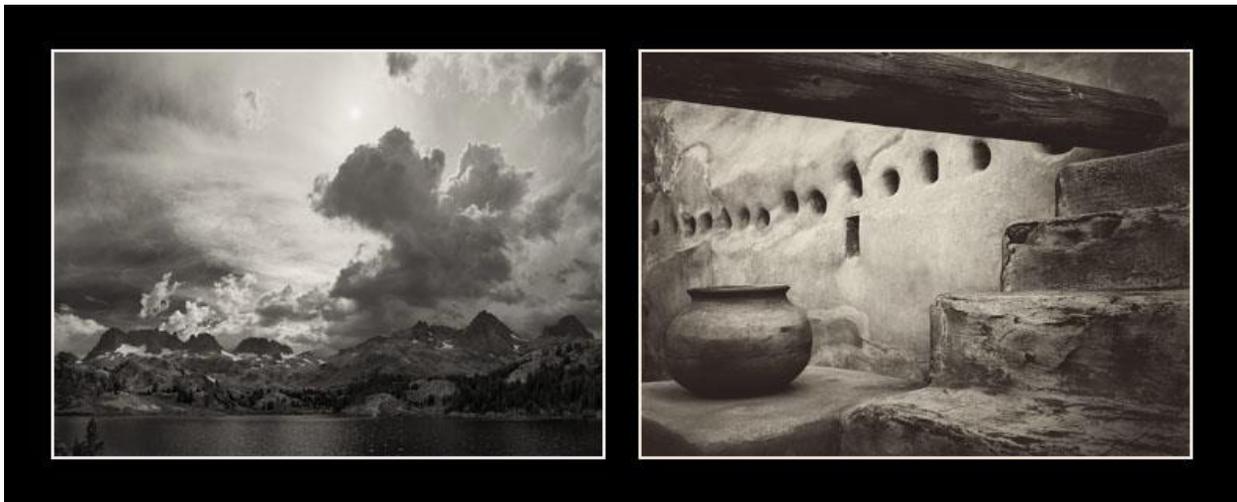


## Carbon Variable-Tone, v. 2 Black and White Inkset Epson 7800 and other K3 printers

[www.PaulRoark.com](http://www.PaulRoark.com)

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This PDF discusses an arrangement for carbon pigment, “Ebony-6”<sup>1</sup> type inksets that adds a blue toner to expand the image tone range of those inksets.<sup>2</sup> The fundamental differences with this ink arrangement are that there are two positions of MK ink as well as the 30% dilution (Eb6-C), and a light blue toner, which can be used when truly cool tone prints are needed. With two MK inks, watercolor papers can often achieve a higher dmax. Arches, for example, can hit a dmax of 1.7 at an ink load of about 120%, spread evenly between the two MK channels. Additionally, the second 30% ink, while not being as neutral as an MK, is useful in pulling the warmth down a bit when a more neutral tone is needed in a 100% carbon print. For optimum results I recommend printing with QuadToneRip.<sup>3</sup>



The above images show the approximate print tones for Arches on the left and Stonehenge on the right – both watercolor papers – using profiles that produce a 100% carbon print.<sup>4</sup> Producing the best 100%

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<sup>1</sup> See <http://www.paulroark.com/BW-Info/Ebony-6.pdf>. The beta inkset tested used generic dilution base c6d. See <http://www.paulroark.com/BW-Info/Ink-Mixing.pdf> for clear base formulas. The concentrated carbon MK was supplied by STS Inks, which acquired Image Specialists (“IS”), the supplier of the “Ebony” MK ink to MIS Associates. The STS version of “Ebony” is slightly warmer than the old IS version, probably due to an upgraded dispersant. The differences are about 1 Lab B unit warmer, and also a much higher dmax on many papers, in particular watercolor papers. The empty carts and chips were also supplied by STS Inks. This MK is not, apparently, the MK used in other STS inks. The new version of Ebony is now available from MIS as “Ebony” v. 1.1. See <http://www.inksupply.com/eb6.cfm>

<sup>2</sup> The basic concepts have been tested in an Epson 1400 at <http://www.paulroark.com/BW-Info/Ebony-Variable-Tone.pdf>, where the blue toner was used, and earlier beta inksets for both the 1400 and 7800 that used two MK positions. This v. 2 uses a new toner. See page 3.

<sup>3</sup> See <http://www.quadtonerip.com/html/QTRoverview.html>. Profiles can be downloaded from <http://www.paulroark.com/BW-Info/7800-CVT-Profiles.zip>.

<sup>4</sup> See <http://www.DavidKachel.com/> for the photographer/artist who introduced me to Stonehenge paper.

carbon prints is still the top priority, not only in and of itself, but also for the best cool prints, one must start with the most neutral carbon core.

The reason to have the highest percentage of carbon in the inkset is simply because it is by far the most lightfast printing substance available, with up to 10 times lower fade than even the selenium toned silver print.<sup>5</sup> Carbon also lacks the artifacts that appear when too much color is used. With the use of the toner, truly neutral or cool prints come within the range on this inkset, and they will have the highest percentage of carbon and least amount of color pigments in them of any inkset for any given degree of coolness and smoothness.

While images on watercolor papers may experience slightly more changes in fade tests than the best inkjet papers, I believe the coatings on inkjet papers makes them inherently less archival than a high quality, un-coated watercolor paper. I use Arches uncoated watercolor paper for what I consider my top prints. Stonehenge watercolor paper provides a very interesting alternative for images that look best with a very warm tone.<sup>6</sup> Uncoated watercolor papers have a long history of stability.

Many papers that are brightened with OBA's (Optical Brightening Agents/dyes) may print cooler with 100% carbon and be preferred by some. I generally avoid such papers because the OBA dyes fade. On the other hand, one of my favorite images that has been on my living room wall is printed on an old favorite of mine – Premier Art Smooth Bright White.<sup>7</sup> More often I use the 325 gsm non-OBA version of this paper. Another, non-OBA paper that has turned in an impressive looking image is the Premier Art Generations Alise paper.<sup>8</sup> I have not tested the brightened version.

## Ink Arrangement

Carbon pigment inks: (In parentheses I note the similar Eb6 dilution.)

Y = 100% MK  
LM = 2% MK (Eb6-Y)  
M = 9% MK (Eb6-LC)  
LC = 6% MK (Eb6-LM)  
C = 30% MK (Eb6-C)  
LK = 30% MK (Eb6-C)  
K = 100% MK (Eb6-K)

Toner:

LLK = 5.5% Canon Lucia EX Blue, 4.5% Lucia EX Cyan, 90% clear base.<sup>9</sup>

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<sup>5</sup> See Appendix 1, below.

<sup>6</sup> Note that Arches sometimes has dust – loose paper fibers on the surface that should be brushed off. This varies with the batch, and the latest one I bought is relatively dusty. If the loose fibers are not removed before printing, they rub off easily and will leave a white mark in dark areas. Some people prefer to print on the back side of Arches, which has a more random texture and may have less of the dust issue with the current batch.

<sup>7</sup> See [http://www.premierimagingproducts.com/pm\\_smoothbwfineart.php](http://www.premierimagingproducts.com/pm_smoothbwfineart.php); Premier Art's OBA-free Smooth Fine Art 325 gsm is the inkjet paper I most often use for my best work that is not on Arches.

<sup>8</sup> See [http://www.premierimagingproducts.com/pg\\_alisefineart.php](http://www.premierimagingproducts.com/pg_alisefineart.php)

<sup>9</sup> Canon Lucia Blue (PFI-106B) and Cyan (PFI-105C or 106B) are used. See for example <http://www.atlex.com/canon-pfi-106b-pigment-blue-ink-tank-130ml-for-ipf6400-ipf6450-ipf6300.html> and <http://www.atlex.com/canon-pfi-106c-pigment-cyan-ink-tank-130ml-for-ipf6400-ipf6450-ipf6300s.html>

## Toner & Color Pigments<sup>10</sup>

Version 2 of the toner substitutes Canon Cyan for Epson Cyan, making also an adjustment in the ration of cyan to blue to compensate for the slightly less dense Canon C. The reason for the change was evidence of precipitation in the original mix (and also in the Epson cyan that was just diluted with the generic base; both the Canon Blue and Cyan showed no change in the 4 month old dilutions). The new blend is the same color as the old, but just very slightly lighter. By using pigments from the same ink family (Canon Lucia) and that appear stable in the generic base, I believe the sedimentation issue should be avoided with this new mix.

The color pigments used in the toner mix are have been selected based on Aardenburg-Imaging fade test results and to further the goal of keeping the hue angle difference to a minimum. See the Lab Color Wheel below.<sup>11</sup> I have placed the Canon Lucia Blue, Epson K3 UltraChrome Cyan, and mixed CVT toner colors on a color wheel that already included the usual colors. The colors of the blue, cyan, and toner inks were taken from draw-downs on non-OBA inkjet paper. In short, they are the actual colors placed on the color wheel according to their Lab L, A and B measures. I also added a spot for the typical range of dilute Eboni carbon.

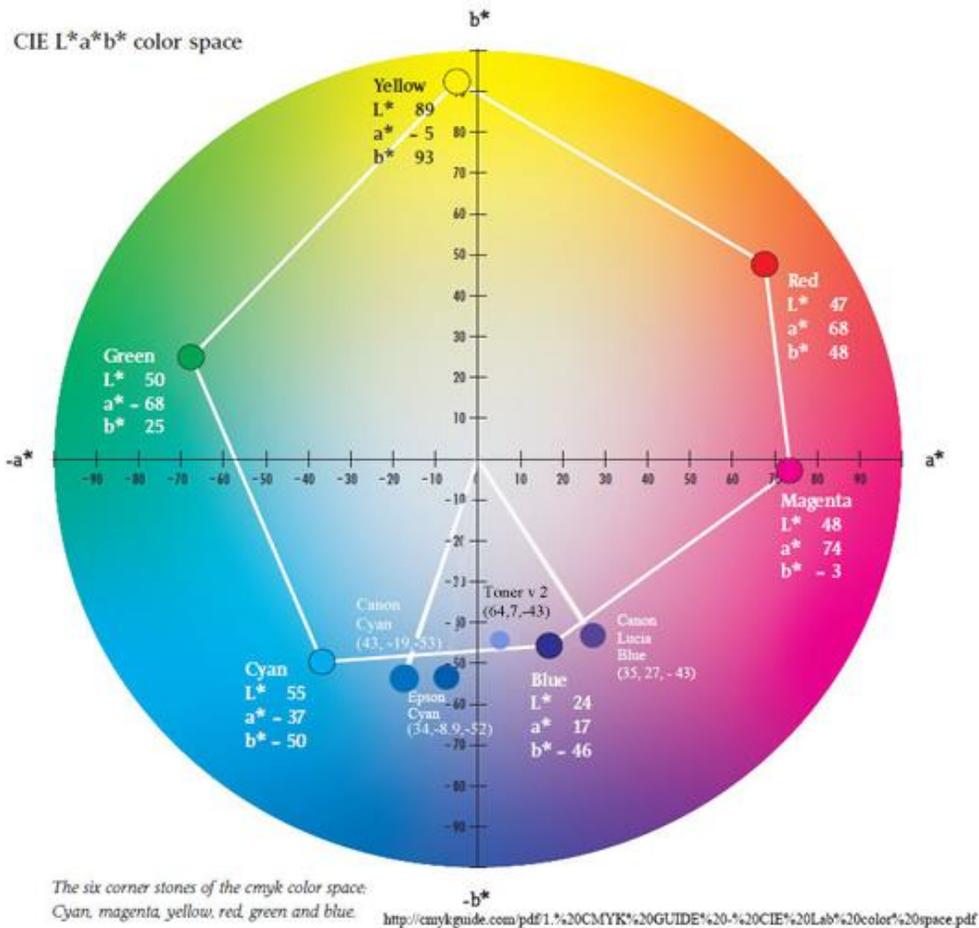
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To drain Lucia tanks, I just poke holes in the soft plastic with a clean awl – one high on the side for air to enter and one near the bottom on the side for the inks to pour out of into a 4 oz. bottle. I do this over a sink.

<sup>10</sup> This is the same toner as used in the 1400 version discussed here: <http://www.paulroark.com/BW-Info/Eboni-Variable-Tone.pdf>

<sup>11</sup> The original color wheel image is from <http://cmykguide.com/pdf/1.%20CMYK%20GUIDE%20-%20CIE%20Lab%20color%20space.pdf>.

## Canon Lucia Cyan and Blue



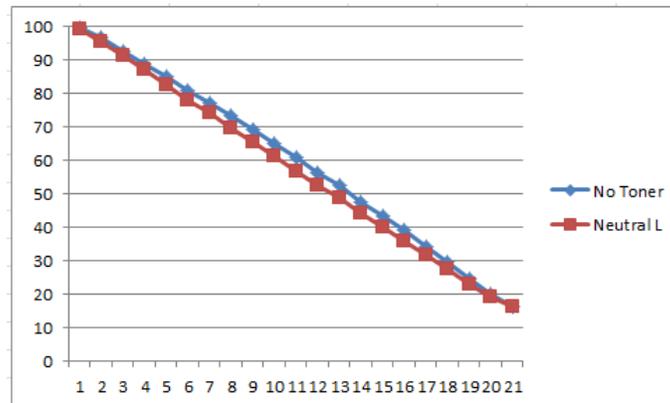
The important thing to notice is the extent to which the pigments I recommend are, in effect, different shades of blue, straddling what lab “blue” is defined as on the chart. The narrow, 50 degree hue angle or distance on the color wheel between the Epson “Cyan” and Canon “Blue” relative to the usual cyan and magenta hue angle is the big difference. The use of color pigments with this small hue angle differential makes for very efficient use of color and minimal risk of differential fade of the color pigments affecting the print tone over the very long potential life of the print.<sup>12</sup>

The dilute carbon range typically encountered with this inkset is also depicted on the color wheel, above. One of the variables that is only able to be controlled via the mixing is the Lab A. This varies somewhat with papers. Arches is the paper that usually has the lowest Lab A. The toner blend is set such that when Arches is printed with a “neutral” profile, the print Lab A and B are flat, horizontal lines between the paper and the deep shadows. The 100% K is cooler, but is seen basically as only darker. With most inkjet papers, when the Lab B is flat the Lab A will rise about 1 unit above the line between the paper’s value and the shadows, giving the print just a slight “selenium” look, which, not coincidentally, is what I and many darkroom workers preferred in the silver print era.

<sup>12</sup> For more control, but at the cost of considerably increased profiling difficulty, the two color pigment dilutions could have been put into different ink positions. This would allow Lab A control.

With this carbon and color pigment mix, very little color is needed to tone a print to a totally neutral. In addition to the relatively neutral Eboni MK, it is again the narrow hue angle that aids the efficiency of the toning. The color pigments are not fighting/offsetting each other the way they do in a typical cyan and magenta setup; they are more directly focused on offsetting the yellow hue of the natural carbon.

The Lab L graph, below, compares a neutral test strip with a 100% carbon version, where the carbon inks were printed with the identical QTR profile.<sup>13</sup>



As can be seen in the above graphs, the additional density added by the toner is never as much as the 5% difference between the steps of the 21-step test strip. If the color pigments totally disappeared, aside from a side-by-side comparison, viewers would not notice a density difference.

Overall, even the best color pigments used here have a fade rate of about 2 to 3 times that of the Eboni carbon.<sup>14</sup> However, since the color inks' total contribution to the density of the print is so low, a neutral print, mathematically, will only have a Lab L/density mid-tone fade rate<sup>15</sup> of approximately 10% more than the 100% carbon print. That compares to over 100% or greater Lab L/density fade rate disadvantage of the OEM B&W approaches.<sup>16</sup> The difference is due to the combination of a more neutral starting carbon and a more efficient as well as much smaller use of color pigments.

The most noticeable problems with third party toners and blended carbon-plus-color inks in the past have related to ink separation and green shifting images as the magenta used for toning faded much faster than the cyan.<sup>17</sup>

<sup>13</sup> The paper was Premier Art Smooth Fine Art 325. The linearized neutral test strip was printed, and then the toner in that profile was turned off and the test strip printed with the same linearized profile, but without the toner.

<sup>14</sup> I rely heavily on <http://aardenburg-imaging.com/> test reports. They are the best that are publicly available. Eboni, Canon Lucia EX and Epson UC K3 Cyan on H. Photo Rag have all been tested out to 140 Mlux-hours of light exposure. Although test patches of the pure color inks have not been tested, there are test patches that are close to the pure colors. These probably provide good estimates of the relative performance of the pure inks as well as the carbon.

<sup>15</sup> Technically, I measure the increase in Lab L. In more common language, however, the density of the print is decreasing. That is, the print is "fading."

<sup>16</sup> Compare Lab L changes of Eboni v. HP and Epson ABW grayscale tests on Hahnemuhle Photo Rag at 140 Mlux-hrs reported at <http://www.aardenburg-imaging.com/>. See also Appendix 1, at the end of this PDF.

<sup>17</sup> See <http://www.paulroark.com/BW-Info/Eboni-v-Cone-N-HPR-140hrs.jpg> for a comparison of carbon v. a popular neutral third party B&W ink.

With respect to the separation, I have tested the toner mix above with my centrifuge, and its performance in that test was as close to perfect as any ink – including OEM LK inks – that I have ever tested.

With respect to the potential green shift, the very small amount of color needed, the high quality of the pigments, and the narrow hue angle between the 2 color pigments suggests this will never be a significant issue. Note that serious green shift has not a problem with OEM pigments and the OEM B&W approaches. Epson ABW appears to suffer most from its yellow fade. They use all the colors in their B&W printing. In the carbon variable tone approach discussed here, much less color is used than in any OEM black and white approach.<sup>18 19</sup> Ultimately, the print will warm as the colors fade. This is consistent with most photographic materials, but this will be at a much slower rate and lesser extent than the historic materials. Note also that the paper and carbon pigment bleach in the opposite direction of the warming that will occur. The only medium that will be more stable is a 100% carbon print.

The ideal carbon offset toner arguably might be composed of only a single blue pigment. This would be so that the fade path would be straight to the warm carbon as opposed to veering off into a green or some other color due to differential fade of the pigments. However, based on my tests, that does and is not likely to ever exist. How much a real world, 2-pigment toner varies from this ideal is, in significant part, measured by the hue angle between the two pigments' colors. Here, the hue angle between the Canon Blue and Epson Cyan of only about 40 degrees is probably as good as it gets with available, high quality pigments. Consider that in a CYM inkset 360 degrees is spanned by the 3 colors. That is an average of 120 degrees between each of the color inks. The huge, typical cyan to magenta hue angle magnifies any differential fade, and, as noted above, the color pigments are working against each other as much as working against the yellowish carbon – very inefficient; more color is needed than would be the case with a narrower hue angle, again magnifying the effect of any differences in fade rate.

## Printing Characteristics and Profiles

My profiles are and will be posted at <http://www.paulroark.com/BW-Info/7800-CVT-Profiles.zip> .

The new “Eboni v. 1.1” carbon is said to be identical to the previous version, but the dispersant may be slightly different. The good news is a higher dmax, the bad news for those who like a relatively neutral print is that Eboni v. 1.1 prints somewhat warmer. It will also need new profiles (or re-linearizing of old ones). So, with this need for new profiles, I've taken the opportunity to try this completely new ink installation. I, personally, like neutral B&W prints, similar to the lightly selenium toned silver prints I

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<sup>18</sup> HP Vivera PK and grays are a carbon-color blends that show great color stability in fade testing, but HP still has to use much more color relative to the carbon due to the very small carbon particles it must use to be glossy paper compatible and stay in suspension in the less viscous thermal-printer inks. Thus it's Lab L fade is 2 – 3 times that of carbon.

<sup>19</sup> For the print tone to go to a negative Lab A – that is, become green – the Lucia Blue would have to disappear totally while more than half of the Epson cyan is still intact, and that is just not going to happen. The Lucia EX Blue patch in the Aardenburg-Imaging test on H. Photo Rag at 140 Mlux-Hours of exposure has a very impressive total delta-e of 1.9.

used to make. This combination reaches that goal better than any alternative I know of, including the silver prints.

The new profiles I've made use a strategy of utilizing some of the denser inks through the midtones more than the "standard" QTR profiling. While I have made some black only profiles, I do not like the degree of "grain" in such prints. I have found, however, that by using the second 30% concentration in the midtones like a "toner," I can achieve a delta-Lab B of about 3 that is very smooth. With more of the 30% and pulling the 100% into the midtones a bit, a delta-B of 2 can be reached with 100% carbon, but its smoothness is not as good, though still fine for many large prints. The goal of using the 30% MK in as a "toner" is to maximize the carbon content for the degree of neutrality achieved, with or without the use of the color toner.

As indicated above, there is a trade-off between relative neutrality and smoothness when only carbon is used. The "standard" QTR profiles are the warmest and smoothest. I have labeled the more neutral profiles with their approximate delta-B. Those with a delta-B of 2 are as "cool" as I wish to go with 100% carbon, and, again, they are smooth enough for most large prints. The delta-B of 3 ("dB3") profiles are visually quite smooth and the ones I'll probably use the most, though they are not, technically, as smooth as the standard, warmer QTR profiles.

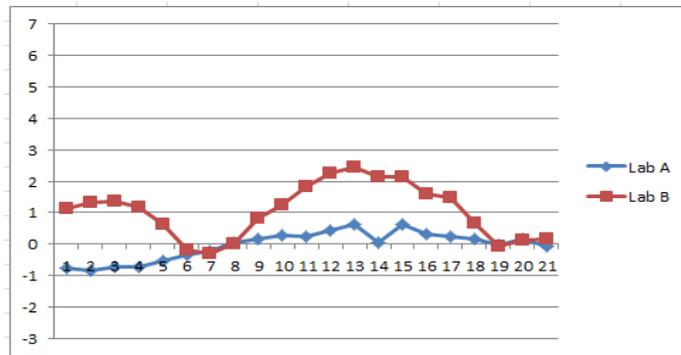
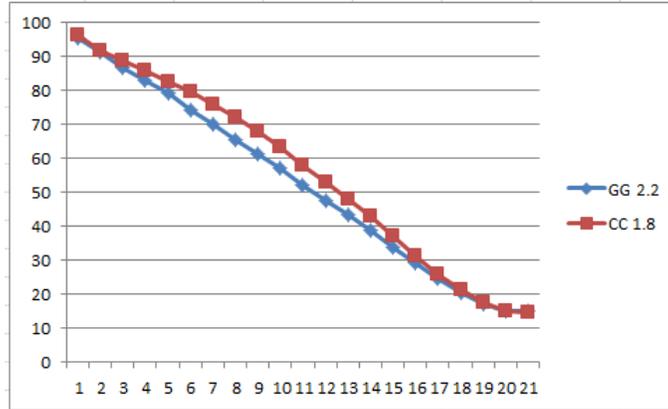
### **Epson Driver**

Because the toner is in the LLK position, there is no way to directly and fully control the print tone with the Epson driver. Additionally, with the second MK in the Y position, printing with no Photoshop curve or one that uses yellow in the highlights, there will be some evidence of dots in the print. Nonetheless, the Epson driver compatibility is useful. In addition to allowing one to print from any application directly, it is also arguably possible to make the best almost neutral Arches print with the Epson driver (more on that, below).

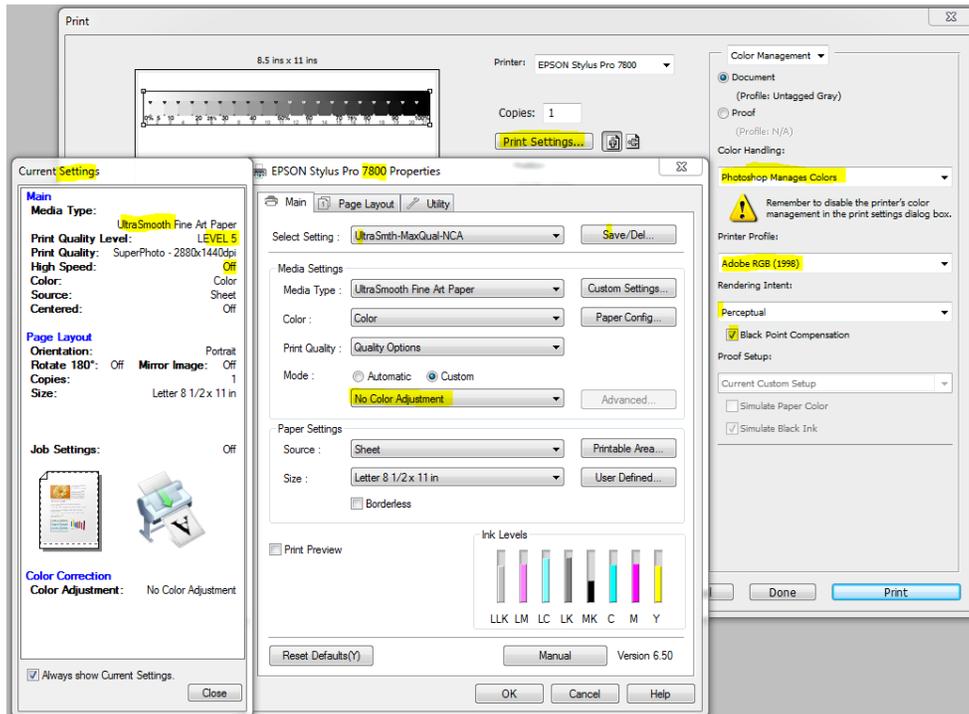
Also, because one can make ICCs and use those to print "color managed" targets that can, in turn, be used to manually calibrate the monitor. I work in a Gray Gamma 2.2 space because it is used by the web and is, in effect, a subset of Adobe RGB (1998) (and nearly identical to sRGB also). So, if I print a target image from my Gray Gamma 2.2 space through an ICC, I will get a print that is printed in Gray Gamma 2.2. That then becomes the print to match the monitor to via the monitor's manual – physical and video board – controls. That assures that my monitor is at the "standard" web space. While many monitors are way brighter than the standards were made for, as a practical matter, the gray gamma 2.2 images look very good on smart phones, which may be where most will see them these days.

With no toner control, the print tone is relatively neutral in the highlights and warmer in the midtones.

If one prints using Color Controls set to gamma 1.8, the print has a good, smooth graph ramp that is slightly lighter than Gray Gamma 2.2. The Lab L curves for Gray Gamma 2.2 and Color Controls gamma 1.8 are shown below. Further below the Lab A and B values are graphed. Premier Art Smooth Fine Art Hot Press 325 was used. ICCs for PA325 and Epson Hot Press are included in the Profile Zip file.



To make these profiles, and when the ICCs are used, the following Epson driver settings must be used:



The settings may vary with the versions of OS and PS. The point is to have “No Color Adjustment” in the Epson driver and also just to pass that information on to the printer without a profile or ICC in PS changing the file. If the original file is Adobe RGB, then Adobe RGB in the PS Print screen will not alter the contents. In my current Win7 – PS CC setup, I can set the PS Print screen to “Printer Manages Colors.” That was the old standard and once again allowed setting simply passes the information through the PS Print pipeline without altering it, and that is what you want when making a profile. Once the profile/ICC is made, it is pulled up in the PS Print screen and applies the alterations needed to “linearize” (or, more precisely, match the print to the working space of) the image file.

Regarding print tone, where there is too much toner being injected (i.e., the print is too cool, like the dip in Lab B at 25-30%, above) PS RGB curves can be used to separate the color curves at that spot and reduce the amount of LLK being put into the mix.

Regarding **Arches watercolor paper**, while the Epson driver is usually considered to render a weak dmax with Arches and other uncoated watercolor papers, it can, in fact, make a print that is very good for some circumstances. Specifically, when the Epson driver of a wide format printer is used the “Paper Configuration” setting can be set to the maximum “Color Density.” When this is done the dmax advantage of QTR is minimized, and the Epson driver print will appear to have good blacks.<sup>20</sup>

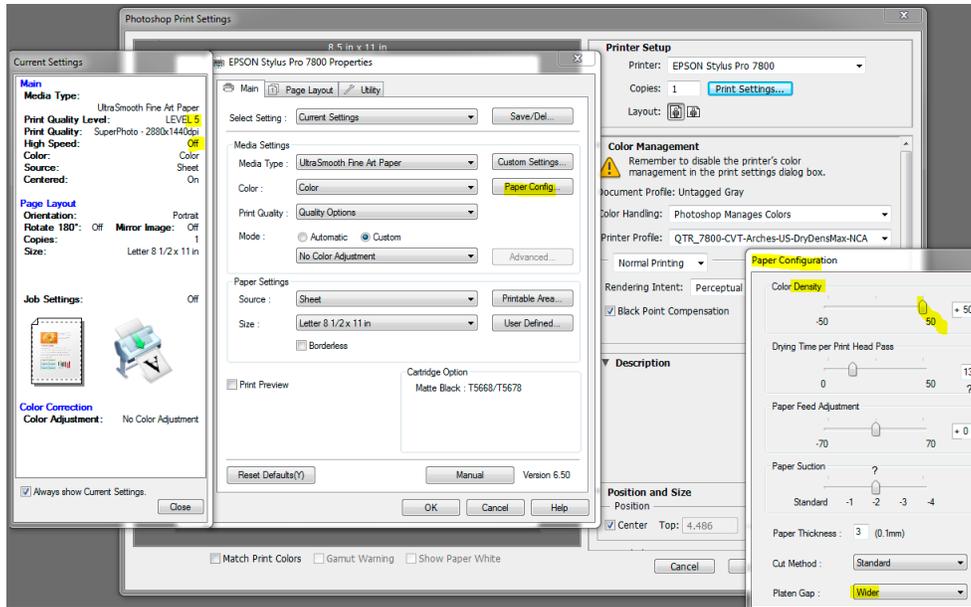
One problem with Arches is that it does not print as smoothly as a coated inkjet paper. For this reason, I recommend it only for “full sheets” (22x30”) if a very smooth appearance is wanted. Still, in a clear, dark (red filtered) sky, one is able to see some blotchiness in some circumstances. The Epson driver workflow described may be able to minimize this in some circumstances.<sup>21</sup>

The Epson driver settings are shown below:

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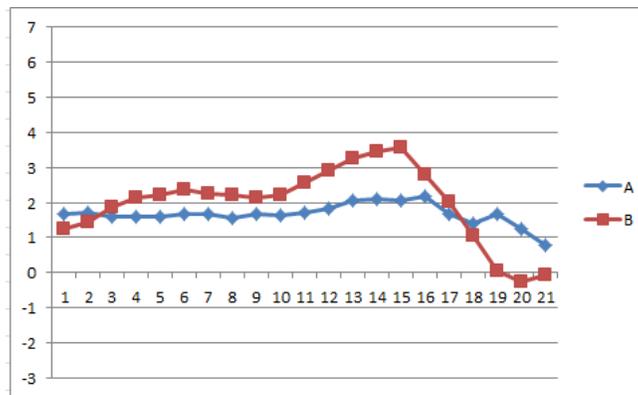
<sup>20</sup> I initially thought increasing the drying time would help. In fact, it may cause the paper to have slight vertical banding, possible due to the vacuum being too high for the paper to sit still over it. A dry time setting of 13 may work while barely increasing the printing time at all. Also, one may want to reduce the vacuum setting to a minus 2; this is uncertain at this point.

<sup>21</sup> With Arches there can also be batches that seem to have an excessive amount of fibers sticking out of the paper surface. Interestingly, the front is usually different than the back side of the paper in this respect, thought they print with the same profiles. At <http://www.wetcanvas.com/forums/archive/index.php/t-1324017.html> a commenter noted that the watermarked, front side “had this kind of very fine, fuzzy texture to it, almost like pilling. ... You can see the fibers sticking up off the paper surface when you look closely.” Blick Art Materials responded, “The Arches Watercolor Paper ... is meant for watercolor, it has to remain slightly more absorbent and thus the fuzzy texture you are describing.”



An ICC is in the Profiles Zip file that makes this a “color managed” workflow. One must be sure the above Epson driver Properties settings are correct for this “7800-CVT-Arches-US-DryDensMax-NCA-rgb.icc.” The “Drying Time” settings do not appear to affect the ICC.

The print tone the results on Arches BW (non-OBA) is shown below:

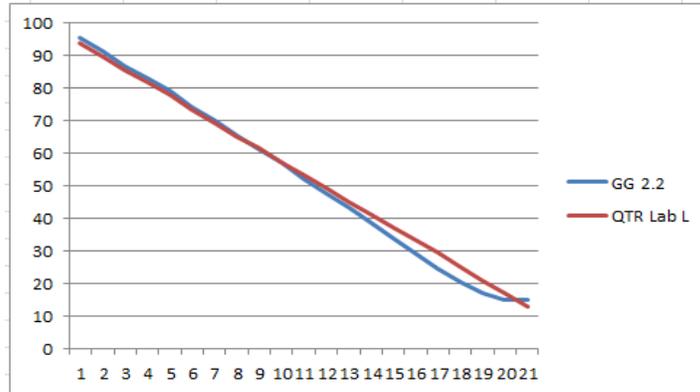


Arches BW, Epson Driver, Max Density

### Printing with QuadToneRip

QTR is the printer utility I use for most of my serious printing. Note that I use Windows 7 and the QTR Windows GUI. Mac users will have a different interface and workflow, but the profiles are entirely compatible.

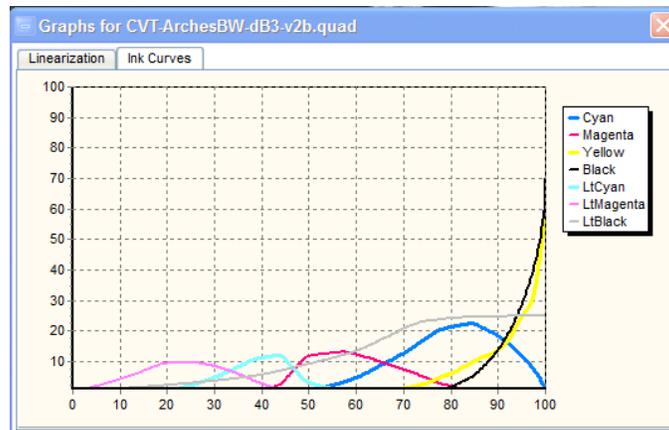
At the outset, know that QTR, when printed from the Windows GUI, prints with a straight line Lab L characteristic curve. See the comparison of the Gray Gamma 2.2 and the QTR Lab L curves, below.



Because I edit in Gray Gamma 2.2, I need to adjust the print to compensate for the differences in how they print. To do this, I apply a Photoshop curve, after I have saved my master file, that offsets this printing difference just before I print the file. I save this printing file to the Desktop with “QTR” in its name. It can just be dragged and dropped into the QTR GUI. After printing, I delete the QTR-adjusted file. The Photoshop image adjustment curve I use is called “GG22-to-QTR.acv” and is in the Profiles Zip file.

The 100% carbon prints can vary in the degree of warmth or neutrality based on how the profile is written. If standard QTR profiling is used the print will be as warm as this inkset can print. That varies with the paper type from about 4 to 6. As noted earlier, more neutral 100% carbon profiles have been made and are market with the extent of their Lab B rise over the paper white.

For Arches watercolor paper, the delta-B=3 curve, which uses standard QTR profiling but with the second 30% K ink being pulled all the way into the highlights is a good combination of smoothness with a little less warmth than simply the usual QTR serial profiling. Visually, without a loupe, I do not believe anyone can will see the additional grain. The curves for this profile are shown below (now on version 2).



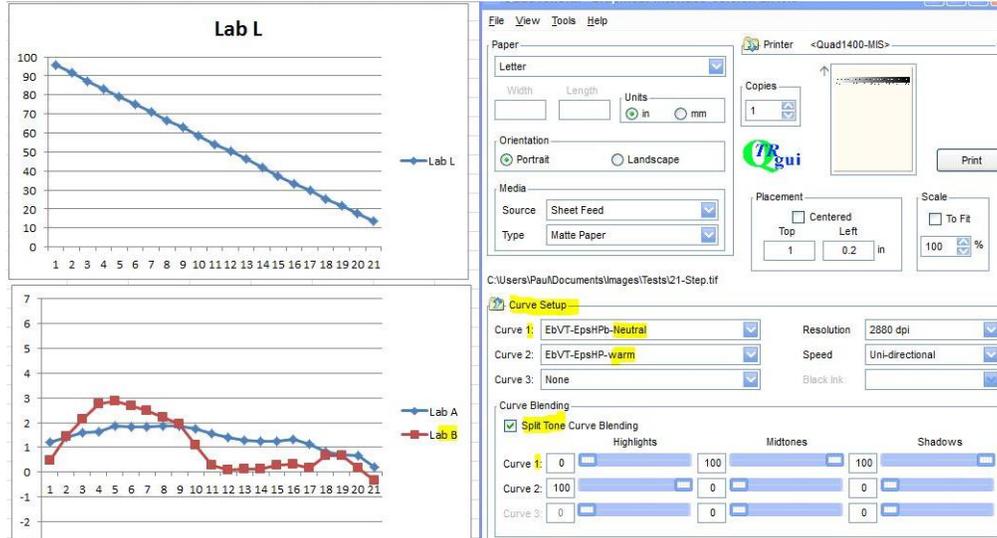
With the neutralized dB3 profile, the toner accounts for about 5% of the density of the print.

While one would think that Arches watercolor paper and inkjet paper would be quite different, the Premier Art Smooth Fine Art 325 (“Pa325”) that I favor was profiled from its warm 100% carbon Delta-B=3 profile to neutral by simply taking the Arches toner curve and pasting it into the Pa325 profile. The

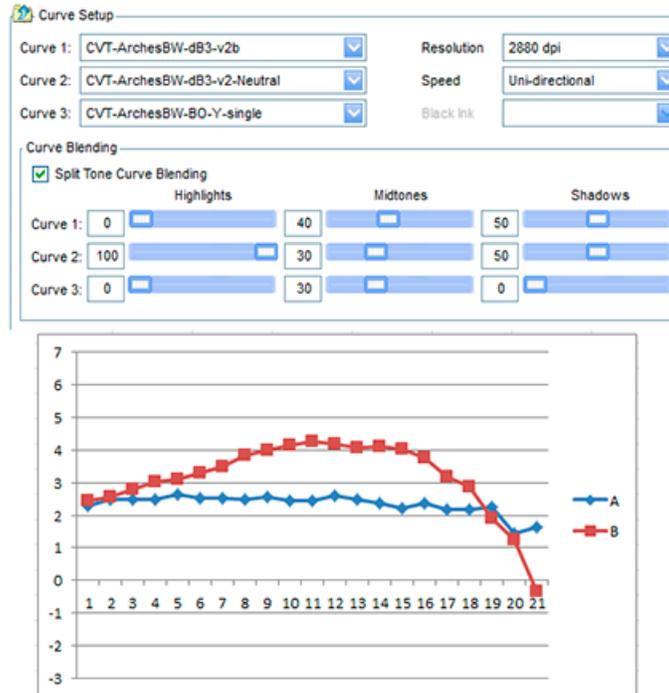
first test strip was a bit too cool. Lowering the ink limit brought that under control in the second test strip. That was all it took to make that neutral tone profile. So, while different papers may react differently to the toner, for many little or no change in the toner curve may be needed.

For cooler prints than the “neutral” (or “N”) profiles print, just increase the ink limit of the toner. It is so light that the profile will probably be fine without linearizing.

With QTR sliders any number of different split tones are possible. Below is one with warm highlights.



I prefer a cooler highlight for clouds, snow, and water white, with warmer shadows. This is the blend that I now recommend for this:



In fact, this blend appears, overall, to be my first choice for prints that do not benefit from extra warmth.

(That's it for now.)

## Appendix 1

### Carbon Pigment Lightfastness

#### Fade Test Data<sup>22</sup>

Aside from the toner, which does not need to be used (and is being fade tested now), the inkset I am describing is 100% Eboni carbon, and 100% carbon pigment images have resulted in the best digital prints tested by Aardenburg Imaging and Archives. What is unique about Eboni is that it results a more neutral print tone than the other carbon pigments.

Comparing the Midtone L\* = 50 test patches among the popular alternative printing approaches, all at 140 Mlux-hours of light exposure and all on Hahnemuhle Photo Rag, these are the delta-e<sup>23</sup> values reported. Lower is better.

MIS Eboni carbon = 0.6  
Cone Carbon Sepia = 0.5  
Epson 3800 ABW = 3.6<sup>24</sup>  
HP Z3100 = 1.9  
Cone Piezo Neutral K6 = 3.5<sup>25</sup>

Another comparison former darkroom printers may relate to looks at a wet-process, fiber based, selenium toned silver print. Aardenburg Imaging has tested the silver prints to 100 Mlux-hours of exposure. So, below I list the delta-e values for the L\* = 50 test patch for the best inkjet print versus the selenium toned silver print that is most similar to what most of us used to print in the darkroom.

MIS Eboni, PremierArt Fine Art Smooth 205 gsm paper, Print shield spray = 0.1  
Ilford Galerie FB Silver print, Selenium toned 1:20, Durst Theta printer = 1.2<sup>26</sup>

This, no doubt, exaggerates the extent to which the carbon print is more lightfast than the silver print. However, when one also looks at the fact of un-buffered silver print paper being destroyed by airborne acids, whereas the buffered inkjet paper is protected, maybe these comparisons are not too far off. Add the problems of the gelatin coating on silver print compared to an un-coated Arches watercolor paper, and it becomes even more apparent that the expected life of a high carbon content inkjet print probably is significantly longer than that of a silver print.

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<sup>22</sup> <http://www.aardenburg-imaging.com/> is simply the best database of fade test information that is available to those of us who are serious about our medium.

<sup>23</sup> Delta-e measures the total movement in Lab L, A and B – i.e., density fade as well as color shift.

<sup>24</sup> Epson ABW does better with a more neutral print, however, I did not find a test of one on H. Photo Rag. In general, the Epson pigments can be close to the HP test values.

<sup>25</sup> See <http://www.paulroark.com/BW-Info/Eboni-v-Cone-N-HPR-140hrs.jpg> to get a better feeling for what these numbers mean.

<sup>26</sup> Part of the silver print's problem was that the paper contained some OBAs. If we look just at the Lab L values or the test patches, the changes were as follows: Eboni carbon = 0.1, silver print = 0.3.