dimensional accuracy, and produces more detailed Images, although they sometimes suffer from excess sharpening.

PQ ANALYSIS METHODOLOGY

A range of test documents from the *SpencerLab* Printer Test Suite was printed on each of the printers in a range of print modes[3]. These test documents included current versions of the *Color Spectrum, Graphic,* and *Graphic RGB* PostScript programs (originally developed as part of the *Color Hardcopy Quality Factors* Study series). Also included was the *Enhanced Graphic* PostScript program (originally developed as part of the

Hardcopy Quality Enhancement Study) and a range of images and application test documents from the suite, covering a variety of printing requirements. Unless otherwise mentioned, evaluation was performed on 24 lb., 94 brightness office bond. Print Quality was analyzed by element type (*e.g.,* black, color, and reverse text, lines, tints, blends, and images) across these test documents.

PQ ANALYSIS RESULTS

Artifacts

While the DocuColor 2240 exhibited only minor misregistration, with our sample printer showing Cyan misalignment of less than 1/600", misregistration was observed in all modes on the AP3800C. Our sample printer showed specific misalignment in Yellow/Cyan, Yellow/Magenta, and Black/Magenta, with 600DPI/Fast mode more than 1/600" out of registration. The consequences of this misregistration were observed in the rendering of Text, Lines, Tints, and Images.

A xerographic edge effect is also evident on the AP3800C. It can be seen around the Horses in the *Graphic* test file and in the text of the *Enhanced Black* test page when printed in the Color mode setting – but not present when printing the same file in Black mode color setting. Overall, this effect impacts the rendering of text and graphics on the AP3800C, sometimes adding excessive sharpening to high-contrast image details.

Text

Reflecting their different print quality issues, Black, Color, and Reverse Text are discussed in more detail in the following sections.

Black Text

The DocuColor 2240 produces excellent Black Text in HIGH QUALITY[4] mode, with smooth edges and no evidence of splatter or stepping. Text is legible down to 2-point; serifs and thin strokes are held down to 4-point, where some minor dropouts begin to appear. Character weight is rendered more finely than on the AP3800C. In STANDARD mode, angled text exhibits very minor stepping that is not apparent in HIGH SPEED as well as HIGH QUALITY modes.

On the AP3800C, although Black text is rendered well, characters are thick, affecting legibility. While text is readable down to 2-point and serifs are held down to 4-point, the heaviness of the characters makes the text more difficult to read than on the DocuColor 2240.

Color Text

Color Text on the DocuColor 2240 is rendered well in the CMYK space, with good uniformity of color within characters. Text is legible down to 4-point, though serifs are lost at 6-point and below. Edges appear smooth, yet there is very slight misregistration, only visible under magnification. Red text is produced with less than 100% magenta; the resultant screening gives a spotty appearance with areas of yellow evident. Process Black is rendered as light black/dark brown, as seen in the word 'dog'. Screened text on the DocuColor 2240 shows obvious patterns; yet let-

ters are well formed. Screening algorithms in HIGH QUALITY mode are different and slightly better than those utilized in HIGH SPEED and STANDARD modes[5]. Orange and Brown text are under-saturated.

On the AP3800C Color Text is legible down to 4-point, with some colors rendered darker than others. Serifs are lost at 8-point and below. Yellow is misregistered as seen in green, red, blue and black characters and process Black exhibits jagged edges, due to misregistration. Cyan splatter is evident in the process Blue. In RGB space, Color Text is rendered thinner and lighter than in CMYK, as seen on the DocuColor 2240. In 600DPI/Fast mode[6], dot screening is very visible in screened text causing character edges to appear jagged; screening is a bit less evident in 1200DPI/Fast mode. As a result of this screening, some text characters appear broken.

Reverse Text

Overall, the DocuColor 2240 produces excellent Reverse Text. Minor fill-ins are seen at 6-point and below and contrast is good between the text and background areas.

The AP3800C Reverse Text suffers from misregistration issues; as seen on our test machine in color text, misregistration of Yellow degrades the quality of the Red, Orange, Brown and Gold characters. Fill-ins start as high as 10-point.
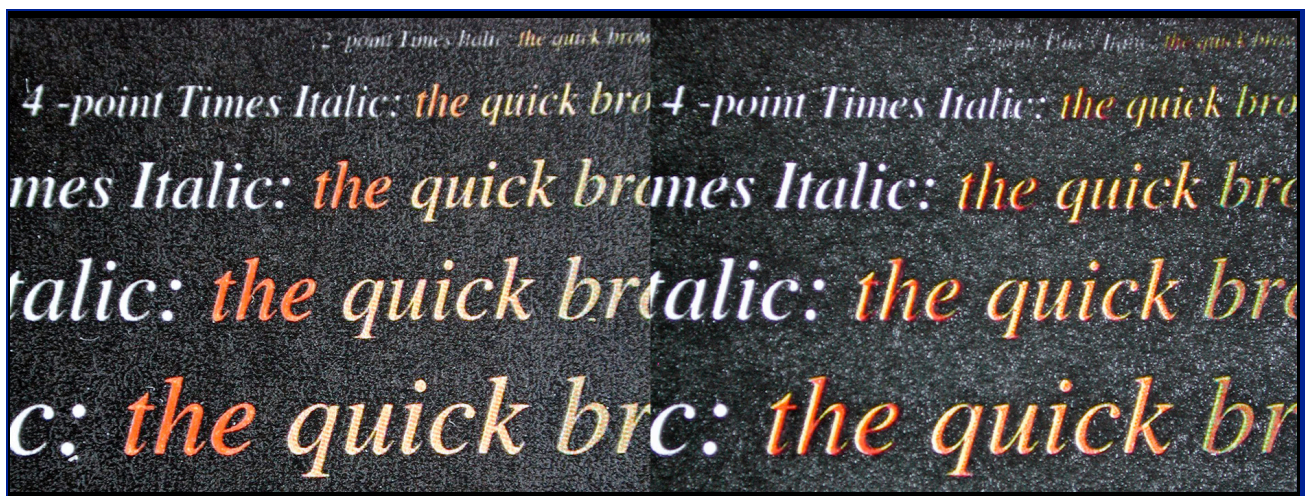
Reverse Color Text: Xerox DocuColor 2240 (left) vs. Ricoh AP3800C (right)

Line Graphics

Black Lines

The DocuColor 2240 produces thick Black Lines that are fairly smooth. However, in HIGH QUALITY mode thin lines (strokes and fills of less than 1/1200") drop out and virtually disappear. In HIGH SPEED mode these lines are visible, yet the horizontal lines (parallel to scan direction) are rendered thicker than the vertical lines (parallel to process direction). Along thin curved lines (strokes of less than 1/600") horizontal line thickness narrows going into the curve and subsequently widens within the curved section. Unlike the AP3800C that produces 1/1800" and 1/2400" strokes at the same width, the DocuColor 2240 renders the strokes at appropriately differentiated widths. Very thin Black Lines, as seen in the car of the *Enhanced Black* file, are produced as dots. On radial lines, HIGH SPEED and STANDARD modes yield more defined and continuous lines than those produced in HIGH QUALITY mode.

On the AP3800C, thin lines in the highest quality mode, 1200DPI/Fast, appear to be rendered better than on the comparable mode of the DocuColor 2240, but at the expense of dimensional accuracy. Black Lines up to 1/1800" hold constant thickness going through a curve from horizontal to vertical. At 1/1800" and 1/2400", verticals are rendered slightly thinner than horizontals and the curves. The 1/2400" vertical appears thicker than the 1/1800" vertical, while the 1/2400" horizontal appears to be the same thickness as the 1/1800" horizontal. Straight, thin Black Lines in the car of the *Enhanced Black* file are smooth, with no visible stepping; however, curved lines in 600DPI/Fast mode exhibit visible stepping. In 1200DPI/Fast mode, the Black reverse radials drop out; in 600DPI/Standard they are visible only above 45°, while in 600DPI/Fast they are visible at all angles.

Color and Screened Lines

As on black lines, thick Color and Screened Lines produced by the DC 2240 are smooth and crisp. However, dropouts are evident in both thin and gray lines, as seen in the *Color Spectrum* car, where gray lines are rendered with a multi-color,

dotted effect – the individual color components are visible. Vertical lines drop out within the registration pattern; in the hairline test pattern screened lines appear as dots. Similar to what was seen in black lines, radial lines of process Black are fractured and barely visible in HIGH QUALITY mode, but are visible in the lower quality modes. Red lines, in the model car, are produced as dark red in HIGH SPEED mode, whereas in the higher quality modes the color cast shifts to orange. Overall, fine line detail is rendered better in the lower quality modes.

On the AP3800C, composite Black radial lines are broken at 1200DPI/Fast and absent at several angles, with lines more visible in 600DPI/Fast mode. Thin Color Lines are rendered with dropouts, with a choppy appearance. Closely spaced lines have fill-in and appear jagged.

Tints

Overall, the DocuColor 2240 produces vivid tints that are smooth and uniform. Screening is visible in the pastels, however, and some minor registration gaps are evident. On the *Enhanced Black* file, line screening and mottling are visible throughout the midtone range. In the OUTPUT: COLOR mode, screening is more obvious and distracting than in OUTPUT: BLACK mode. Screening in the RGB tints is more visible than in CMYK tints.

Tints on the AP3800C appear mottled and are not rendered smoothly, as may be seen in the blue of the Horses drawing from the *Graphic* file (following). Registration gaps are very noticeable and more severe than those of the DocuColor 2240, contributing to color loss on tint edges. Process Black/Neutral acquires a magenta cast at over 80%, and appears too cyan below; 100% Process Black is rendered lighter (and more magenta) than 90% Black. Banding is observable in large tint areas. In both CMYK and RGB tints, the screening pattern is visibly annoying in 600DPI/Fast mode, especially in the lighter pastels and Black tints at 30-70%, and to a lesser degree in 1200DPI/Fast mode. RGB Yellow is rendered with both Magenta and Cyan dots visible.
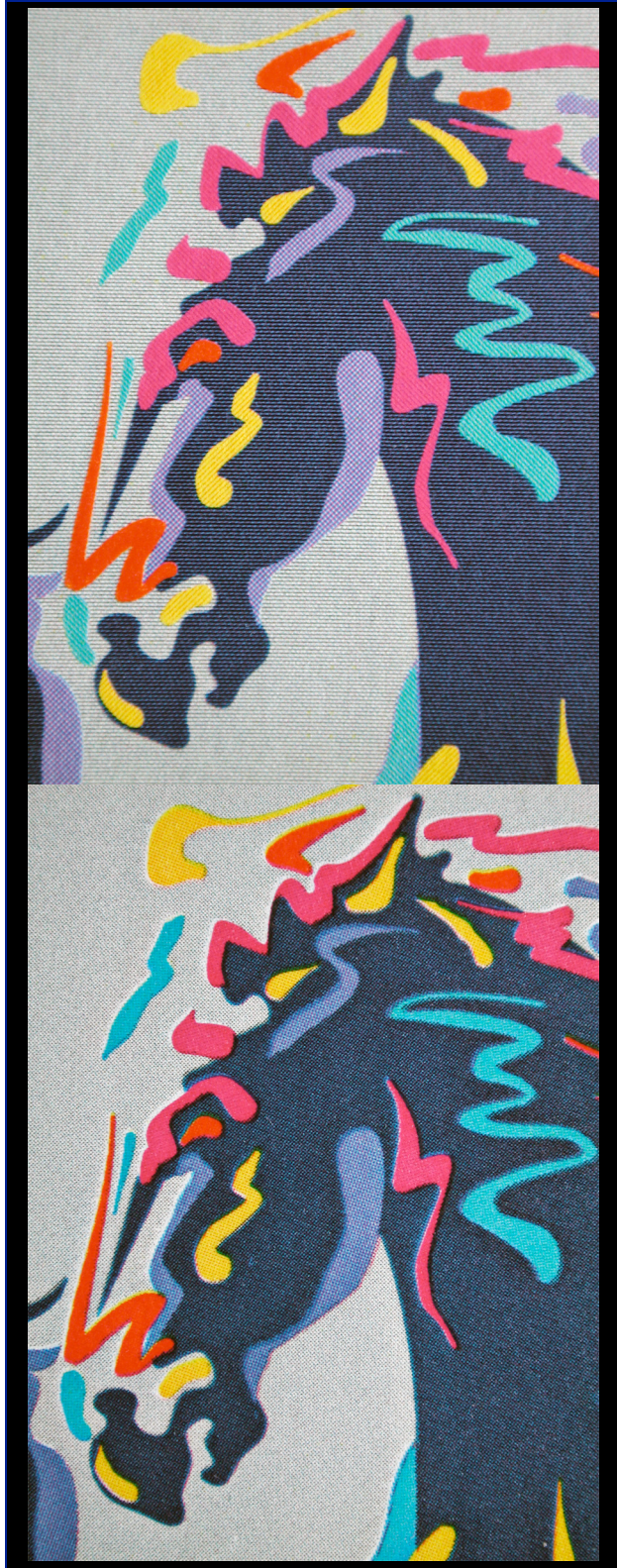
**Registration and Tints:
Xerox DocuColor 2240 (above)
vs. Ricoh AP3800C (below)**

Blends

The DocuColor 2240 produces Blends that are rendered well within each individual color, however transitions between colors are harsh. In the CMYK rainbow blend, harsh transitions occur between Yellow-Red, Magenta-Blue, and Green-Cyan. Midtones and shadow ranges are generally well rendered. In HIGH SPEED mode, screening is visible in the Green-Yellow areas. Color ramps are smooth with minor loss in the highlights. Black hits full saturation at approximately 90% with minor loss of shadow detail. In the shadow-highlight blends, Red, Green, and Cyan display harsh transitions. Cyan midtones extend further into the highlight area in SCREEN: FINENESS than in GRADATION mode.

The AP3800C displays smoother transitions between Blends, however banding and screening detract from the blend quality. On the CMYK color ramp, 100% process Black appears brown, with shifts back and forth between Magenta and Cyan casts throughout. Narrow highlight ranges are seen in all colors. In the rainbow blends, Yellow has a narrow region and Green has non-linearities. Harsh transitions appear in Yellow-Green, but otherwise transitions between colors are smooth. Screening is noticeable in 600DPI/Fast mode. In the highlight-shadow Blends there are harsh transitions in Yellow and Red, and Green produces a slight cyan shift in the midtone-to-highlight range. In the RGB Blends, harsh transitions appear in Cyan-Purple and Green-Yellow transitions with non-linearity in Green. In the highlight-shadow RGB Blends, Cyan shifts to purple before going to black. Most RGB Blends are produced with a narrow highlight range.

Image (Skin Tones): Xerox DocuColor 2240 (left) vs. Ricoh AP3800C (right)

Images

On the DocuColor 2240, skin tones are rendered well, yet lack saturation and have a slight yellow cast. Although minor banding is evident on the bodies in the *Babies* test file, they are smoother than those from the AP3800C. In the sky of the *Castle* file in GRADATION mode screening, the highlights appear realistic, but the midtones have some magenta cast; on the other hand, in FINENESS mode there is a cyan cast. Sky color in STANDARD mode has a more magenta cast than in HIGH QUALITY mode. Also, the sky areas are not rendered smoothly and exhibit banding. Fine detail is lost in the red bricks of the castle front and shrubbery appears too saturated. The *Bridge* file is rendered with an overall yellow cast, also making the greenery unrealistically bright. Shadow areas, as seen in the *Isle* file, lack detail.

The AP3800C renders skin tones with a strong overall magenta cast (as may be seen in the woman's headshot from the *Color Spectrum* test file, above), along with some banding, contouring, and visible screening. All images are rendered with excellent detail and sharpness, as seen in the castle brickwork and mountain areas. SUPERFINE mode provides sharper detail than FINE mode, but perhaps at the expense image boundary artifacts where instances of excessive sharpening appear (perhaps due to an xerographic effect), exaggerating details unnaturally, as is visible in the above example. On the *Castle* file the sky color is produced well, whereas on the *Bridge* file both the sky area and bridge are rendered with some magenta cast. In the *La Boca* file, the Black background area suffers from gloss non-uniformity.

About *spencerLAB*

The *SpencerLab* Digital Color Laboratory is an independent printer evaluation laboratory that provides services to vendors and corporations for whom color printing is mission-critical. The Laboratory follows strict guidelines in the integrity of both methodology and reporting; vendor-sponsored studies do not guarantee favorable results. *SpencerLab* has developed industry-standard test software, and performs print quality, throughput speed, cost-per-print and ink and toner cartridge yield, and ease-of-use analyses for color and monochrome printers in all technology classes, from inkjet and laser printers to digital color presses.

SpencerLab is operated by Spencer & Associates Publishing, Ltd., a premier information technology consulting boutique specializing in the application of Digital Color Technology to all aspects of color imaging. For over a dozen years Spencer & Associates has been providing strategic support to manufacturers in product planning, development, and launch. Color printing workflow analysis, print system selection, and usage optimization services are provided to corporate users.

For more information, please contact *SpencerLab* by telephone at 631-367-6655, by email at info@spencer.com, by fax at 631-367-2878, or visit our web sites at www.spencerlab.com and www.spencer.com.

---

[1] The *SpencerLab* Digital Color Laboratory conducted this evaluation under Xerox Corporation sponsorship. As an independent test laboratory with a broad base of industry clients, *SpencerLab* believes that this report maintains its reputation for the integrity of its test procedures and analyses. Results stated herein are based upon testing of actual products believed to be representative.

[2] The *SpencerLab* Printer Test Suite, now in ßeta, is an extension of Spencer & Associates' *Color Hardcopy Quality Factors* test suite, a de facto industry standard since 1990.

[3] Xerox Corporation supplied Xerox DocuColor 2240 print samples for analysis in modes selected by *SpencerLab*.

[4] Xerox DocuColor 2240 driver mode resolutions are: HIGH QUALITY = 1200 X 1200 DPI; STANDARD = 600 X 1200 DPI; and HIGH SPEED = 600 X 600 DPI.

[5] This correlates with the screening options: FINENESS is a 200-lpi screen intended to enhance the definition of fine text and graphics, while GRADATION is 150-lpi screen intended to increase the number of tone levels in blends and photographic images.

[6] Ricoh AP3800C driver mode resolutions are: 1200DPI/ FAST = 1200 X 1200 DPI; 600DPI/STANDARD = 600 X 1200 DPI; and 600DPI/ FAST = 600 X 600 DPI.