



February 2009

for Affiliates

this month in Center research:



## Non-CMYK Pictorial Color Image Reproduction

Rules, sometimes, are meant to be broken. For example, printing freshmen learn that lithography works based on the principle of "ink and water do not mix." By the time they are seniors, they learn that emulsified ink is necessary in order for a lithographic press to function properly. After all, ink and water do mix.

Any printing student or professional will admit that a golden rule in pictorial color image reproduction is that process color or CMYK inks should always be used. To challenge the rule, one must ask the question, "Can pictorial color images be reproduced using non-CMYK inks?"

This is the question that is answered in the paper "Non-CMYK Pictorial Color Image Reproduction." The paper was authored by Bob Chung, Gravure Research Professor in the RIT School of Print Media, and was published in *Test Targets 8.0* in the "Gallery of Visual Interest" section.



[Download a PDF of this article here.](#)

### Reproducing Pictorial Color Images

Achieving pictorial color image reproduction using non-process inks follows the same concept as using process inks, i.e., (1) color printer characterization, (2) color conversion, and (3) color printing. Color printer characterization defines the relationship between device color signals and CIELAB values. Ordinarily, CMYK colorants are chosen for their ability to achieve large color gamut. When characterizing non-CMYK printing device, the key criterion is the ability to render color of interest as oppose to achieve large color gamut. In the color conversion stage, pictorial images are converted from the RGB color space to the printer space via an Application Programming Interface (API). In the color printing stage, color-managed images are printed in registration using the inks that characterize the color printer.

#### Figure 1. A pictorial color image reproduced by non-CMYK inks

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### Center Spotlight



#### RIT/CIAS Alumni Industry Events!

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**Register Now!**

**Society for Photo Education (SPE) CIAS Alumni Reception** - March 27  
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**On-Demand/School of Print Media (CIAS) Alumni Reception** - April 1  
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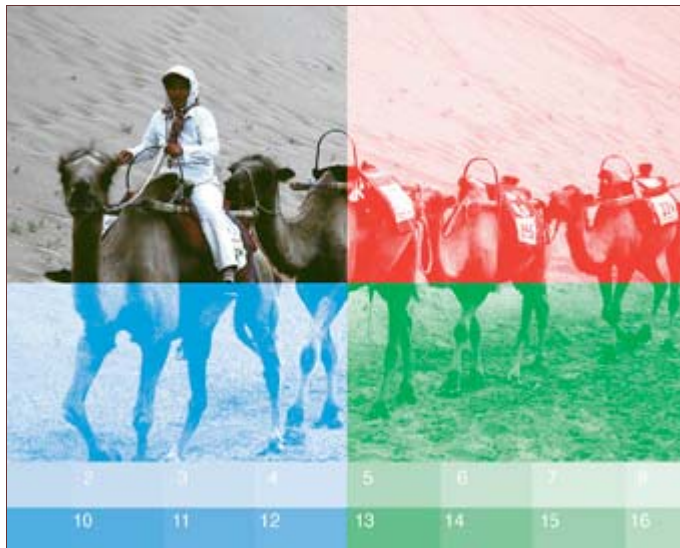


#### Print in the Mix

Print in the Mix is "a unique site demonstrating the role of print as a viable information medium in the marketing mix." This **free** resource is published by the Printing Industry Center.

#### Sample Fast Fact:

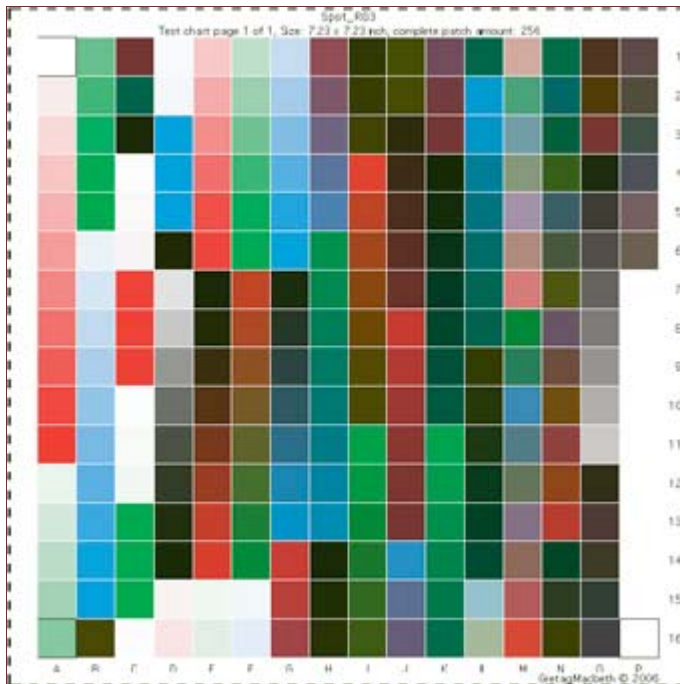
*According to a first-of-its-kind study from the Direct Marketing Association, in conjunction with PSA and Zubi Advertising, direct mail is a key marketing tool for reaching the Hispanic market; 92% of all companies marketing to Hispanics report*



### Tools and Materials for Reproducing Color Images Using Non-CMYK Inks

Special software and hardware are necessary to implement pictorial color image reproduction using non-process inks. First, X-Rite's ProfileMaker 5 MultiColor Package is used to define a special color characterization target. In this case, three Pantone colors (32\_red, Hex\_green, and 2925\_blue) are printed by an HP Indigo 5500 digital press capable of printing CMYK plus three spot colors (Figure 2a). X-Rite's Spectrolino/Spectroscan is then used to measure the printed target. Colorimetric data was used by ProfileMaker 5 to build a custom spot-color ICC profile.

**Figure 2a. Color printer profiling target**  
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X-Rite's Multicolor Plug-In for Adobe Photoshop serves as the API to convert pictorial RGB image data to non-CMYK color space (Figure 2b). In this case, perceptual rendering is chosen in the color conversion. Converted images are saved as EPS files and placed in the InDesign file. The InDesign file is exported as a

**non-catalog direct mail as the most prevalent offline channel employed.**

[Read the full fast fact here.](#)

Have you visited **Print in the Mix** yet? Find out how this site can help you 'make the case' for print!

[printinthemix.rit.edu](http://printinthemix.rit.edu)

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 February & March 2009

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##### March 6

WEBINAR: Color Printing Fundamentals

##### March 10 - 12

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##### March 16

WEBINAR: Lithographic Troubleshooting

##### March 17 - 20

Matching Proof and Press

##### March 23

WEBINAR: Color Printing Process Control

##### March 25 - 27

Lithographic Relationships and Variables

PDF file for color printing. Color printing using non-process inks involves printing the same way the spot-color characterization chart is printed.

#### Figure 2b. MultiColor Photoshop Plug-In

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#### Process Color Gamut and Non-process Color Gamut

Process color inks and Pantone certified spot-color inks are transparent in nature. When overprinting different amounts of inks, the resulting color follows subtractive color mixing principle, i.e., starting from white paper, the more inks are overprinted, the darker the printed color becomes. Color gamut refers to limiting colors that an imaging device can render. CMYK-color gamut has generous volume. Non-process color gamut, on the other hand, has small gamut volume.

Using the ProfileMaker 5 tool set, Figures 3a and 3b compare the color gamut between the HP\_CMYK and HP\_RGB in 2D (3a) and 3D (3b) respectively.

#### Figure 3a. 2D color gamut comparison between HP\_CMYK and HP\_RGB

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For more information on these and other programs, or to register for any of these programs, visit

[www.seminars.cias.rit.edu](http://www.seminars.cias.rit.edu)

#### The eReview

The eReview is a monthly publication of the Printing Industry Center at RIT for registered Affiliate companies. Articles are also published in the quarterly printed publication *PrintReview*.

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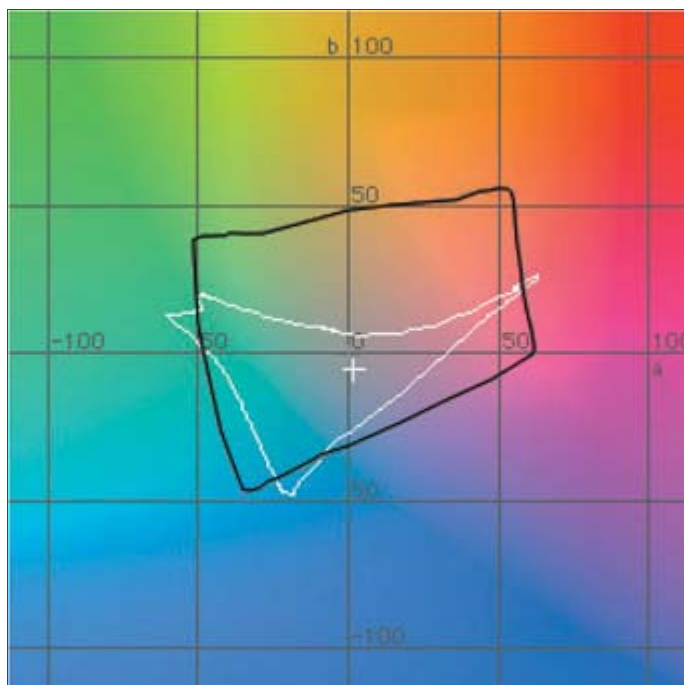
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#### About the Center

Dedicated to the study of major business environment influences in the printing industry precipitated by new technologies and societal changes, the Printing Industry Center at RIT addresses the concerns of the printing industry through educational outreach and research initiatives.

Support for the Center comes from:

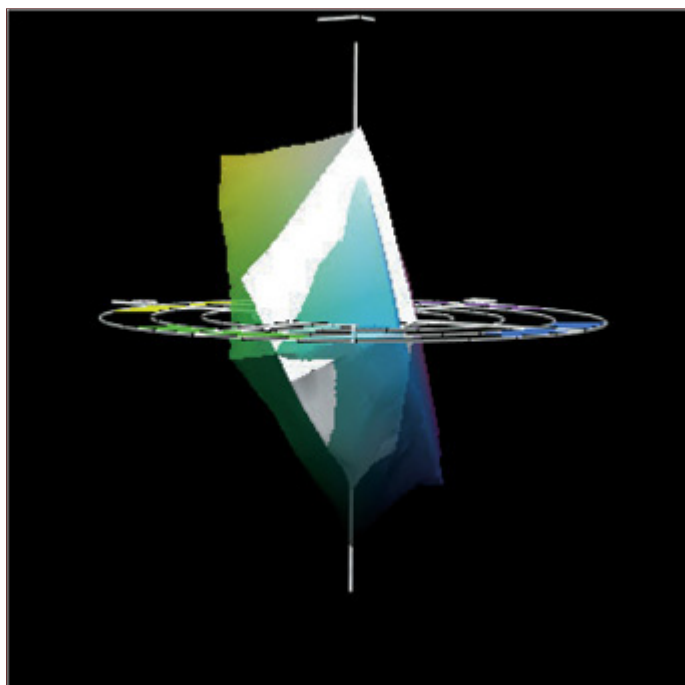


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**Figure 3b. 3D color gamut comparison between HP\_CMYK and HP\_RGB**

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In Figure 3a, the black line is the boundary of the CMYK color gamut of the HP 5500 digital press and the white line is the boundary of the RGB spot color gamut at medium  $L^*$  level. While its color gamut is smaller, the non-process inks have more saturation towards their primaries, i.e., redder red, greener green, and bluer blue.

In Figure 3b, the color-rendered solid is the CMYK color gamut of the HP 5500 digital press and the white solid is HP 5500's RGB spot-color gamut. Notice that whites and grays are reproducible by either printing process. While CMYK color gamut can accommodate the reproduction of yellows and oranges, the RGB

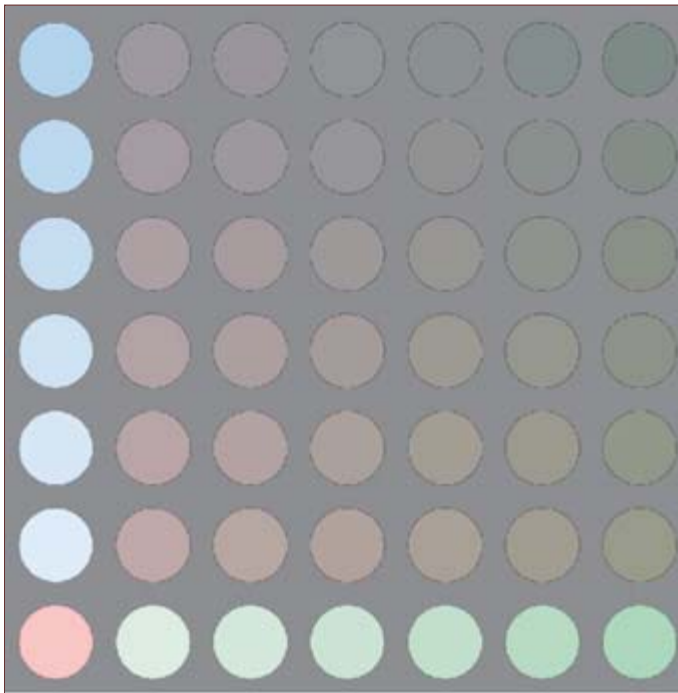
color gamut can be an effective color reproduction process if (1) non-process inks, e.g., red, green, and blue, are already used as brand colors, and (2) color of interest in the pictorial color image is reproducible.

### Seeing is Believing

Let's evaluate the gray balance chart, printed by the HP\_5500 RGB inks (Figure 4a) as well as by the HP\_5500 CMYK inks (Figure 4b). Notice that all patches in Figure 4a have a constant red dot area with green dot areas varying column-wise and blue dot areas varying row-wise. Similarly, Figure 4b has a constant cyan dot area with magenta dot areas varying column-wise and yellow dot areas varying row-wise. If there is a color match in neutral, the match between the two ink sets is metameric, i.e., two objects have the same color, but have different spectral reflectance values.

**Figure 4a. Gray balance from RGB inks**

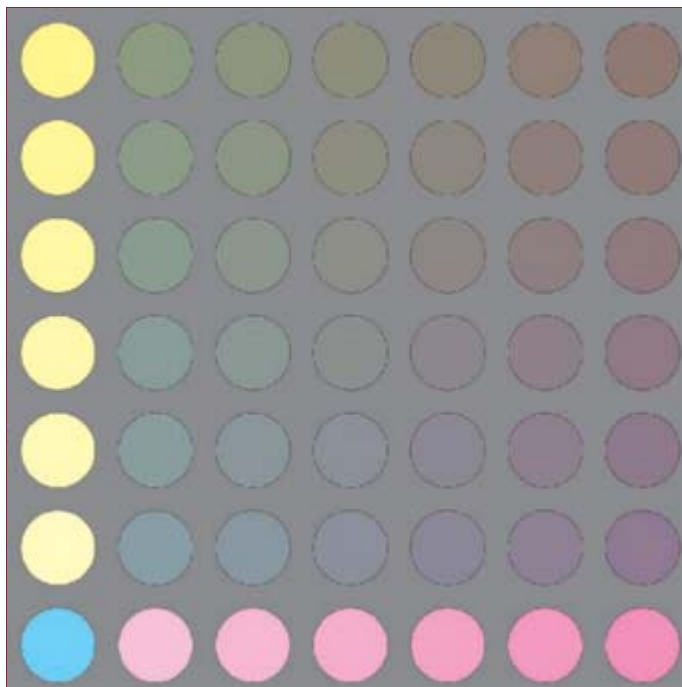
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**Figure 4b. Gray balance from CMYK inks**

[click to view image full size](#)





Let's evaluate an example of color reproduction, Boating, with memory color (Figures 5a and 5b). Blue sky, white cloud, and turquoise water are colors we can associate with the beauty of nature. When these colors are reproduced in a pleasing manner, it does not matter if non-CMYK inks (Figure 5a) or CMYK inks (Figure 5b) are used.

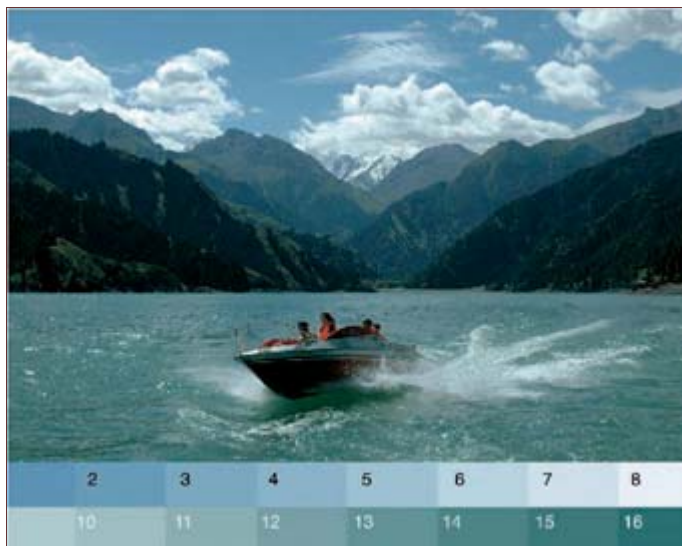
**Figure 5a. Pictorial color reproduction of memory colors using non-CMYK**

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**Figure 5b. Pictorial color reproduction of memory colors using CMYK**

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Let's evaluate an example of color reproduction, Glazed Ceramic Pots, without memory color (Figures 6a and 6b). First, a ceramic pot can be any color. So, there is no memory color that can serve as a visual reference. Without a loupe, how would one recognize which printing process is used to reproduce which image? Well, the answer lies in the color gamut capability of the ink sets. Figure 6a has more saturated green and Figure 6b has more color rendering capability in the yellow region of the color gamut. Thus, Figure 6a is printed by non-CMYK colors while Figure 6b is printed by CMYK colors.

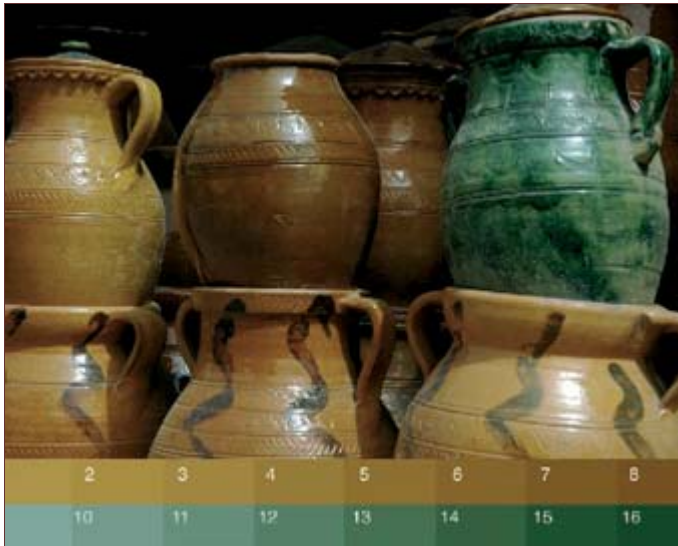
**Figure 6a. Pictorial color reproduction of non-memory colors using non-CMYK**

[click to view image full size](#)



**Figure 6b. Pictorial color reproduction of non-memory colors using CMYK**

[click to view image full size](#)



## Conclusions

This article shows that pictorial color images can be reproduced with CMYK inks as well as non-CMYK inks. Process color or CMYK printing provides a large color gamut in comparison to other 4-color subtractive primaries. This enables hues in all pictorial color images to be reproduced. This is also a liability because the color variations are likely to occur in the color printing stage if there is no strict process control measure.

Non-process colors are primarily used as brand colors as dictated by consumer product companies. Because of the advances in color management, it is possible to render pictorial color image reproduction if colors of interest in the image and the spot color gamut are compatible to each other. One example is to use spot colors to decorate contemporary building materials with wood grains or marble patterns. By carefully selecting spot colors that cover a small range of colors of interest, the color reproduction process is much more stable than CMYK color printing. Each has advantages and disadvantages. The choice lies in the customer's need and technology fit.

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### About *Test Targets*

*Test Targets*, published annually by the School of Print Media since 2002, is the result of teaching and learning from the SPM curriculum. Students, faculty, and staff work together to create content focusing on process control and color management. In addition to research and content creation, the group also performs pre-media, prepress, and printing tasks using facilities at SPM and PAL. The quality of the publication and its track record have won accolades in the U.S. and worldwide.

*Test Targets 8.0* is the latest version of this publication. To purchase your own copy, visit [the Cary Graphic Arts Press](#).

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