"Eboni-6"

100% Carbon Pigment
Black and White Printing
For Many Epson Printers

www.PaulRoark.com
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Eboni-6 is a monotone, black and white inkset composed of MIS Associates' Eboni carbon matte black pigments, along with five dilutions of it. The inkset produces extremely smooth, 100% carbon pigment prints on matte papers.

The prints can range in tone from relatively neutral to warm, depending on the paper used. The ability to make visually neutral B&W prints is what distinguishes Eboni-based inksets from other 100% carbon inksets.[1]

While Eboni-6 as such has not been tested by a sophisticated third party tester, another Eboni inkset is the most stable ever tested, with a midtone rate of density and color change, as measured by delta-e, that is only 20% that of a comparable Epson UltraChrome "Advanced B&W" mode test print.[2]

Because Eboni-6 is for matte papers only, it does not require the binders needed for glossy papers. These binders are a major factor in inkjet clogging. My Eboni-6 printers have been the most clog free of any I've ever used. The 1400 Eboni-6 combination virtually never clogs.

Eboni-6 will appeal to those who want very stable fine art prints. With no color inks in the inkset, profiling is easier, while fading and color ink artifacts, including metamerism and tone shifts cease to be concerns. Eboni-6 in the Epson 1400 printer is my top recommendation for B&W – for both beginners and advanced printers.[3]

For wider format printing, I now recommend the "K2" and "K3" generations (e.g., 7600 and 7800). The modern cartridges are much easier to agitate than the old 7500 carts. I use the 1400 and 7800 with various versions of Eboni-6 in them.

A variety of printing procedures or workflows can be used, including the Epson driver and QTR.

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[1] On Epson Hot Press Natural, the Eboni-6 Lab B, where an ICC is used with the Epson driver, has a Lab B rise from the paper white to the maximum Lab B of only 1.3 Lab B units. A one unite color difference in the Lab color scheme is barely perceptible.

[2] See http://www.aardenburg-imaging.com . Carbon pigments do not show faster fade for the more dilute mixes. See http://www.paulroark.com/BW-Info/Carbon-stability-Density-v-Delta-e.jpg Thus, the dilute Eboni positions in Eboni-6 should hold up as well as the concentrated one that has been tested.

[3] Those who want a turn-key glossy-compatible, variable-tone inkset, see http://www.paulroark.com/BW-Info/UT14.pdf.

A. Background – Lightfastness and Tonal Stability

Maximum image stability – lack of fading and tone shifting – is and should be a primary goal of high quality B&W printing. While color pigments used in inkjet printers today allow color images that exceed the life of most wet process color prints, they are not up to the stability expected of B&W silver prints. The eye is very sensitive to color differences in the near-neutral range, and the use of high gamut color pigments in the vast majority of B&W inkjet printing systems will inevitably cause the prints to shift tones as the color pigments fade at different rates. As such, these prints cannot be expected to be as stable as the traditional silver prints. High quality carbon pigments do have the stability to challenge the silver prints, and B&W images composed of nothing but very stable carbon should satisfy the most demanding B&W print connoisseurs. For stable B&W prints, carbon is king.[4]

Most dilute carbon inks are too warm to make neutral B&W prints. Eboni-6, however, combines the relatively neutral Eboni carbon pigments with a dilution base that retains most of that neutrality on a number of papers, while printing quite warmly on others. As such, by selecting different papers one can achieve print tones that cover a significant range of tones used by fine art printers.

B. Ink Positions

There are 6 densities of ink in Eboni-6. The placement of the inks, by MIS abbreviated designation, is as follows (with a note as to approximate density of the ink):

K = Eboni (The standard MIS Associates carbon matte black ink)
C = EB6C (30% Eboni, similar in density to the standard MIS UT dark gray density)
LC = EB6LC (9% Eboni, similar in density to the MIS UT Light Carbon density)
M = EB6M (18% Eboni, similar in density to standard LK)
LM = EB6LM (6% Eboni, similar in density to standard LLK)
Y = EB6Y (2% Eboni, a very light "LLLK")

The density order, from most to least dense is: K, C, M, LC, LM, and Y.[5] (Note that the 1400 loads the inks in the different order, with yellow on the left. Follow the printer's color coded order for installing the cartridges.)

K2 printers can use M (18%) also in the LK position.
K3 printers can use M and LM in the Lk and LLK positions. They can also use C and LC in the LK and LLK position.

[4] See http://www.paulroark.com/BW-Info/R1800-Lightfastness.pdf for general information relating to carbon pigment lightfastness.
[5] See http://www.paulroark.com/BW-Info/Eboni-1800.pdf for the unique ink order used for the R1800 printer.

In desktop printers, be sure to **remove the tab** (usually yellow) **on MIS cartridges** that block the air intakes before installing the cartridges.

To order the inkset from MIS, go to http://www.inksupply.com/eb6.cfm. For the 1400, pre-loaded carts are available at http://www.inksupply.com/product-details.cfm?pn=EB6-1400-SET. These carts can be refilled from bulk bottles. If one is new to inkjet printing, starting with pre-filled carts is a good idea.

Note that **flushing** the printer is **required** before switching from an UltraChrome inkset to Eboni-6. This is particularly important with wide format printers that have tubes between the carts and the heads.[6] Eboni-6 and UltraChrome inks should also not mix on the parking pads. As such, rinse them before installing and do not have UltraChrome inks in the same printer as Eboni-6.

C. Printing Workflow Options

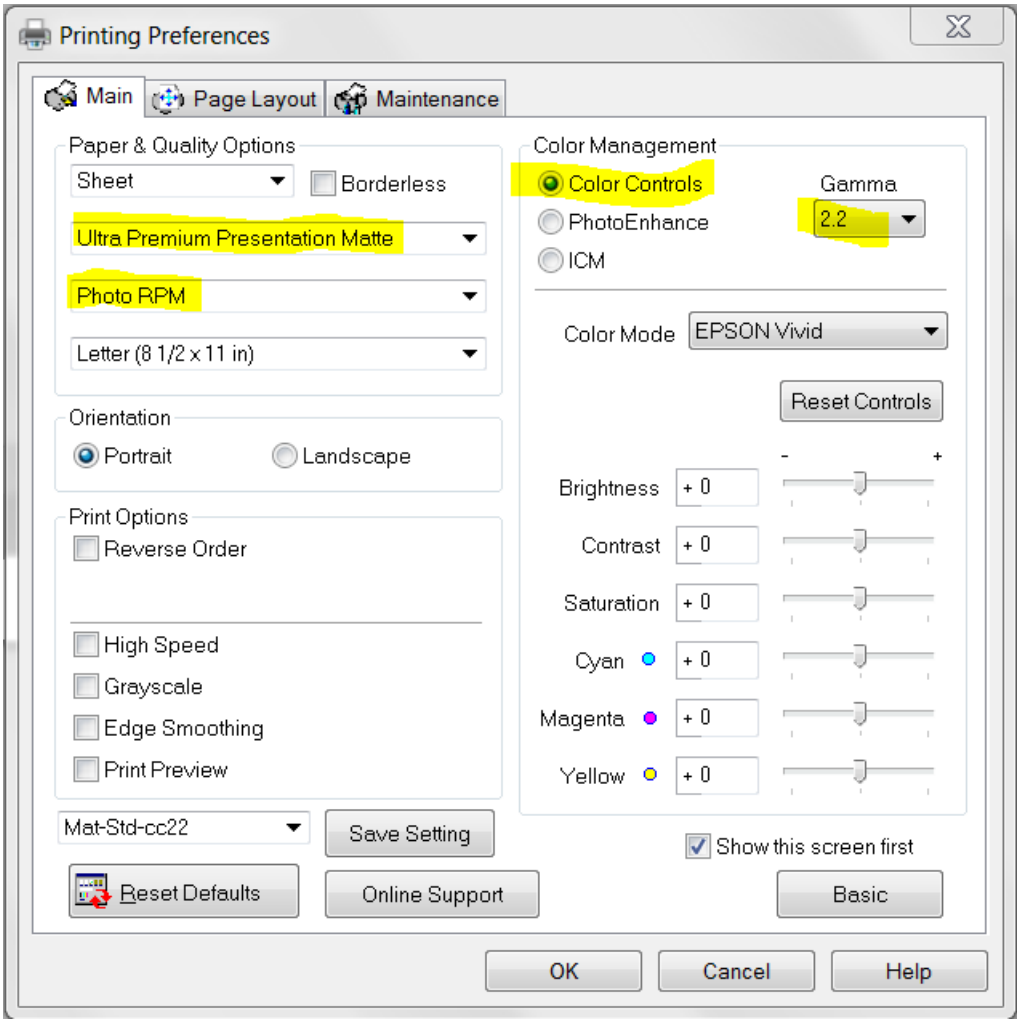
While the ultimate in control will come with a rip like QuadToneRip ("QTR"), the Epson driver works very well with Eboni-6 and is very simple to use and profile. This is particularly true when an ICC made with QTR's "Create ICC-RGB" is used with the Epson driver. Below are several options with respect to workflows. In all cases, a grayscale file is used, not a color, RGB file.

1. Epson Driver – "Color Controls" Checked, No ICC

Most Epson models will print reasonable well with the Epson driver settings shown on the screen grab, below.

[6] Note regarding **wide format** printers and **CIS/CFS units**: All pigments settle with time. I have observed settlement with this inkset that is a bit faster than average. As such, agitating carts and CIS units is even more important than usual. This should have no impact on desktop printers with individual carts because they are agitated routinely when during printing.

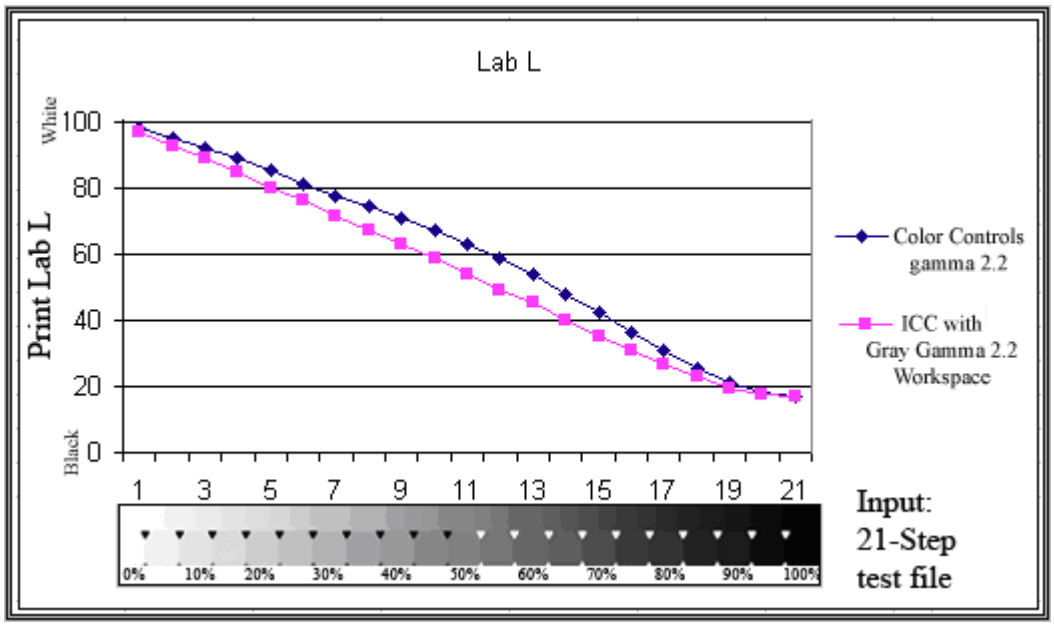
These are the recommended settings for Eboni-6 in the Epson 1400 printer. They are set in the "Advanced" driver "Properties" box. Note that I am using Windows 7 with Photoshop CS4.



Matching how the image looks on the monitor is usually the primary goal. Below, I compare, graphically, (1) the results of the Epson driver with the above settings with, (2) the ideal density distribution for Gray Gamma 2.2, which is the most common grayscale working space, and a subset of Adobe RGB and sRGB. A calibrated monitor should display an image in this gray space with these relative densities, although I note that no print can match the brightness of modern LCD monitors.

The black curve in the graph below shows the Lab L (luminances) for the Epson 1400 with above settings. A 21-Step test file is printed and the test patches from the paper white (0%, #1) to the 100% black (#21) are measured with a spectrophotometer. The red curve shows the ideal distribution where an ICC is used and the working space is Gray Gamma 2.2. As the graph below indicates, printing with only the Color Controls checked

in the printer driver, with no ICC, may result in a print slightly lighter than the ideal print from a gray gamma 2.2 workspace.



2. Epson Driver – ICC in Print Preview

The use of an ICC in the Photoshop or Elements Print Preview has significant advantages. Grayscale ICCs are easy to make using QTR's "Create ICC" or "Create ICC-RGB." I recommend the latter version for greater compatibility with some current image editors. This program is part of the QTR download. To download this program, go to http://www.quadtonerip.com/html/QTRdownload.html

An ICC "color manages" the workflow, in the sense that a calibrated monitor will automatically give a good match to the print's relative densities. (ICCs can also be used to "soft proof" the print tones, but that is beyond the scope of this article.)

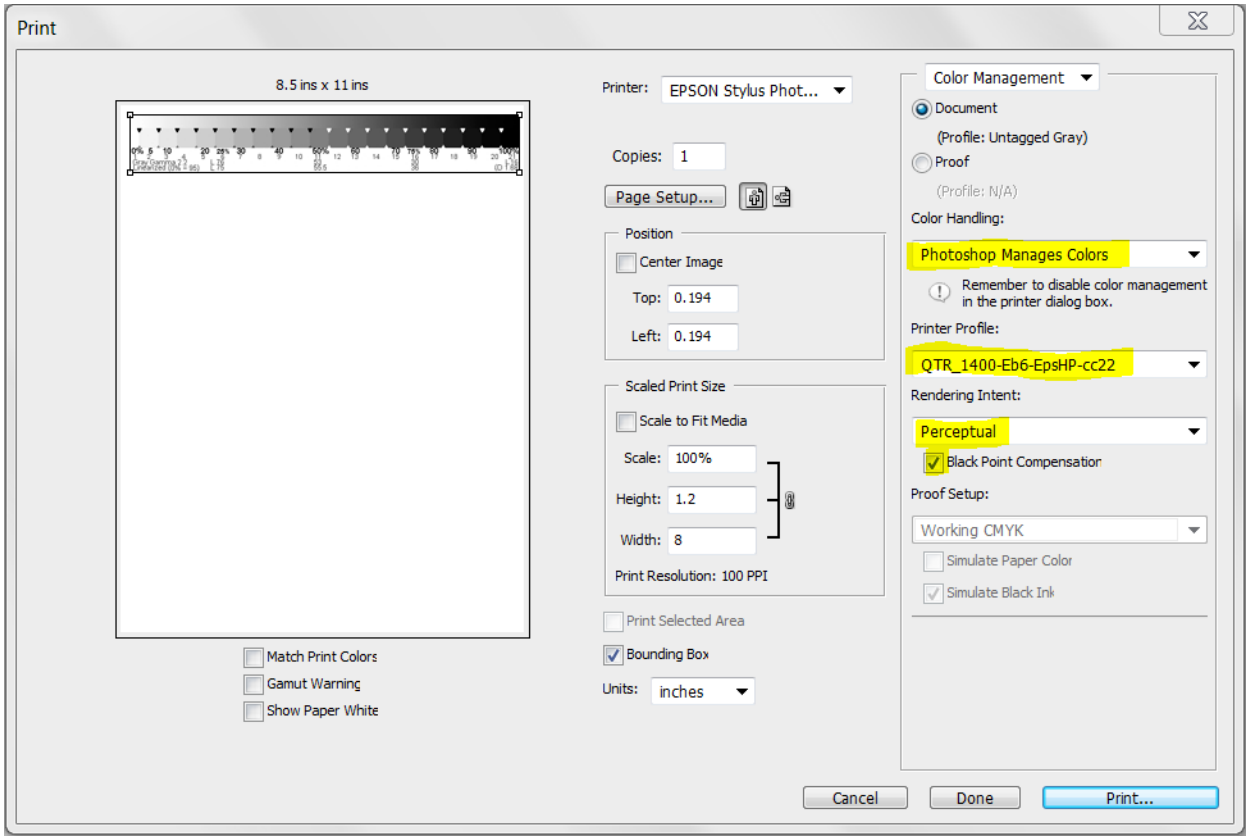
Briefly, ICCs are made with Create-ICC by printing a 21-step test strip and taking the Lab L or density readings from that test strip to, in effect, tell the printer how to match the monitor.

ICCs are made for specific printers, papers and inksets, and the printer drivers must use the same settings as were used when the original test strip was made. As such, I recommend that the name of the ICC include not only the printer, inkset and paper name, but also the key driver settings.

The Print Preview screen-grab below shows an example. This print preview is from PS CS4 and for the Epson 1400, Eboni-6 setting shown above. Here, an ICC for Epson Hot Press is being selected. The "cc22" indicates that Color Controls with gamma 2.2 should be used. If "No Color Adjustment" was used in the driver, "nca" would show in the ICC

name. Note that CS5 will not allow the use of an ICC with "Color Controls;" the "nca" (No Color Adjustment in the Epson driver) setting is required for ICCs in the newest OS's and image editors.

My 1400 Eboni-6 profiles – including ICCs as well as QTR profiles and some ACV Photoshop curves – are posted at http://www.paulroark.com/BW-Info/1400-Eb6-Profiles.zip.[7]



Note that whether "Black Point Compensation" is checked or not does not appear to make any difference. Elements does not even have the option.

When one makes an ICC the use of a spectrophotometer to read the test strip is ideal, but one can also use a flatbed scanner for this purpose.
See http://www.paulroark.com/BW-Info/Making_B-W_ICCs.htm for some tips on using Create-ICC with a flatbed scanner. I use a ColorVision Print Fix Pro spectro.

[7] See http://www.paulroark.com/BW-Info/Eboni-6-profiles.zip for some profiles for other printers.

3. Epson Driver – ICC Made with "Create ICC-RGB" & Photoshop Image Adjustment Curves

The Epson driver workflow that gives the most control and smoothest results uses an ICC made with QTR's "Create ICC-RGB." This type of ICC can have a Photoshop image adjustment curve embedded in it that can "partition" the inks, putting only the lightest inks in the highlights. While partitioning for smoothness is not a significant issue for the 1400, old printers may benefit from it. The purpose for a partitioned workflow with the 1400 is that it can result in a more neutral print tone. This workflow also results in a high bit depth pipeline from file to printer, unlike the Epson ABW mode printing.

PS image adjustment (*.acv) curves are included in the Zip file. The 1400 curve using printer setting NCA results in the most neutral prints on the 1400. The Epson Hot Press QTR profile is similar.

See http://www.paulroark.com/BW-Info/Embedding_Photoshop_Curves_in_ICCs.pdf for information on embedding Photoshop curves in ICCs.

See http://www.paulroark.com/BW-Info/Eb6-C6-curves.pdf for more on the Photoshop curves used in making ICC profiles with QTR's "Create ICC-RGB" program.

4. Printing with QuadToneRip (QTR)

QTR provides the most control and flexibility. It is the only way to print black only, and its ability to fine tune ink limits also often results in a slightly better damx. For printing on uncoated watercolor paper, such as the classic Arches uncoated Hot and Cold press papers, the use of QTR is essential. As noted further below, the ability to blend different profiles allows QTR to print with tones that cannot be duplicated with the Epson driver.

That said, I do recommend that novices start with the Epson driver. (A separate PDF will outline profiling and printing with QTR. See pages 6 – 12 of http://www.paulroark.com/BW-Info/Eb1400.pdf for more information on QTR printing for now.)

D. Papers & Print Tones

As noted above, the print tones produced by the Eboni-6 inkset range from relatively neutral to warm, depending on the paper and printer used.[8] In general, the maximum Lab B value (yellow-blue axis) indicates the warmth of the print. The higher the Lab B value, the warmer the print will appear. The maximum Lab B values have ranged from neutral[9] to about six with matte papers and Eboni-6.[10]

[8] The spectro used is also a variable, and my current one appears to be reading high Lab B values in the paper white and light tones.

[9] My old 7500 could hold the maximum Lab B value to just slightly negative with Premier Art Smooth BW paper. The larger the dots, the more neutrally the carbon generally prints.

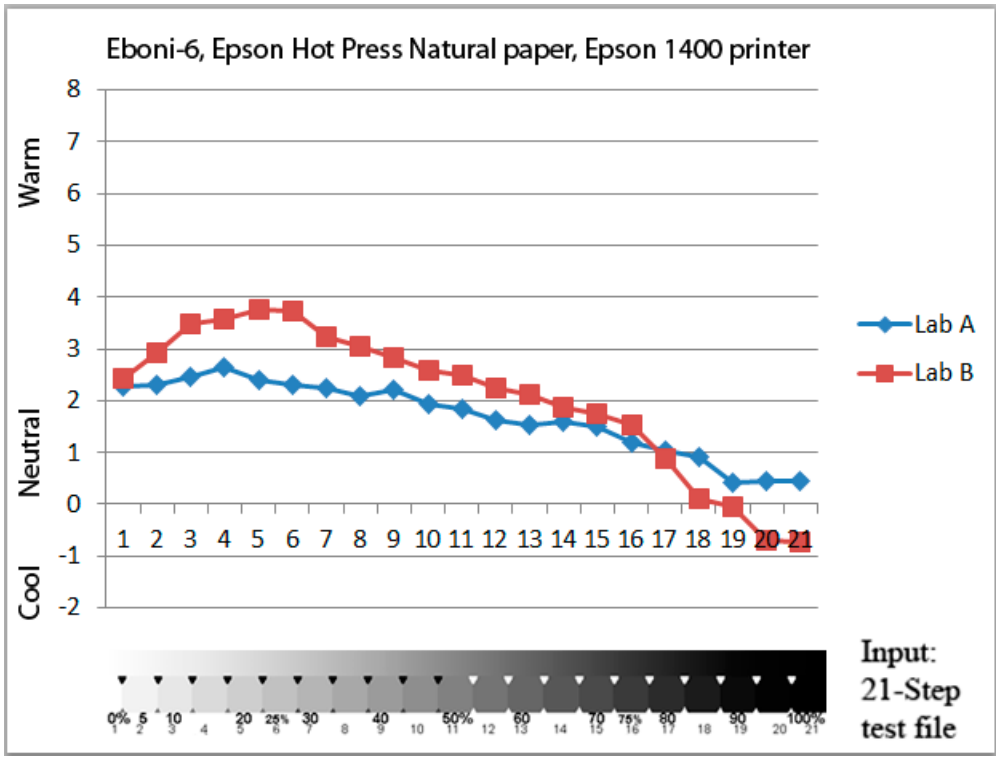
The difference between the paper white Lab B and the maximum midtone Lab B also strongly affects the sense of warmth, as the eye tends to do an automatic white balance on the paper white or other white reference (like the mat board or the bright white copy paper on our desks) that is close to what is being viewed. The increases in Lab B have ranged from 1.3 to about 7 with the full inkset. Black only printing on some papers can cut this down a bit more – i.e., is more neutral. In the Lab color model, one Lab unit is barely perceptible to the human eye. As such, the 1.3 Lab B increase over the paper white exhibited by the Epson Hot Press Natural paper makes it appear just slightly warmer than neutral. See the graph of this paper's color response to Eboni-6, below.

Note that computer monitors are usually very "bright white" (bluish, 6500 K) and copy paper is brightened (bluish). It is best to remove yourself from that environment to view test strips and prints. Creamy natural paper and the most neutral carbon prints on that paper will look warm next to the monitor and brightened paper. View the test prints against the mat board you use and with the lighting that is expected. The whiteness (color temperature) of the light sources will also affect how the prints look.

Lab A also affects tone, but it is essentially set by the paper and remains relatively constant. A slightly positive Lab A (red/magenta) is generally preferred to avoid the print taking on a green tint; thus all of the papers show this characteristic to some extent.

I like to display the print tones via graphs that show in a very objective manner the Lab A (red/magenta positive and green negative) and Lab B (warm yellow positive and blue negative) values for each of 21 density steps on a 21-step test file.

[10] See http://www.paulroark.com/BW-Info/Color-basics.jpg and http://en.wikipedia.org/wiki/Lab_color_space for some basic information on the Lab color model.



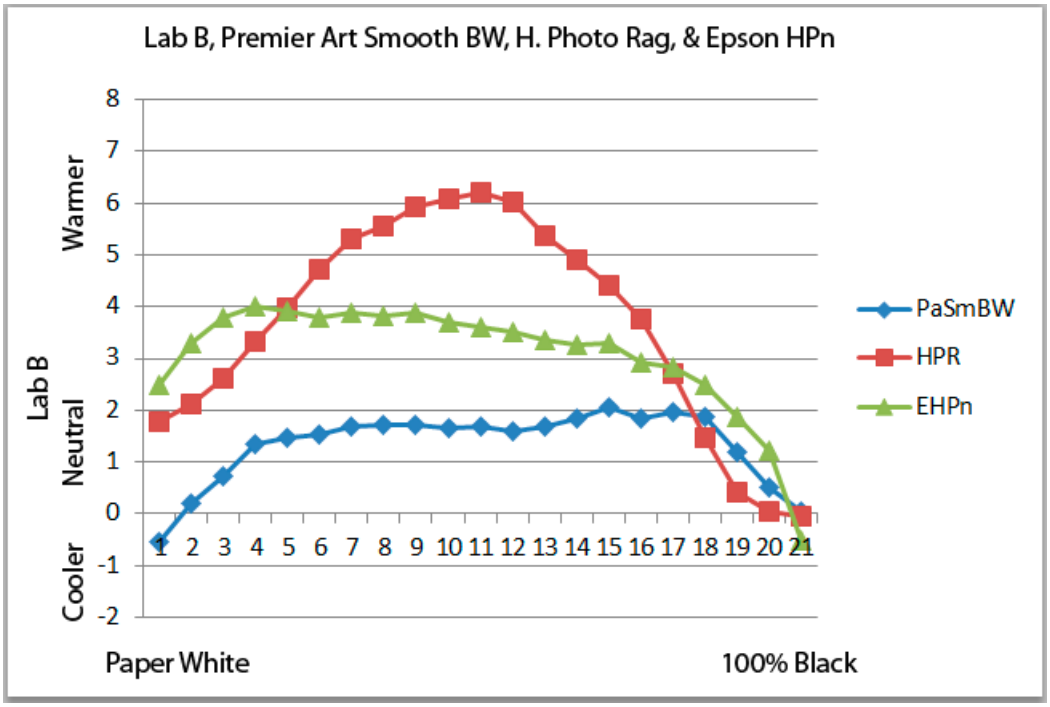
Note that I have seen significant variance in the paper white Lab B readings depending on the spectro used and the substrate that is under the paper at the time it is measured. The bottom line here is that I believe the paper whites I'm now reading are a bit more than one Lab B unit warmer than one usually sees for the papers.

In general, all natural paper has a positive Lab A and Lab B. The "gallery white" (not bright white) mat board that I use for a substrate for the measurements here has a Lab B = 5 with the spectro I'm now using. On the other hand, other samples of the mat board and other spectros have given the mat board a Lab B = 3+. At any rate, with a relatively substrate that is quite "creamy" in tone, the printing papers will have a higher Lab B reading than if they were measured on a brightened piece of copy paper. Additionally, the spectro I'm using might be reading the paper whites as warmer than other spectros.

The graph below shows the Lab B measure for 3 significant papers. Premier Art Smooth BW is a paper that makes what I think of as the most neutral-cool print possible with these carbon inks. These look very good next to a cool tone silver print. Under glass, most do not see the difference (glazing hides the matte surface). Although not shown here, the paper has a slight selenium tone, which is a slight elevated Lab A. PA Smooth BW is a brightened paper that contains OBAs. These are dyes that will fade, increasing the warmth of the paper with time. I have used it regularly and like the way it looks next to my silver prints. However, for fine art or uses where print tone stability is a top priority, a non-brightened paper is recommended.

Hahnemuhle Photo Rag (HPR) is a well-known paper and had, until recently, the best dmax of any matte paper. While it has some brighteners in it, they are minimal, may be in the paper as opposed to the coating, and have held up very well in tests. Many consider the paper white of HPR to be neutral. One usually sees a Lab B for HPR of just under Lab B = 1. As such, this graph below shows a good comparison of the paper tones, with HPR setting the standard for a neutral white. The print tone on HPR, however, would be considered warm or medium warm.

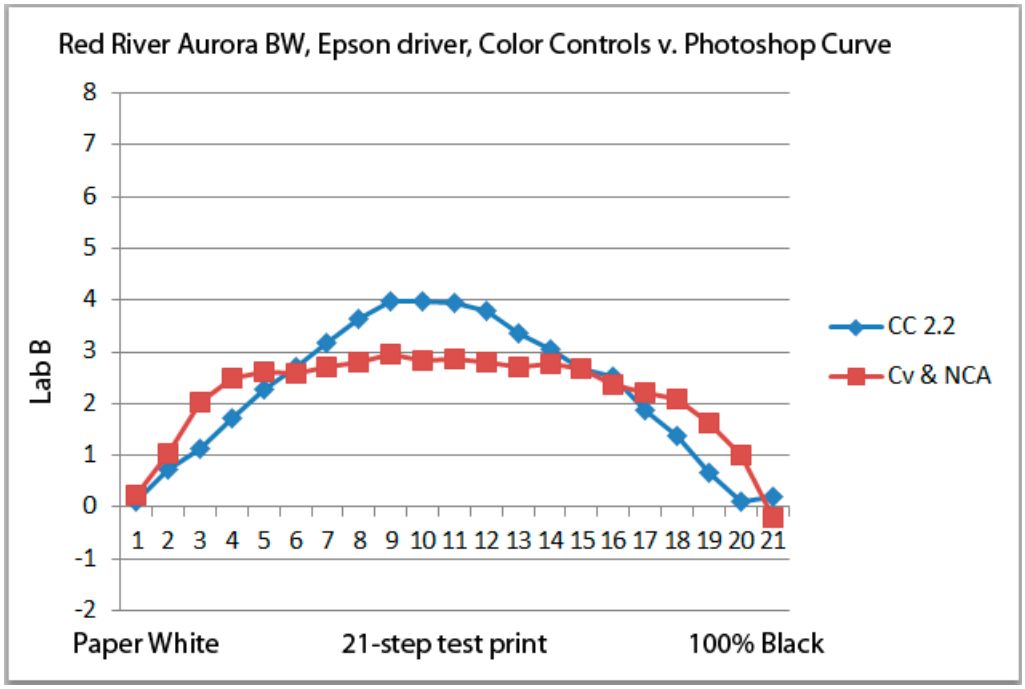
Epson Hot Press Natural is an un-brightened (no optical brightening agents of "OBAs) paper. It is among the "brighter" of such paper, having a Lab B just slightly above that of HPR. It has a lower Lab B than many natural papers, such as the "gallery white" mat board I use and the traditional "bright white" but un-brightened Arches watercolor paper. It has a very low rise in Lab B and is the non-brightened paper I now use most and recommend for a relatively neutral fine art print.[11]



The graph below shows the Lab B for Red River Aurora BW, but printed with different profiles.[12] Where the Epson driver with Color Controls and Gamma 2.2 is used, the print is a bit warmer than when an ICC that incorporates a Photoshop curve is used. This is

[11] I buy much of my paper from http://www.atlex.com/
[12] Red River paper makes a number of high value papers. They sell direct from http://www.redrivercatalog.com/

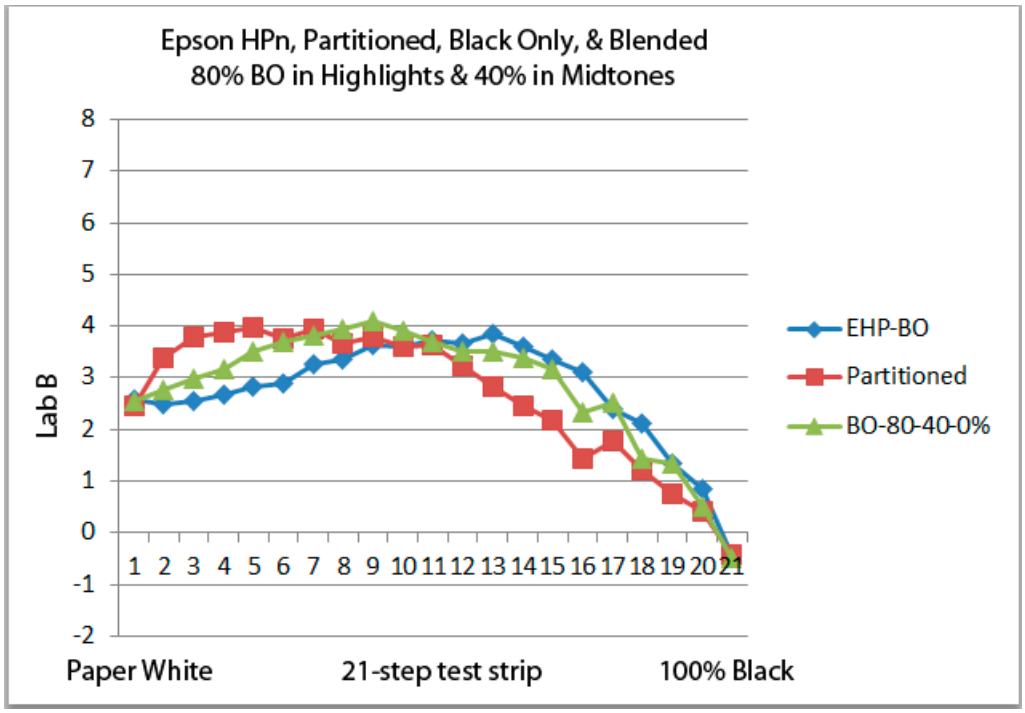
printed with the driver set to No Color Adjustment and the curve in an ICC. The curve in the ICC uses the maximum amount of the lightest Eb6-Y ink in the profile.



One very useful feature of QTR is the ability to blend different profiles. With, for example, Epson HPn Black Only (BO) printing gives the most neutral tones, particularly in the highlights. The partitioned profile, however, makes for very smooth prints. To me, the BO highlights are smooth enough for most prints. Where the BO approach becomes the roughest is in the midtones. This is because the 1400 nozzles have variable drop sizes. The tiny 1.5 picoliter droplets are used only in the highlights. In the midtones larger drops are used.

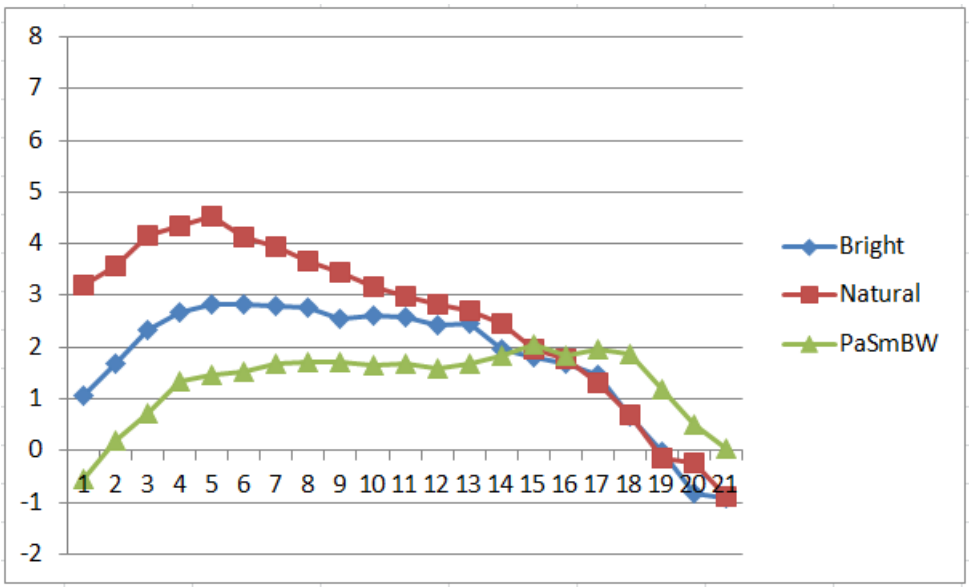
What I like to do is blend the BO and partitioned profiles in QTR to get the smoothness of the partitioned workflow, particularly in the midtones, and also get the more neutral BO highlights – or a compromise between the neutral tone and smoothness.

The graph below shows the Lab B values for Epson HP natural printed with a fully partitioned profile, the Black Only profile, and then a blend that is 80% BO in the highlights, 40% in the midtones and 0% in the shadows.



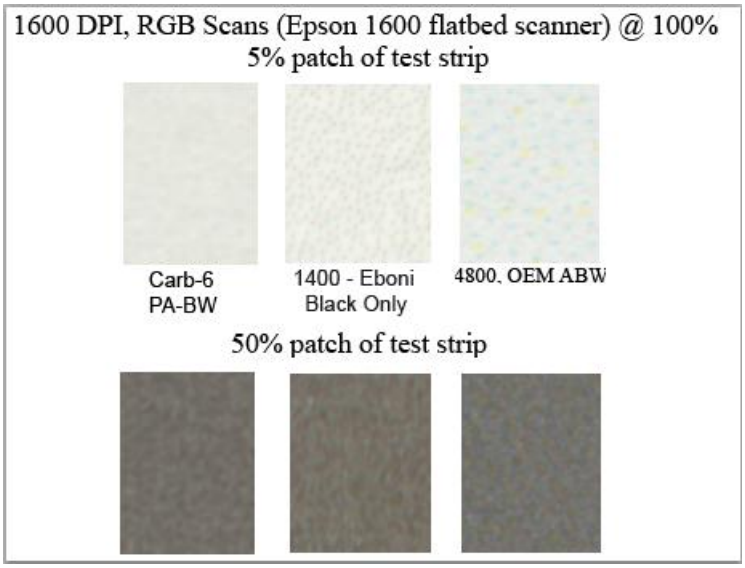
The graph below shows the Lab B measures for the 3 papers that have the lowest delta-Lab-B's. That is, from the paper white to the maximum Lab B, the degree of warmth is held to a minimum.

Epson Hot Press Natural & Bright, and Premier Art Smooth BW



E. Image Structure Comparison

The 1600 dpi (flatbed) scans shown below give some objective information about relative smoothness.



The test patches shown above are, on the print, only 1.75 mm high. So, to get a better idea of smoothness, adjust your viewing distance from the monitor. On my monitor the images are 35 mm high. So, if the normal print viewing distance is 14" (according to Kodak), I'd have to view my monitor from a bit more than 23 feet away to adjust for the magnification shown here.

The bottom line is that the Eboni-6 inksets with the lightest inks have extremely smooth highlights and midtones. On modern printers the inkset prints virtually dotless. The 1400 with its 1.5 pl drop size (highlights only) also makes black-only prints that I find quite good for many purposes. The main issue I've had with that approach is in the midtones, where I find the graininess of the drop (larger than 1.5 pl in the midtones) combines with film grain to make middle gray, smooth skies look too rough. There, as noted above, QTR can be used to combine the BO and partitioned profiles to get the best of both.

A 100% carbon pigment printing workflow, like the one discussed here, appears to make the most stable inkjet images possible with today's technology. The carbon pigment prints may be even more archival than the old wet-process silver prints due to the buffered paper base that has not been subjected to the harsh processing chemicals of the old wet darkroom processes. It is where I think fine art B&W printing should be.

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