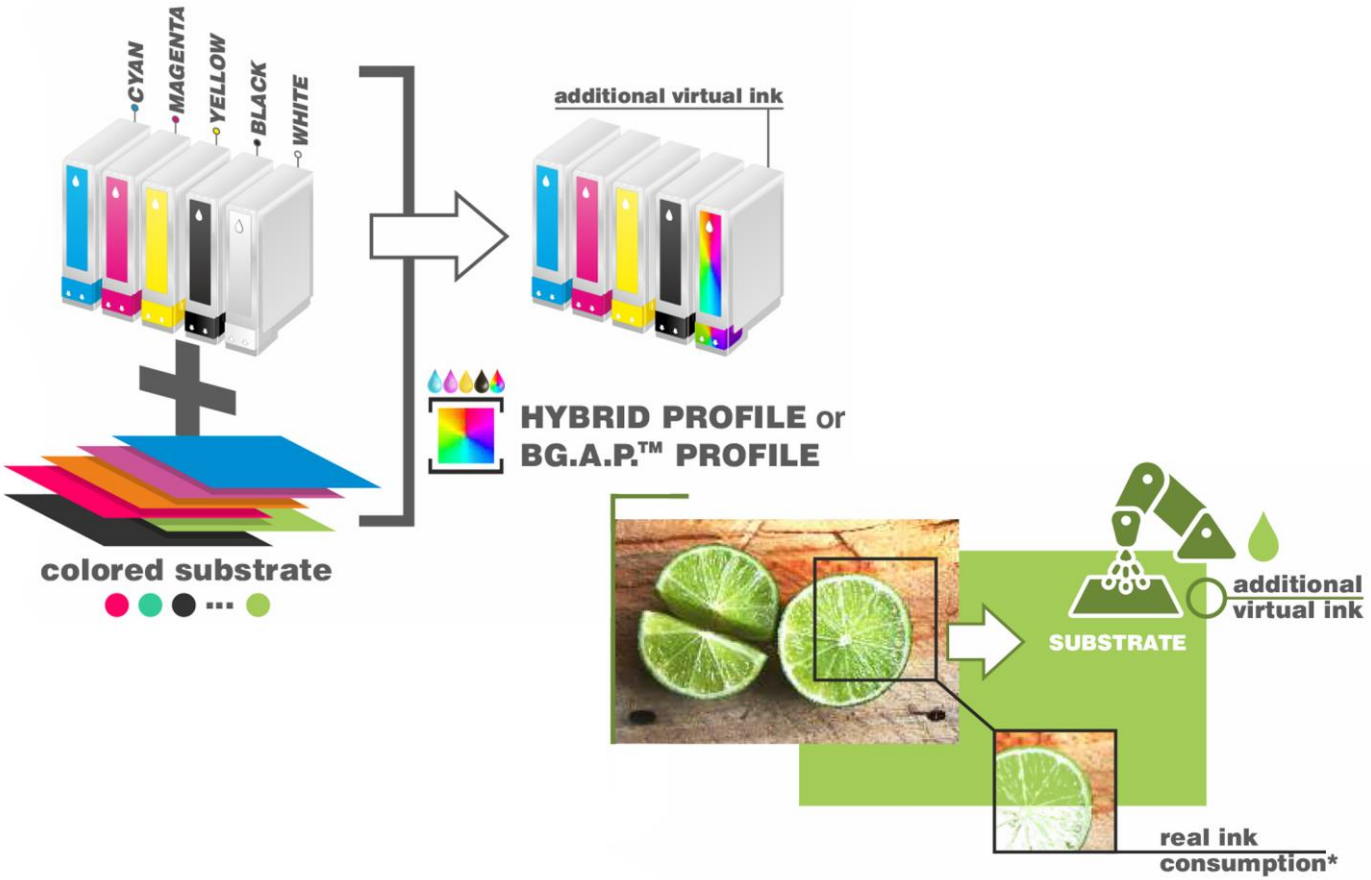
A new approach for printing on colored substrate: BG.A.P.™ or Hybrid Profiles



BackGround-Adaptive Profiles (BG.A.P.™)

Are designed for the calibration of:

- Printing systems with a “White” colorant printed on colored media.

Or, more generally:

- Printing systems where one colorant has such tristimulus values that can be used as a better reference white compared to the media itself.

The traditional printing process (CMYK):

- Uses semi-transparent inks (‘process inks’) that absorb selected parts of the spectral reflectance of the substrate.
- These inks are defined as subtractive.
- “reference white” is defined as absence of ink.

The white-ink printing process (CMYK+W):

Uses the same 'process inks' on the previous slide plus one ink (White) that has a non-selective spectrum and usually is more opaque than the other inks.

- White ink is not subtractive.
- White ink can be printed with variable densities.
- White ink can be used as basis for the other inks.
- "reference white" is defined as 100% of white ink (or the maximum printable white in on the selected surface).

The ICC standard.

Colorimetric data must be embedded into the profiles using a profile connection space (PCS).

The PCS defined in ICC specification 4.3 is based on the CIE1931 standard observer. In short, PCS can be either CIEXYZ or CIELab relative to the illuminant CIE d50.

The PCS color space encodings are based on media-relative colorimetry in which tristimulus values are scaled to the range of the *mediaWhitePointTag*.

The *mediaWhitePointTag* specifies the CIEXYZ tristimulus of the media white point.

6.3.2.2 Translation between media-relative colorimetric data and ICC-absolute colorimetric data

The translation from ICC-absolute colorimetric data to media-relative colorimetry data is given by Equations (1) to (3).

$$X_r = \left[\frac{X_i}{X_{mw}}\right] X_a \quad (1)$$

$$Y_r = \left[\frac{Y_i}{Y_{mw}}\right] Y_a \quad (2)$$

$$Z_r = \left[\frac{Z_i}{Z_{mw}}\right] Z_a \quad (3)$$

where

X_r, Y_r, Z_r	are the media-relative colorimetric data (i.e. PCSXYZ);
X_a, Y_a, Z_a	are the ICC-absolute colorimetric data (i.e. nCIEXYZ);
X_{mw}, Y_{mw}, Z_{mw}	are the nCIEXYZ values of the media white point as specified in the mediaWhitePointTag;
X_i, Y_i, Z_i	are the PCSXYZ values of the PCS white point.

"Media-relative" colorimetry is consistent with the fact that the human visual system adapts its response to the highest-energy stimulus in the visual field.

This is true as long as the highest-energy stimulus is enough bright and neutral to allow adaptation.

When this type of relative colorimetry is used, the color of the substrate has no effect on the device gamut.

In **BG.A.P.™** profiles the color of the media is not the highest-energy stimulus in the visual field, so the human visual system doesn't adapt to it.

Instead the human visual system adapts to the tristimulus of the 100% of white ink.

Measurements are scaled by the tristimulus of the white ink, not by the one of the media.

The *mediaWhitePointTag* specifies the cieXYZ tristimulus of the 100% of white ink.

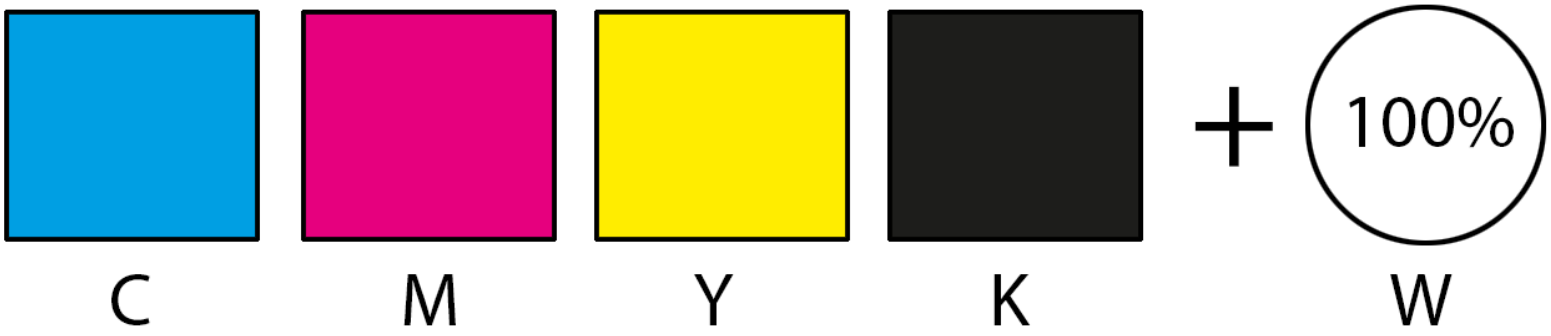
When this type of relative colorimetry is used, the color of the substrate has a huge effect on the device gamut.

If the substrate contributes to the device gamut, then it can be considered as a colorant.

We can refer to CMYK+W colorspaces as to CMYK+(media color) ones.
(examples: CMYK +blue, CMYK +orange, CMYK +green, etc.)

THE BASIC CMYK GAMUT

Since the reference white is the 100% of white ink, the whole CMYK colorspace printed on a flat layer of 100% of white ink can be considered the basic CMYK colorspace.



GREYSCALE INK FUNCTIONS

Minimum Luminance = 8,272

Process : Idle.

done.

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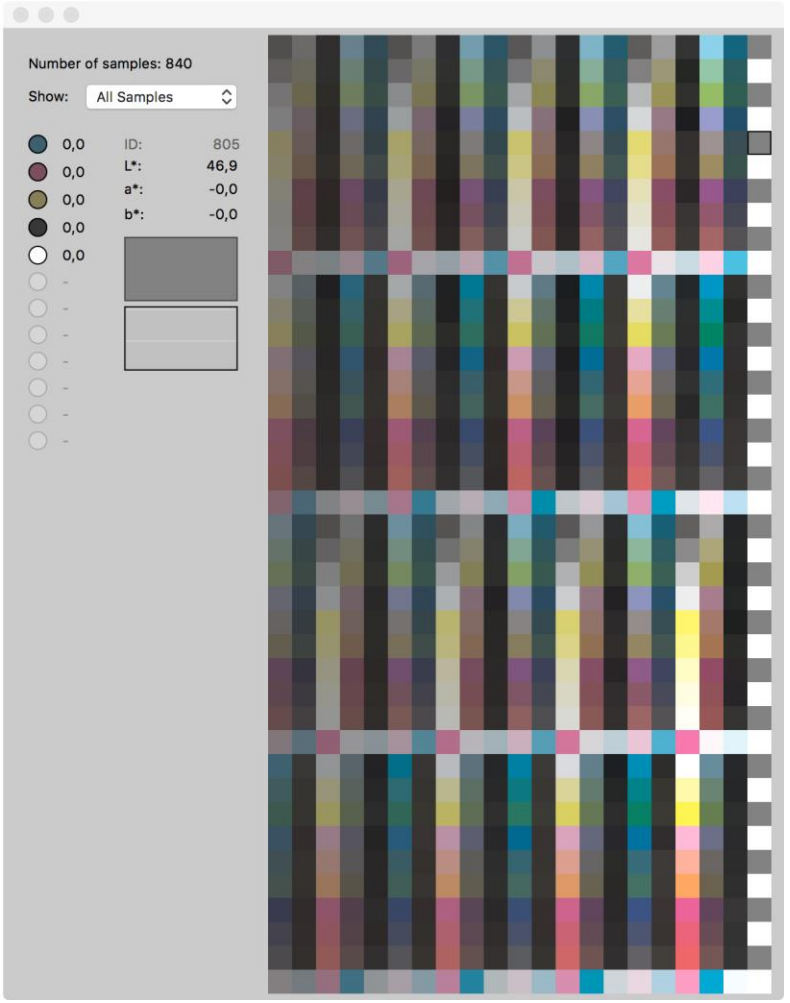
Example 1:
GREY SUBSTRATE



GREYSCALE INK FUNCTIONS

Minimum Luminance = 8,521

Process : Idle.

done.

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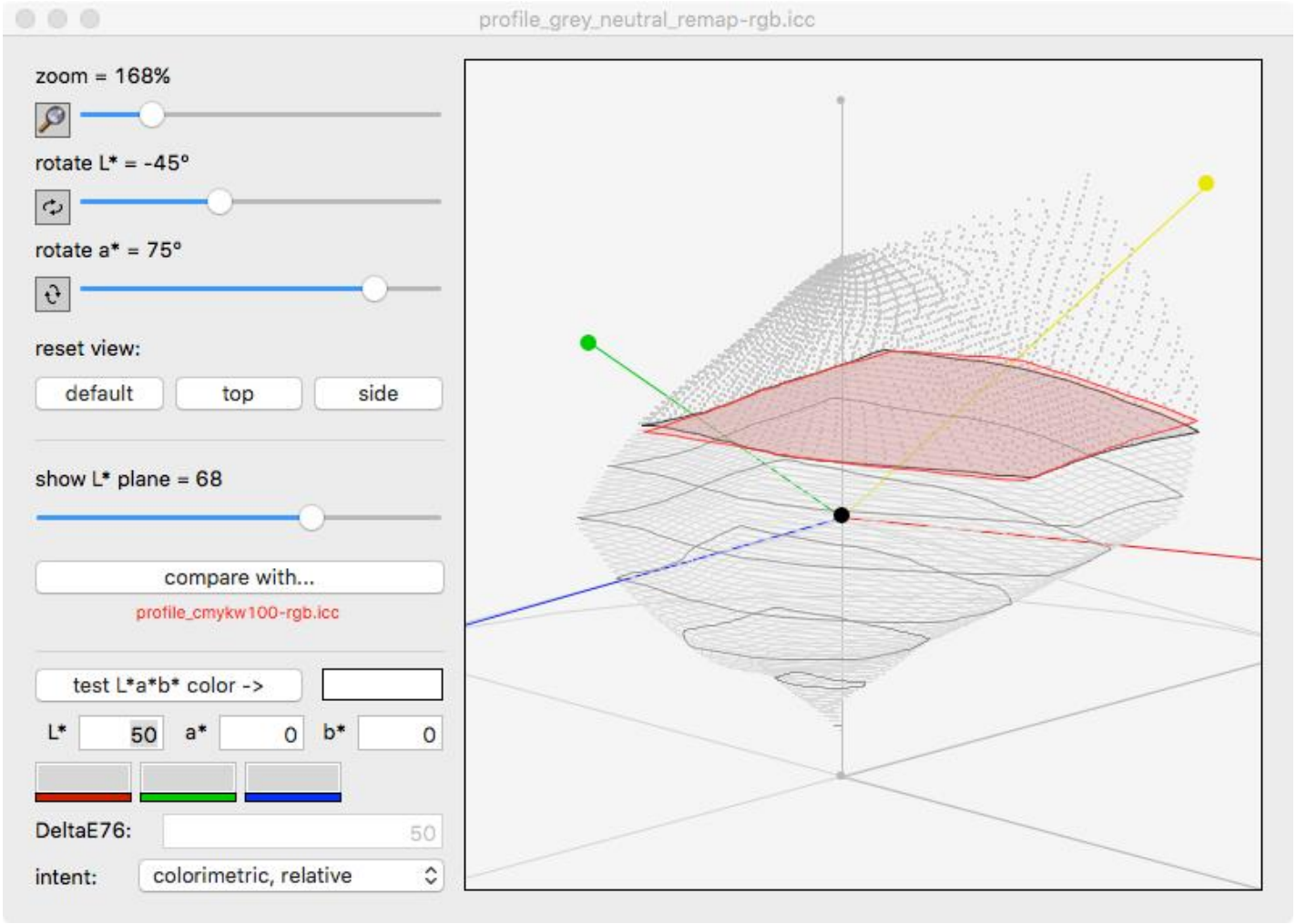
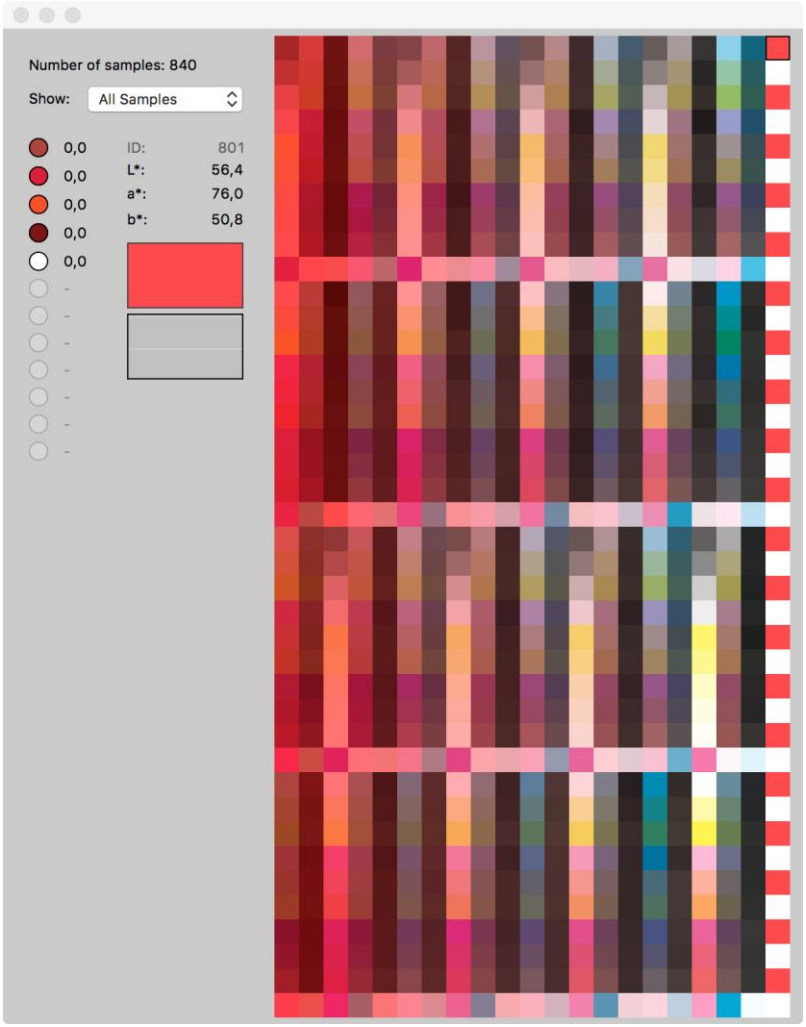
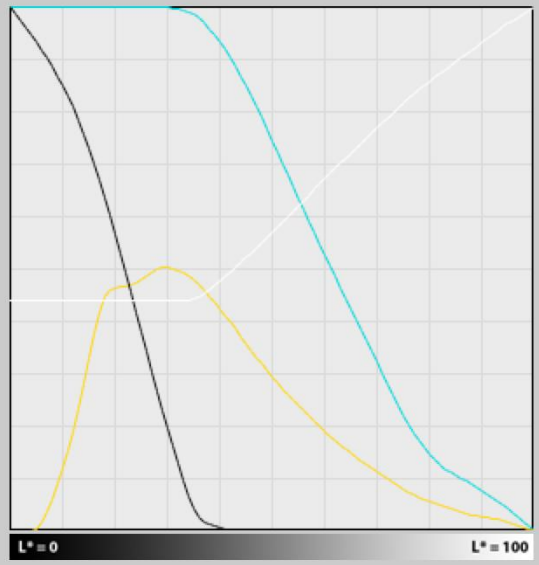

profile_grey_neutral_remap-rgb.icc
zoom = 168%
rotate L* = -45°
rotate a* = 75°
reset view:
default
top
side
show L* plane = 68
compare with...
profile_cmykw100-rgb.icc
test L*a*b* color ->
L*
50
a*
0
b*
0
DeltaE76:
50
intent:
colorimetric, relative

Example 2:
RED SUBSTRATE



GREYSCALE INK FUNCTIONS



Minimum Luminance = 11,356

Process : Idle.

done.

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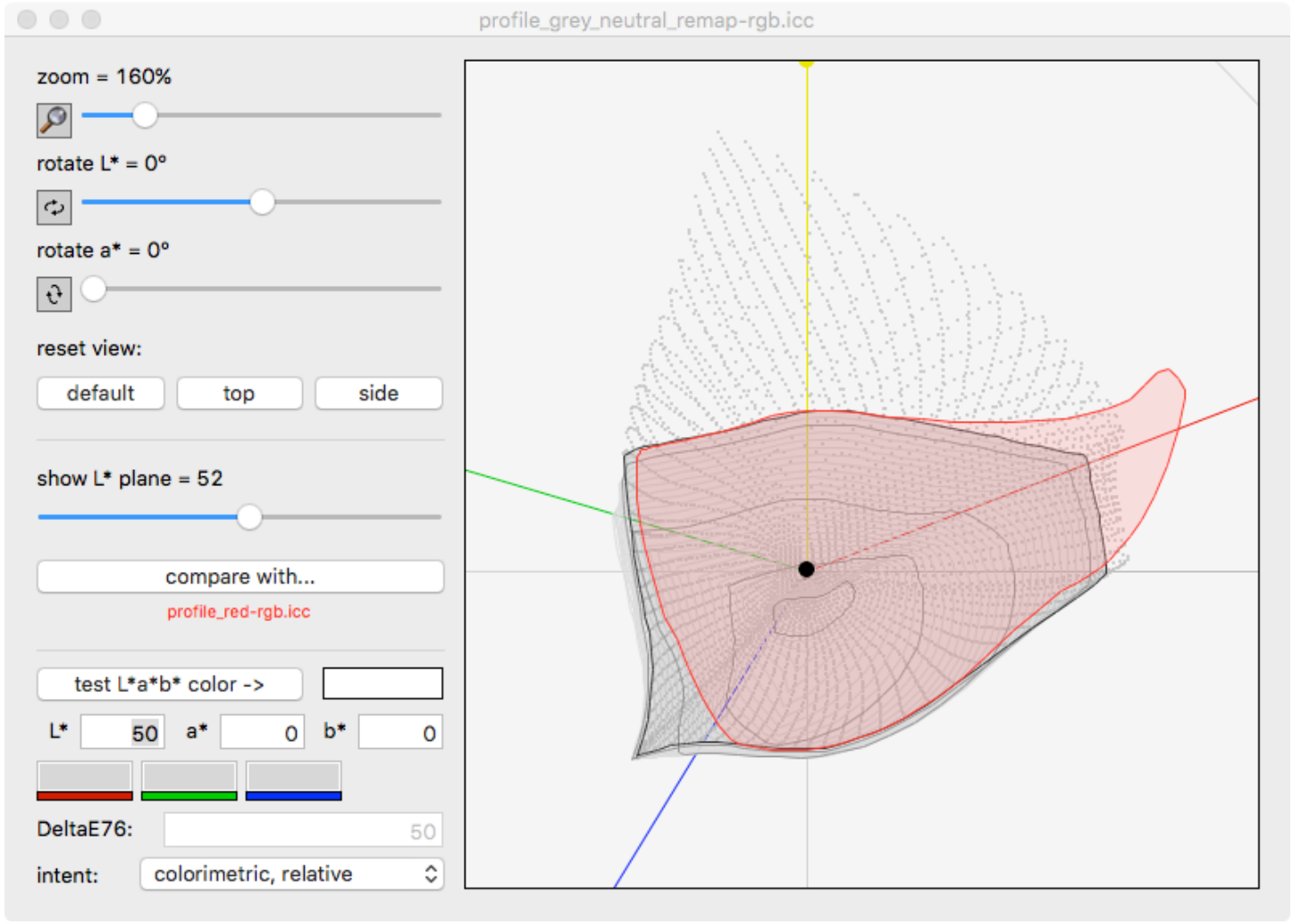
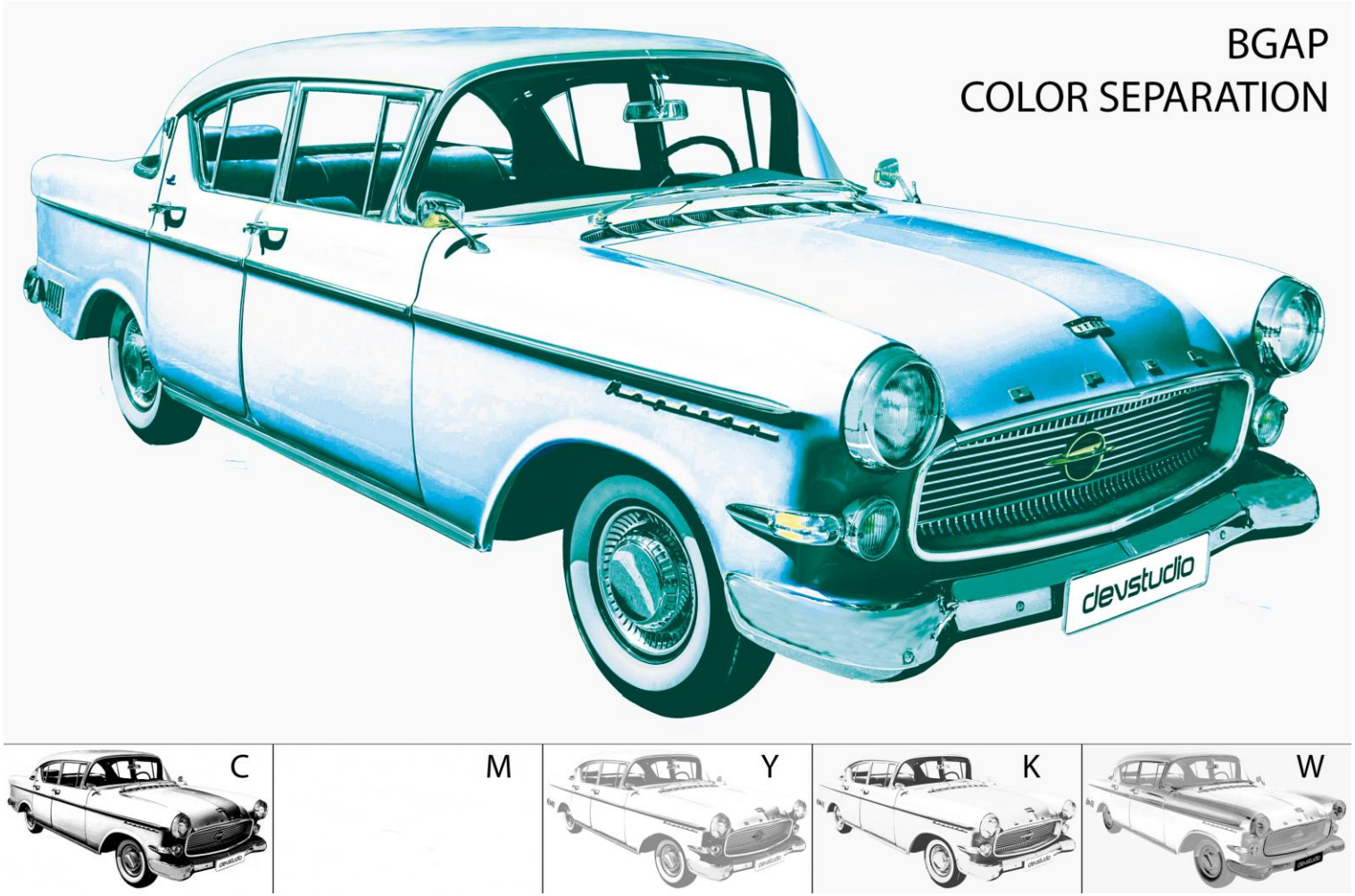

profile_grey_neutral_remap-rgb.icc
zoom = 160%
rotate L* = 0°
rotate a* = 0°
reset view:
default
top
side
show L* plane = 52
compare with...
profile_red-rgb.icc
test L*a*b* color ->
L*
50
a*
0
b*
0
DeltaE76:
50
intent:
colorimetric, relative


BASIC CMYK
COLOR SEPARATION
devstudio
C
M
Y
K
W


BGAP
COLOR SEPARATION
devstudio
C
M
Y
K
W

BG.A.P.™ ADVANTAGES:

LOWER COST.
Lower ink consumption of both white and process colorants.

MORE COLORS.
Expanded color gamut of the system when the substrate color lies beyond the boundaries of the process colorants' one.

MORE FLEXIBILITY.
It allows to obtain special effects on textured or reflective materials and preserves the original look and feel of the surface of the printing medium. The image "merges" to the surface.

Some examples…

DTG market, T-Shirt pleasing to the touch and to the sight

Natural leather: print with hybrid profile allows a much more natural look and

Gold paper

Alluminum or silver paper

Alluminum Dibond

Wood

Thanks for your attention

SW RIP & Technologies for Digital Print