Working With Color CMYK Files (for Publication and Pre-Press Printers)

From dynamic to dull. Perhaps the most frustrating process in the imaging world is to go from RGB files—those files that look good on a computer screen—to CMYK—those image files that immediately lose pizazz to become lifeless and drab. Worse, contrast can decrease. And then, if these shifts weren't bad enough, colors can shift once more from what you see on your computer screen to what is seen on the screen at the publishing agency and then to what is published.

Saturated colors. In the former instance, the greatest contribution to this problem is the world of research itself: so many colors in research are saturated. They are completely green, completely red, completely blue, and so on. Research colors tend to be more primary versus colors in the real world which are more pastel and less concentrated. That phenomenon is especially true when coming from the world of Silicon Graphics® computers and their screens, in which deep and saturated colors display richly, but the colors translate to no other output.

From your monitor to publication. In the latter instance—regarding computer screens and how poorly one a computer screen matches the output at the publisher—the best advice is to use a high end *hardware* calibrated monitor (such as the Barco® line of monitors). On the more affordable level, Macintosh® computers with Apple's® self-calibrating computer screens (these monitors adjust color as the cathode ray tubes age and lose capacity) are recommended by many print shops. The printing and graphic arts industry was built upon technologies developed by Apple.

Other solutions. Having said that, the next best solution is to make your best print from your RGB file (if possible), or make your best print on a CMYK printer. Send the print with the digital file and ask the publisher to match the colors. When viewing your own print, you might consider buying a viewing booth, or setting aside an area you can light with 5500 degree Kelvin fluorescent lights (available at professional photography retailers or graphic arts suppliers). These lights provide a "standard" color temperature for evaluating prints. If prints are evaluated under other lighting conditions, colors can shift to green (most fluorescent lighting), to red or yellow (under incandescent lighting), to blue (in shadows near window light), or a mixture of two or all three.

Adjusting colors. You can adjust colors that have faded or lost contrast after changing from RGB to CMYK. Three methods are suggested, depending on the degree to which colors are "out of gamut." In all situations, color changes are made using *Hue & Saturation*. Remember that each image has its own peculiarities, and the RGB to CMYK process requires trial, error and experimentation.

Check To See How Much Color Shifts

1. Under *View*, select *New View*. A second image will appear. Arrange image windows so that both, or important parts of both, can be viewed (image can also be duplicated).

2. Under *View*, select *Preview* then *CMYK*. Evaluate whether significant color shifts have occurred.

3. If colors look okay, select one of the two images. Under *Image*, select *Mode* then *CMYK*.

If colors are unacceptable, start with the following steps:

1. Close *New View* image window.

2. Duplicate RGB image (under *Image*, select *Duplicate*).

3. Convert duplicate image to CMYK (under *Image*, select *Mode* then *CMYK*). Flatten the image. Align so that important parts of both images are visible.

In general, if the color shift is **small**, work with the CMYK image

In general, if the color shift is **great**, work with the RGB image.

Method 1. Color and Contrast Restoration on CMYK Images with Small Color Shifts

1. Select CMYK image.

2. In *Actions* window, click on *Color- hue & saturation* (or, under *Image*, select *Adjust* then *Hue & Saturation*). Work on colors one by one.

3. In dialogue box, click drop down box next to *Edit*. Choose a color that has shifted. Or... Use Eyedropper tool to select offending color.

4. Slide *Saturation* slider to the right to increase saturation, to the left to decrease. You may also want to lighten or darken with the *Lightness* slider.

These tools, by themselves, may bring color into acceptable range. If these do not solve the problem with color shift, restore color and contrast with Method 2.

Remember that blues and purple-blues will print as dark blobs. Move *Hue* slider to left to add green.

Hue & Saturation Dialogue Box

Click on arrowhead to select color, or use Eyedropper tool.

Most problems with CMYK have to do with saturation of hue. Move slider to right to brighten, to left to affect contrast. Subtle adjustments in *Hue* and *Lightness* may also help.
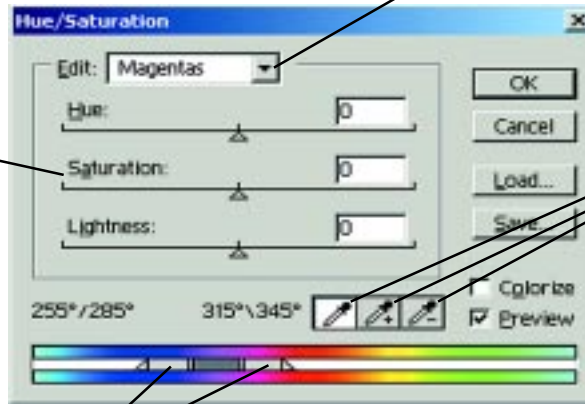
You can edit your selection further by using the Eyedropper tool to click on the features in your image that contain the colors you're interested in changing. Click on the first feature with the unmarked Eyedropper tool, and then on additional features with the plus (+) Eyedropper tool. If you accidently choose an un-wanted color, use the minus (-) Eyedropper tool to click on the same point, or start over again.

Note: When using Eyedropper tool, be sure to select numerous points, including bright to dark values within each hue.

Or... expand or contract range of colors by adjusting sliders (available when a color is selected).

Method 2. Color and Contrast Restoration on RGB Images with Large or Problematic Color Shifts

1. Select RGB image. Duplicate RGB image and align on screen so that important areas are visible.

2. Under *View*, select *Gamut Warning* (or, better yet, use Control+Shift key + y).

3. In *Actions* window, click on *Color- Hue & Saturation* (or, under *Image*, select *Adjust* then *Hue & Saturation*). Work on colors one by one. Select colors by using eyedropper tools as described in the previous method.

Keep gamut warning overlay on, especially when selecting bright objects against a dark background (as in darkfield microscopy). Be sure to use plus (+) Eyedropper tool to select to edges of objects, much easier seen when gamut warning is active.

4. Adjust the *Saturation* slider first. Keep in mind that all colors will print if saturation is set low enough (to the left). Adjust slider until a fair amount of the gray overlay disappears.

5. Adjust *Lightness* slider by increasing (moving to right) shy of eliminating too much contrast. Now increase *Saturation* as much as possible (move slider toward center) without increasing gray overlay. The idea is to work between the two, lightening as much as possible without losing contrast, and keeping saturation as close to the center as possible. Don't be surprised if the color you are working on needs dramatic desaturation.

6. Adjust *Hue* carefully to determine if a shift in one direction or the other might increase chances of eliminating gray overlay. Play with all three to get close to your desired color and contrast.

You may need to turn gamut warning off and on. That is best done with the keyboard command while the *Hue & Saturation* dialogue box is open (Control/Command + Shift + y).

You need not remove all the gray overlay, just 90 percent or so.

7. Make image CMYK: in menu under *Image* choose *Mode*, then *CMYK Color*.

Use the gamut warning indicator to decide which colors need to be altered. The gray overlay dissapears when colors are adjusted correctly. That may not happen with the saturated colors used in research. Expect to remove 90 - 95% of gray overlay for any hue: the remaining unbalanced color will be at edges of bright or dark samples. These small areas of unbalanced color are imperceivable when printed.

Use Gamut Warning to Preview Out-of Gamut Colors
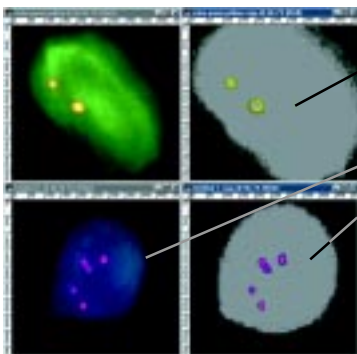
Everything covered in gray repre-
sents what will **not** transfer well to
CMYK.

Gray overlay shows edges where
too dark to be seen by eye. After
clicking on the first point with the
Eyedropper tool in the Hue &
Saturation dialogue box, be sure to
use the plus (+) Eyedropper tool to
click on multiple points, including
dark peripheries.

Image on left is how
RGB image appears
as uncorrected
CMYK; on right is
the corrected CMYK
image in green hue
only.
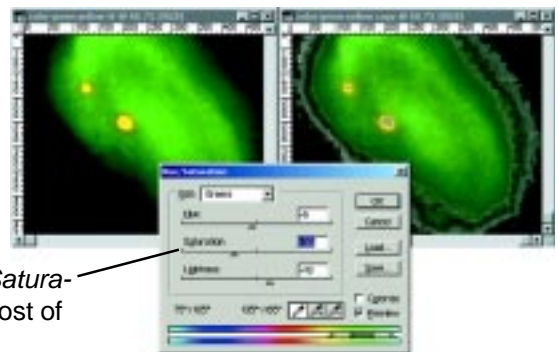
Desaturation using the *Satura-
tion* slider eliminates most of
the gray overlay.

CMYK Correction for Blue

Shades of blue appear bright on a computer display, but tend to print dark and without contrast, especially after being changed to CMYK mode. This means for correcting blue tends to print close to what is seen on the screen, but, for exact matches of hue, you'll need to use the method on the following page.

1. Move the *Hue* slider to the left to add green (make more cyan). Move to about -30.

2. Adjust *Saturation* and *Lightness* by eye. Evaluate the color after printing to a hard copy, as opposed to evaluating by looking at the display on the computer screen.

3. When satisfied with the result, in menu under *Image* choose *Mode*, then *CMYK Color*.

Example of RGB Image (on left) Corrected for CMYK in the Blue Hue (on right)

Only in certain colors, such as cyan-blue, does an increase in saturation help.

Steps to Follow When Color Matching is Near-Impossible

If Method 1 or Method 2 do not give you good color matching from RGB to CMYK color space, then use the steps that follow. These use Pantone Inks® as color guides. Because colors contain a range of hues from dark to light, and because only one particular ink color is chosen, color changes may have to take place in stages. In that manner, a bright green may be selected using *Color Range*, and then a mid-green, and so on. These steps require trial and error, and fiddling is a requirement.

1. In menu under *Window*, select *Show Color*. Click on arrowhead at top right and select *CMYK Sliders*. Leave this window open.

2. Click on representative area of image with eyedropper tool containing the color you'd like to match.

3. Double click on foreground image at bottom of toolbar icon. In *Color Picker* dialogue box, click on *Custom*. Click *Book* drop down list and choose *Pantone Coated* (journals are typically printed on what's called coated stock: the shiny paper found in magazines).

4. Choose ink color that best represents color you'd like to match.

5. Write down the CMYK values.

Show Color Window

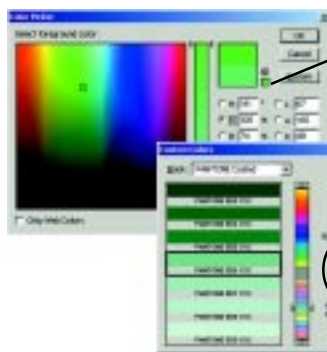Click on arrowhead to select CMYK Color.
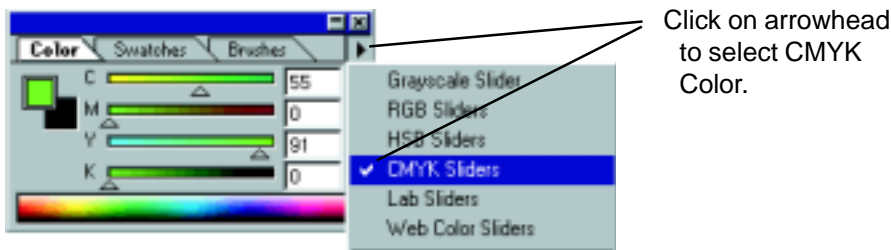
Color Picking to Obtain Pantone Ink Colors

Choose brightest hue with Eyedropper tool.
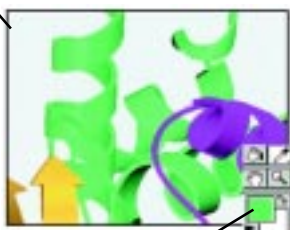
Double click on foreground box.

Click on *Custom* button.

Pantone color selection is at top, eyedropped color at bottom.

Write down CMYK values.

Make Selections Around Desired Colors Using Color Range

6. In *Actions* window, click on *Color Range* button (or in menu under *Select*, choose *Color Range*).

7. In dialogue box, use eyedropper tools to select color you wish to work on. Use the leftmost eyedropper tool to select the first color, then use the plus (+) Eyedropper tool to add more shades of the same color. Set *Fuzziness* high (50 -100). For bright objects against a dark background, keep gamut warning overlay on to be sure you are selecting to the edge of your objects.

You may wish to hide the moving outline (selection) while making changes. To do so, press Command/Control key + h. It's a lot easier to see your corrections, but the downside is that you can forget that you've hid the selection later.

Color Range Dialogue Box

Set to *Sampled Colors*.

Fuzziness should be set 50-100 or so.

Use leftmost Eyedropper tool to click on first point in desired color. Use plus (+) Eyedropper to select additional shades of the same color.

Check *Selection*.

White areas indicate what has been selected.

Adjust Colors Using *Curves*

8. In *Actions* window, click on *Contrast Adjust- Curves* (or in menu under *Image*, select *Adjust* then *Curves*).

9. Click on representative color in image with Eyedropper tool (identical or close to the position chosen when determining ink color).

By clicking and pulling line in *Curves* dialogue box to the left across the top, or down along the right, adjust *Red* and/or *Green* and/or *Blue* Channels individually while looking at the *Show Color* Dialogue box to match CMYK values to those you have written down (see table on the following page). Turn *View Gamut* off and on using Command/Control + Shift + y keys to test the efficacy of your changes. If the hue doesn't look right, use *Curves* line across and down to fine tune by eye while ignoring CMYK values in *Show Color*.

For example, if representative value reads 65% Cyan, 0% Magenta, 100% Yellow and 0% K (black) on the closest match of a Pantone ink value, adjust Red channel and Blue channel to achieve a similar reading. Values will change on the *Color* palette as adjustments are made in the *Curves* dialogue box. Readjust by eye.

Do not expect to see a perfect match of hues! Some colors are outside the gamut (breadth of color available) of what can be printed by a printing press. Do expect, however, to improve upon the RGB image *with a slightly different hue.*

Curves Dialogue Box

The *Curves* dialogue box shows a sloped line in a grid. Black values lie at the bottom and white values at the top (as long as the "black" side of the gradient along the bottom shows black at the bottom-left).


Click on left triangle to place dark gradient on left.

In that way, any adjustment made by pulling the top of the curve would then affect whites more than any other values, and pulling along the bottom would affect mostly black values. By clicking at the center of the line, you can create an adjustment point. By moving that point the line becomes curved and thus affects mostly midtones either by brightening or by darkening.

### Adjusting Curves While Looking at Color Values
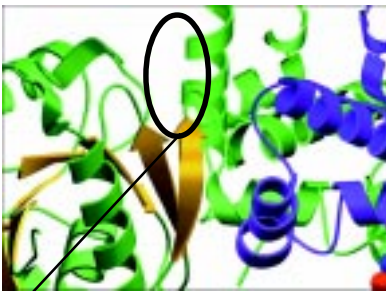
Click on shade of ink-matching color on image while *Curves* dialogue box is open (in this case, in green range).
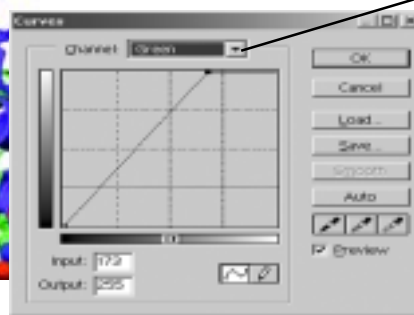
Click drop down box and choose color channel.

Move top of line to left or down to increase or decrease percentage of that color.

View values here interactively while adjusting the top of the line in Curves dialogue box
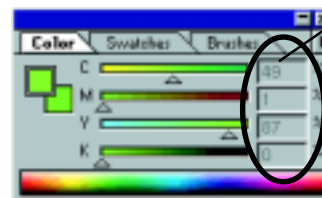
Final Steps

11. Once satisfied with adjustments while in RGB color space, change *Mode* to *CMYK Color*: in menu under *Image* choose *Mode*, then *CMYK Color*. Flatten image if prompted to do so (in menu under *Layers* choose *Flatten Image*). Be sure to have saved the RGB image before doing so.

12. For final adjustments and fine tuning, use *Hue & Saturation* or *Curves* to adjust colors and contrast.

RGB Channels to Use for CMYK Colors

Use the appropriate Red, Green or Blue channels in Curves dialogue box to adjust for CMYK colors shown in color bar.

Color	Channels
Violet	Blue and Red
Indigo	Blue and Red
Blue	Blue and Green or Red
Cyan	Blue and Green
Green	Green and Blue or Red
Yellow	Red and Green
Orange	Red and Green
Red	Red and Green

Reviving Contrast in the CMYK File

Once you've made the CMYK file using methods outlined in previous pages, and once you have corrected the color in CMYK color space so that it matches the RGB hues fairly well, the image may yet be devoid of contrast Often contrast can be revived by simply moving the bottom of the line in the *Curves* dialogue box to the right, thus introducing more black in the darker parts of the image. Less frequently, more dramatic steps must be taken. These concern ways in which contrast can be introduced into ranges of tones, whether these are shadow areas, mid-tones or highlights.

Overall Contrast

1. Use *Color Range* to select areas of interest according to procedures outlined earlier.

2. In *Curves* dialogue box, click *Channel* drop down box. Select Black. Drag line across bottom to increase black values (and contrast).

**Adjustments Within Tonal Ranges (Shadows, Midtones, Highlights)**

1. Use *Color Range* to select areas of interest according to procedures outlined earlier.

2. In *Curves* dialogue box, determine where values of interest lie along line. To do that, click and hold with eyedropper tool on areas of interest. A circle should appear along the line.

3. Make 3 points at that location along the line. Bend line so that hills and valleys create shadows and highlights within narrow color range.

Reviving Contrast In Highlights Using *Curves*

Original RGB Image

CMYK image after color corrections
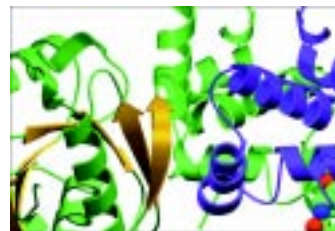
Application of curves to green areas. Extra points added to bend line.

Green and purple after Curves adjustments