

# **“Ebony” Carbon Variable-Tone Black and White Inkset Epson 9800, 7800 and similar printers**

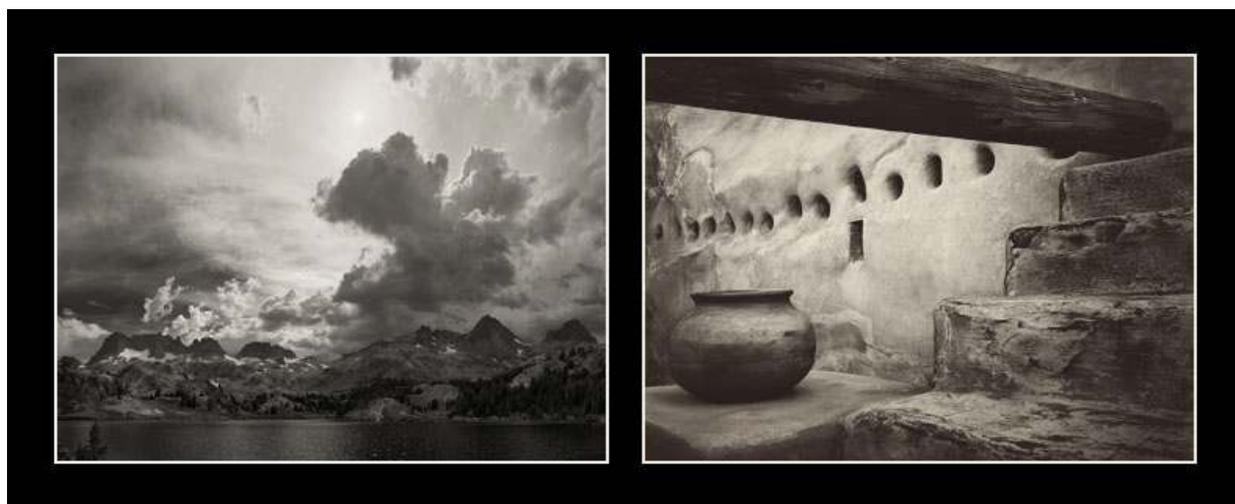
[www.PaulRoark.com](http://www.PaulRoark.com)

2/11/2016 (10/24/18 update)

This PDF discusses an “Ebony-6”<sup>1</sup> carbon pigment based inkset for the Epson 9800 (and 7800). As with the other “Ebony Variable Tone” inksets I’ve mixed lately, this one uses a light blue toner to expand the image tone range of the otherwise 100% carbon inkset from warm carbon to cold tone. The goal here is to make the most lightfast,<sup>2</sup> as well as most cost effective<sup>3</sup> means of producing large museum quality B&W prints, not only with standard matte inkjet paper, but also with Arches (Hot Press, smooth 140 lb.) watercolor paper and 44” wide rolls of canvas being included in the target media. This inkset prints only on matte paper and is Epson driver compatible only to a limited extent. I will be using QuadToneRip for most serious printing and will post the limited profiles I make.<sup>4</sup>

This inkset is, in effect, a merger of inksets I have used in my 7800<sup>5</sup> and a 3880,<sup>6</sup> using what I found to be the best aspects of each. The light blue toner is the same as in the 3880 version, and like that version the 2% super-light carbon ink is not used. Like the 7800 version, this one uses 2 MK positions to achieve the best dmax on Arches watercolor papers.

While there is a light blue toner in this inkset to allow truly neutral/cool prints that have silver print lightfastness, the best 100% carbon pigment prints are still a primary goal. The range that this inkset can achieve with that most lightfast imaging approach is shown below. 100% carbon prints with a warm tone.



<sup>1</sup> See <http://www.paulroark.com/BW-Info/Ebony-6.pdf> . See <http://www.inksupply.com/eb6.cfm>.

<sup>2</sup> A neutral print with more stability than a silver print, as well as an even more stable warm carbon print when warm tone is wanted. Note that with canvass a near neutral, 100% carbon black only approach is possible.

<sup>3</sup> MIS bulk (pint) ink prices are about 15%, on a per/ml basis, the price of Epson ink bought from Atlex.com. If you mix your own inks from MIS Ebony MK and generic dilution base (C6b recommended), the cost can be as low as about 3% of the OEM ink costs.

<sup>4</sup> See <http://www.quadtonerip.com/html/QTRoverview.html>. Profiles can be downloaded from <http://www.paulroark.com/BW-Info/9800-EbVT-Profiles.zip>.

<sup>5</sup> See <http://www.paulroark.com/BW-Info/7800-Carbon-Variable-Tone-2015.pdf>

<sup>6</sup> See <http://www.paulroark.com/BW-Info/3880-Ebony-Variable-Tone.pdf>

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 to us, with up to 10 times lower delta-e than even the selenium toned silver print.<sup>7</sup> Carbon also lacks the visual artifacts (e.g., metamerism) that appear when too much color is used.

Dilute carbon is, by nature, warm. However, with the use of the light blue 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. Also, 100% MK ink prints very neutrally, and on Arches and a few other papers, a mostly MK print can be 100% carbon and within what most will see as neutral.

Many papers that are brightened with OBA's (Optical Brightening Agents/dyes) may print cooler and be preferred by some. Many avoid such papers because the OBA dyes fade.<sup>8</sup> On the other hand, one of my favorite images, that has been on my living room wall for years, is printed on Premier Art Smooth Bright White.<sup>9</sup> This paper has traditionally printed the most neutrally with Eboni-6. More often, however, I use the 325 gsm non-OBA version of this paper.<sup>10</sup> Very similar to this is the Epson Hot Press, which comes in both "natural" (no OBA's) and "bright" version.

One of the targets of this project was the Epson Exhibition Matte Canvas. Interestingly, it has a non-OBA yet bright white base.

While cotton based inkjet papers printed with Eboni carbon have produced the most lightfast images, Arches un-coated watercolor paper is, in my opinion, the most archival due to its lack of any coating. Over the very long haul, I expect the coatings to fail, including on silver prints (which have a number of other issues that limit their lives).

### **Ink Arrangement**

Y = 100% Eboni MK v. 1.1  
LM = 6% MK (Eb6-LM)<sup>11</sup>  
LC = 9% MK (Eb6-LC)  
M = 18% MK (Eb6-M)  
C = 30% MK (Eb6-C)  
LK = 30% MK (Eb6-C)  
K = 100% MK (Eb6-K)

LLK = Light Blue Toner (13.75% Blue, 11.25% Cyan Canon Lucia pigments,<sup>12</sup> 75% clear base.<sup>13</sup>)

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<sup>7</sup> See Appendix 1, below.

<sup>8</sup> There may also be evidence that the faded dyes have a negative effect on longevity. Source -- Mark McCormick-Goodhart, <http://www.aardenburg-imaging.com/>.

<sup>9</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.

<sup>10</sup> These papers are siblings of Epson's Premier Art Scrapbook paper, which Epson once claimed was their most archival paper. In fade testing at <http://aardenburg-imaging.com/> this paper with Eboni carbon produced the best results.

<sup>11</sup> MIS sells Eboni-6 pre-mixed at <http://www.inksupply.com/eb6.cfm>. I consider their dilution base to be essentially equal to my C6B base and when last tested the profiles were the same for it and the c6b base dilutions.

<sup>12</sup> Canon Lucia Blue (PFI-106B) and Cyan (PFI-106C) are the inks used in Canon's iPF6300 printer. See for example, <https://www.itsupplies.com/Canon/Canon-imagePROGRAF-iPF6300/iPF6350>. 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.

## Toner & Color Pigments

I have mixed and worked with a number of light blue, “cold” toners over the years, including those marketed by MIS Associates and a number that many users just mixed themselves from readily available inputs.<sup>14</sup> The basic approach that has worked the best for most users is where there is a single light blue toner ink that offsets the carbon yellow tone.<sup>15</sup> I have found that the standard “light” ink densities (like LM, LC and LLK) are essentially invisible in the highlights.<sup>16</sup>

Of course, a full color set allows more flexibility in toning, but I’m a black and white photographer. My images stand or fall based on composition and content, not color. I have found that the simplicity and other benefits of a single toner outweigh the flexibility of having multiple colors in the printer. The single toner covers the traditional neutral to medium warm silver print tonal range very simply and efficiently. With only one light blue toner, all the other positions can be relatively neutral carbon, adding to the smoothness of the print. This is simply the easiest to live with B&W inkset format I’ve found.<sup>17</sup>

This light blue toner is made with Canon Cyan and Blue Lucia EX pigments and the generic dilution base “C6b” which can be mixed with readily available chemicals or purchased from MIS Associates.<sup>18</sup> The use of a blue Canon pigment minimizes the hue angle between the two pigments needed to mix the toner. In this case, the cyan-blue hue angle is 50 degrees, as opposed to about 120 degrees for a typical cyan-magenta mix. By minimizing the difference (hue angle) between the pigments used, more cooling is achieved with less color, and the degree of color shifting of the image due to differential fade of the two pigments is minimized.<sup>19</sup> The ideal might be a single-pigment toner, but there is no single-pigment blue that correctly offsets the carbon warmth. So, using the best blue and cyan available seems like the second best solution, and best real world solution. With the relatively narrow hue angle, the blue and cyan pigments won’t be offsetting the colors of each other as much as when cyan and magenta are used. The Canon Blue pigment gets us closer to the ideal carbon-yellow offset needed to reach neutral.

One advantage of a toner made with two color pigments is that the Lab A values can be altered by changing the ratios of the cyan to blue pigments, while the narrow hue angle minimizes the risks of overdoing this and minimizes batch to batch variations. I usually target a slight increase in Lab A over the paper white. In general, I’ve found a negative Lab A – green – is not desirable. On the other hand, a slightly elevated Lab A is what the classic “selenium toned” silver print had.

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<sup>13</sup> Clear base version C6B is recommended. It can be purchased from MIS at

<http://www.inksupply.com/roarkslab.cfm> (no royalties to me). The mixing formula is also shown there.

<sup>14</sup> The first “variable tone” B&W inkset was made by me using Piezo inks in March 2001. See a bit of the history at [http://www.spinics.net/lists/epson/old/2001\\_01/msg02842.html](http://www.spinics.net/lists/epson/old/2001_01/msg02842.html).

<sup>15</sup> The primary variable in “cool” to “warm” traditional silver prints is the Lab B value.

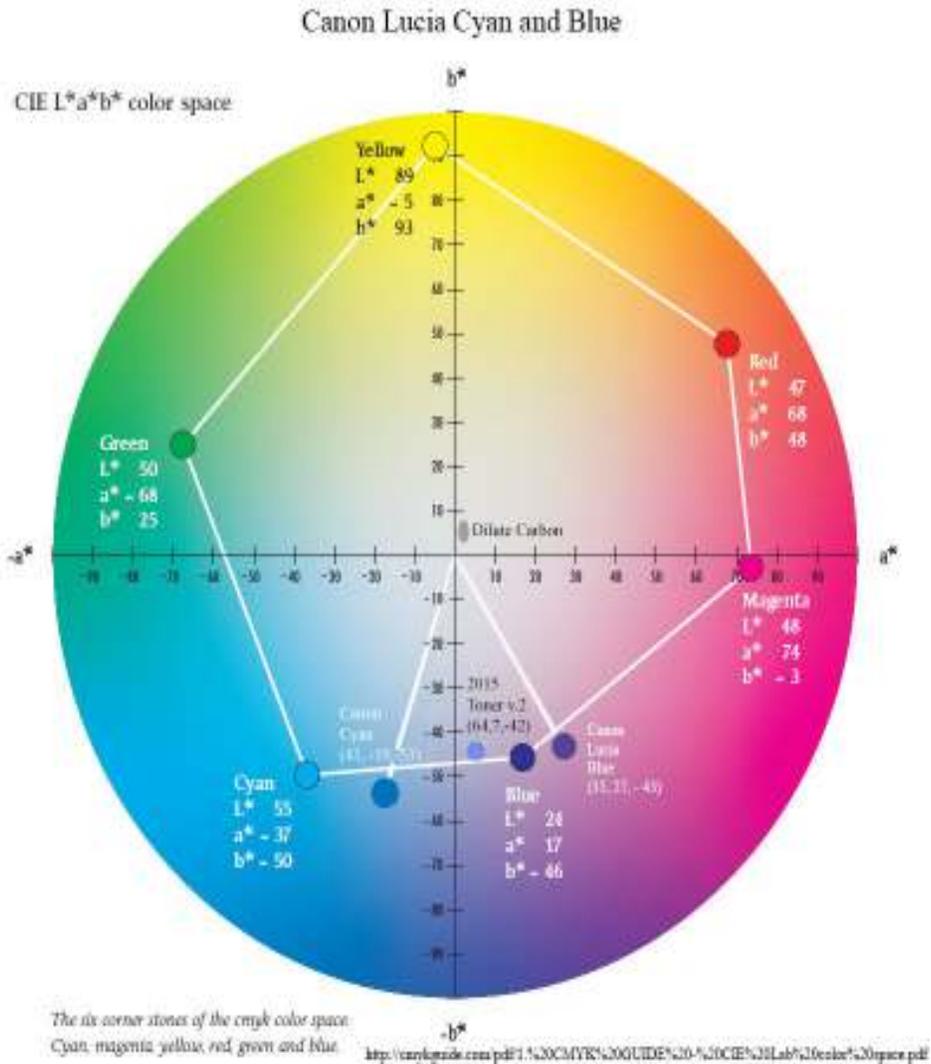
<sup>16</sup> The toner Lab L or density is approximately the same as the lightest carbon ink, which is the 6% MK (Eb6 LM). Even with a 2400 dpi RGB scan the color toner dots do not show. A 2400 dpi RGB scan of the highlight area of a neutralized carbon H. Photo Rag test strip is at <http://www.paulroark.com/BW-Info/3880-EbVT-HPR-Neutral-2400-scan.jpg>. This was printed by QTR.

<sup>17</sup> I am experimenting with some glossy compatible B&W approaches, but the lack of a binder in the matte ink dilution base is a major benefit in terms of avoiding clogs. Gloss compatibility comes with a price. Since glossy media are less archival, I have chosen to use my dye based inksets for the best glossy B&W. See, for example, <http://www.paulroark.com/BW-Info/4000-Noritsu-2K.pdf>

<sup>18</sup> See <http://www.inksupply.com/roarkslab.cfm>. An earlier effort used Epson K3 cyan, but it appears there is a long term stability problem with that mix.

<sup>19</sup> The delta-e of the Canon “cyan” and “blue” test patches in <http://www.aardenburg-imaging.com/> fade testing were both 1.9 at 140 Mlux-hours (Canon iPF6300 Lucia EX ink, H. Photo Rag paper). See a reproduction of that test page at <http://www.paulroark.com/BW-Info/LuciaEX.JPG>.

The Lab color circle, below, illustrates what the pigment colors are. The typical CMY and RGB colors were included on the original, connected in a rough hexagon shape.<sup>20</sup> I've added the Canon pigment colors, the final toner color, and the dilute carbon color. The toner color listed was read from the 35% test patch of a QTR Calibration Mode print. The higher the density, the greater the gamut. The Lucia EX Blue and Cyan patches were measured from draw-downs of the Canon inks.



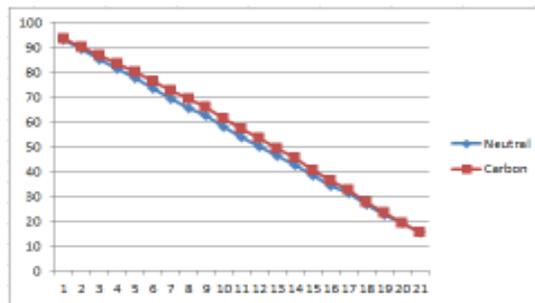
<sup>20</sup> See <http://cmykguide.com/pdf/1.%20CMYK%20GUIDE%20-%20CIE%20Lab%20color%20space.pdf>

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>21</sup>

With respect to the ink 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. In practice I’ve noticed not color separation. Note that I agitate my large format printer carts every couple of weeks regardless.

With respect to color shifting over time, while a neutral toned print cannot do as well as a 100% carbon print, but matching or exceeding the performance of a silver print is realistic. In the Aardenburg-Imaging fade test of Lucia EX, the B2 “purplish blue” test patch is very close in its Lab A and B to the toner mix. At 100 Mlux-hours of light fade, that test patch lost 1.6 units of Lab A. Its Lab B is about -40 at the print density of the test patch. The carbon on a number of good non-OBA papers has a Lab B increase over the paper white of about a about 4 units. To offset this increase (warmth), only 1/10<sup>th</sup> of the toner amount needed to achieve a Lab B = -40 is needed. This indicates that the Lab A drift at 100 Mlux-hours (about 51 Wilhelm display years) for a neutralized carbon print would be about -0.16. The silver print tested by Aardenburg-Imaging had a negative Lab A drift at 100 Mlux-hours of 3 times this amount.<sup>22</sup> A single Lab unit of measure is often described as “barely visible.” A neutralized carbon print is going to be very stable.

Below, I look at the Lab L impact of the toner. 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>23</sup>



As can be seen in the above graphs, the additional density added by the toner is, at most, about 5% -- the 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 probably not notice a density difference. The print tone, of course, would move from neutral (Lab A and B of the image equal to the paper tone) to medium warm (about a delta Lab B = 4). In practice, the Lab L fade caused by the toner pigments will never be visible.

<sup>21</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.

<sup>22</sup> See <http://www.paulroark.com/BW-Info/Carbon-Silver-Print-Lightfastness-Compared.jpg>. Note also that, although Aardenburg Imaging tests have cyan and blue test patches, those test patches may include other pigments, as determined by the printer drivers. Nonetheless, in such tests, at 140 Mlux-hours on H. Photo Rag, the Canon cyan and blue test patches had the same total delta-e measures. See my screen grab of the test page at <http://www.paulroark.com/BW-Info/LuciaEX.JPG>. See <http://www.aardenburg-imaging.com/> for the original testing results.

<sup>23</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 (not used) and a 100% carbon pigment test strip printed with the same linearized profile.

Although the best inkjet color pigments have a fade rate of about 2 to 3 times that of the Eboni carbon, 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>24</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>25</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.

This inkset arrangement is compatible with different toner mixes, and I may develop newer, better and/or less expensive or more convenient toners, but as of 2018, the Canon toner described here seems to be the best alternative for my uses. I assume pigment technology will continue to advance, and this basic ink arrangement seems like the most flexible in terms of control and near universal compatibility with Epson inkjet printers.<sup>26</sup>

### Printing Characteristics and Profiles

My profiles will be posted at <http://www.paulroark.com/BW-Info/9800-EbVT-Profiles.zip>. I update this routinely as profiles are made.

In general, carbon pigments all tend to be warm to some degree. The glossy compatible ones are the warmest. That is one reason the OEM inksets have to use more color inks. Eboni is the most neutral carbon matte black ink I am aware of that has no dyes in it.

Different papers print with different degrees of warmth. This warmth is most easily measured by the Lab B values of the prints. Glossy papers with glossy compatible carbon pigments will have a Lab B (yellowish-warm) of up to 14, about half way to a true sepia tone. The glossy carbons on matte paper will have a Lab B of about 8. Eboni-6 usually has a Lab B of between 4 and 7.<sup>27</sup>

In actual display, the increase in Lab B over the paper base is often the primary source of visual warmth. When a print is displayed on the wall, away from a very cold computer monitor or brightened typing paper, the eye will do a "white balance" on the mat paper or paper white of the print. Thus the "delta Lab B" of an ink profile and paper is perhaps the most important single measure we have for the apparent warmth of an image on near-neutral paper.

My QTR profiles have the pre-linearization Lab L, A and B readings of a 21-step test print in their Notes sections. So, even with just Notepad, you can double click on the \*.qidf file and see how the paper prints. Likewise, Notepad can open an ICC, and, again, the full pre-linearized Lab L, A and B will appear. The "carbon" profiles show how the carbon by itself prints on the particular paper.

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<sup>24</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>25</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>26</sup> The Epson piezo electric head technology is more tolerant of higher viscosity inks, which allows larger, more neutral carbon particles to be suspended in the ink. Thermal technology of Canon and HP are excellent, but at this time Epson remains the best for this type of carbon B&W inkset. It is interesting to note that the HP PK pigments diluted in generic base to make an LK did better in centrifuge testing than did the OEM HP LK.

<sup>27</sup> I most often refer to the delta Lab B – that is the difference between the paper and the maximum Lab B reading of the test strip – as the "lab b" of the paper.

So far in profiling with Eboni-6 ver. 1.1 in K3 printers, Red River Aurora Natural has the lowest delta Lab B among inkjet papers, followed closely by Premier Art's Fine Art, Smooth Hot Press 325. Hahnemuhle Photo Rag is among the warmest printing neutral papers. Surprisingly, the amount of toner needed to neutralize the warmth is not much different among the papers.

The densest Eboni inks are more neutral than the more dilute ones. A "black only" (only the Eboni MK ink) print on some papers is almost neutral. The Eb6-C (30% Eboni MK) dilution can also be more neutral than the more dilute inks. As such, using these denser inks along with the dilute inks can produce a print that, while not being as smooth as a standard Eboni-6 print, can be smooth enough for large wall displays and have a delta Lab B of about 3, which will look quite neutral and smooth in wall displays.

The blue toner, of course, allows totally smooth and neutral prints. However, to make the most lightfast neutral prints, start with the most neutral carbon profile. My strategy has been to make a 100% carbon "delta B = 3" profile first, and then make a modified version of the carbon profile that adds the toner as needed to make a neutral print. The QTR sliders can then be used to achieve any intermediate tone or a split tone. I fine cooled highlights to remove the yellow from clouds, snow and white water, and then warm carbon shadows often makes the most pleasing profile for landscape work.

### Printing with the Epson Driver

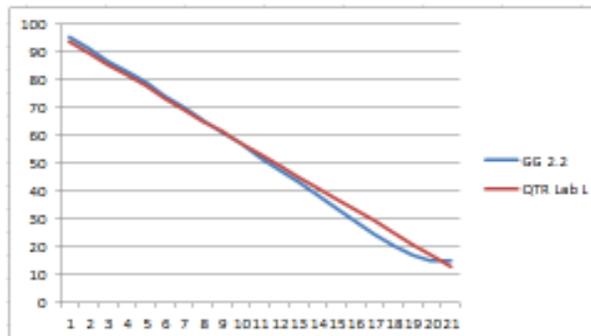
Because the light blue toner is in the LLK position, it is not directly controllable via Photoshop curves. That said, it is indirectly controllable, and I have made "neutral" and "warm" Photoshop curves and ICCs for Premier Art 325 paper. The curves will probably be close to what other papers need. With Premier Art 3245 the Neutral curve/ICC has a Lab B rise of about 1 unit. The Warm curve/ICC has a Lab B rise of about 5. My curves and ICCs use UltraSmooth paper type setting and the highest quality level, with High Speed off. Most inkjet papers will be warmer with the warm curve.

The dmax with the Epson driver is usually a bit lower than it is with QTR.

### Printing with QuadToneRip

QTR is my preferred printing utility. Note that I use Windows and the QTR Windows GUI. Mac users will have a different interface and workflow, but the profiles are 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.



When I edit using a monitor profiled to 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

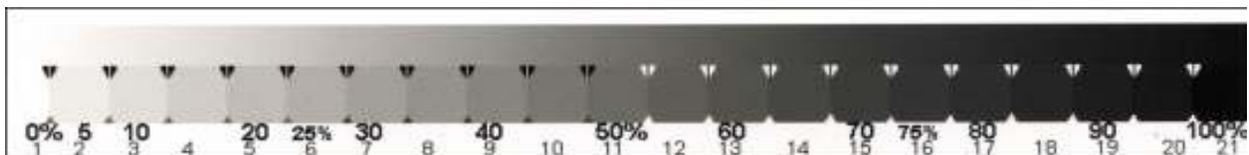
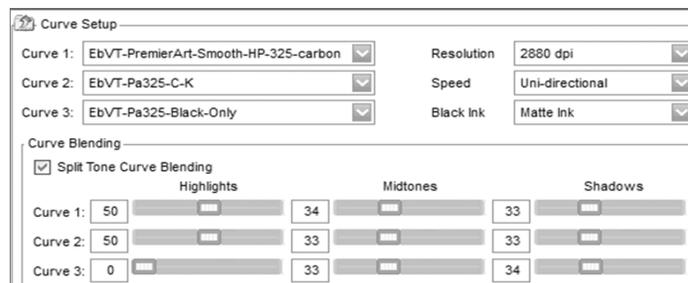
“QTR” in its name. It can just be dragged and dropped into the QTR GUI. After printing, I delete the QTR-adjusted file. The Photoshop image adjustment curve I use is called “GG22-to-QTR.acv” and is in the Profiles Zip file.

More recently I’ve been using an MS Surface Studio setup, with is so bright that I’ve had to make a custom viewing layer to evaluate images for printing. I suspect as monitors get brighter, people will have to make their own curves layers that adjust for the difference between the monitor and print print brightness.

Some handle this adjustment issue by converting the their workspace to QTR\_Gray\_Matte\_Paper, an ICC that is supplied in the QTR download. In either case, be clear that you are no longer in Gray Gamma 2.2, and the images will probably look dark in that space. The internet uses the gamma 2.2 space, as does Adobe RGB, which is what our cameras generally capture images in (sRGB is very similar also). Working in Adobe RGB (1998) and Gray Gamma 2.2, can, thus, be useful. One way or the other, you’ll want to match the image on your monitor to how the print looks in the target lighting. Some trial and error is probably useful here.

One of the features of QTR is that one can use more than a single profile at the same time. This can be useful for split toning (use a warm profile in the highlights and a cooler one in the shadows) and for combining different 100% carbon profiles to achieve a 100% carbon print that is cooler, even if a bit mote grainy.

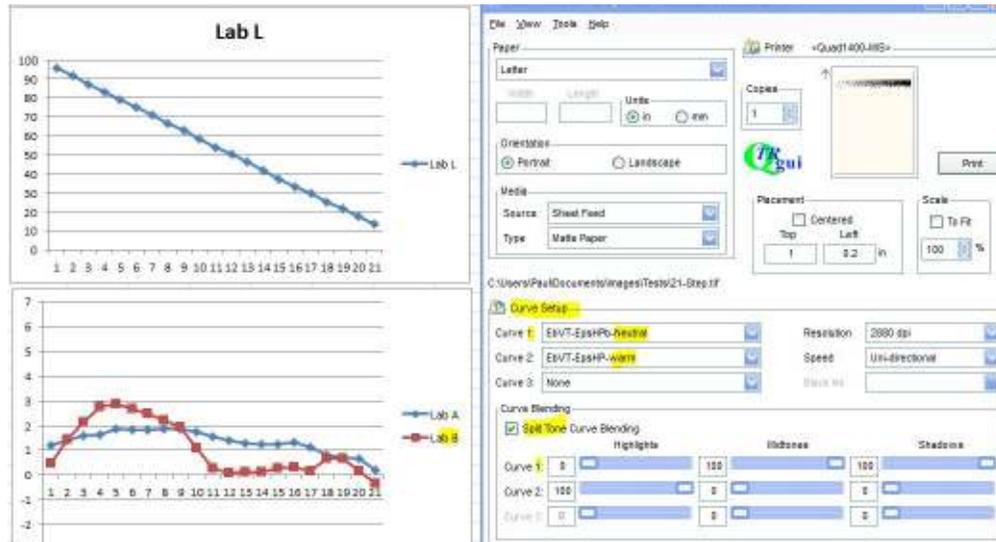
The image below shows the setup and resulting print where a QTR profile using all the dilute inks was combined with one using only the C and K inks as well as a Black Only profile to achieve a 100% carbon print with a delta Lab B of 2.6.



For large wall prints, it is doubtful that anyone will notice the slight graininess of this print. This test strip original was 8 inches wide. The image is 200 dpi. The Lab B of the paper was adjusted to Lab B = 0 so that the “brighter” background of the Word document would not bias the delta B = 2.6 of the print as it would be seen displayed on the wall (and not around bright paper or monitors). The colors of the scan are not particularly accurate.

When the 100% carbon and neutral profiles use the same carbon core, using the sliders in QTR, even with an extreme split tone, keeps the Lab L about as straight as the original profiles. All the slider is doing is, in effect, changing the amount of toner and making very small offsetting changes in the linearization multiplier. See an example, below, made with the 1400 version of this approach. The main point is that

the split tone sliders do not affect the Lab L curve the way they often do if two different partitions of differently toned gray inks are used.



A more common use of the QTR sliders is simply to combine a carbon/warm with a neutral profile to achieve a print tone that is between the two. Thus with the 100% carbon and toned “neutral” profiles, all the intermediate print tones are available.

For colder prints – where the Lab B dips between the paper white and black point – one has to go to the “neutral” profile and increase the Ink Load of the Yellow position (blue toner) ink. This will add some density to the image, such that a re-linearization is technically needed. However, in practice, the amount of blue one might want is probably going to have only a minimal impact on the Lab L/gray ramp values.

In practice I stay with a relative neutral, non-split tone profile for virtually everything.

### Printing on Arches Watercolor Paper

The 9800 is much like the 7800, but my sample appears to have a  $d_{max}$  that is about 0.07 less than the 7800. I cannot tell if it is just a different batch of MK or the printer itself. The bottom line is that I will use the 7800 for Arches full sheets. Although Arches presents some challenges in printing, I think the results are worth the effort. Carbon on Arches is an important approach for me and one that I will continue to pursue (unlike the canvas experiments, outlined below).

### Experimenting with Printing on Canvas<sup>28</sup>

A primary purpose for my purchasing a used Epson 9800 was to make large canvas prints. To be honest, when I started this canvas project I had never seen a canvas B&W that I liked. However, the modern canvas substrates, in particular Epson’s Exhibition Matte Canvas Natural, can make some very appealing images.

<sup>28</sup> Note that I do not recommend attempting to print canvas on desktop printers. Desktop printers, lacking the vacuum systems of the more serious professional printers, are likely to have head strikes. Also, with no roll paper feature, loading the canvas is tricky.

To summarize my views up front and after the fact relating to this canvas experimentation, I doubt I'll be buying much canvas in the future. There are better alternatives: traditional matte under glass/acrylic for most, and satin paper for very large, un-glazed work.

Back to the canvas experimentes, to minimize the chances of head strikes, I recommend setting the platen gap to "Wider." There is some decrease in sharpness, but on the wall, it is doubtful anyone will ever notice it.

Matte canvas is the appropriate type to use. My testing is consistent with Premier Imaging's statements that their Generations Matte Canvas achieves the best dmax (up to 1.74). Epson Matte Canvas Natural also has a good dmax (up to 1.69). Interestingly, the non-OBA Epson is almost as "bright" (negative Lab B, of "cool") as the OBA-containing Generations Matte Canvas. In fact, it often looks whiter. Note that there is typically a "gesso" layer between the tan canvas and the inkjet coating. Brighteners of various kinds might be in this gesso layer.<sup>29</sup>

One attraction of canvas is sometimes said to be that it can be displayed using a "canvas wrap" approach, avoiding the cost and weight of a large frame and glass/acrylic. Modern, pre-cut, easy to use stretcher bars are available from outfits like Breathing Color. That said, I like a frame. So, my canvases have been adhered to a board and framed. With the matte canvas, I use 1/8<sup>th</sup> inch acrylic over the canvas for protection. I've seen too many soiled and worn canvas wrap edges to be comfortable with that mode of framing. (Also, canvas wrap these days seems to say "Costco" to me, not "fine art." I prefer some sort of frame around the canvas (perhaps even if the canvas is, indeed, a wrap inside).

How one re-stretches canvas, as needed, is another variable and issue that makes me want to avoid it entirely. Traditional tape-hung matte paper under an appropriate over-mat and under glass/acrylic seems like a much more reliable way to go.

Most say that a heavy, water-based coating is needed on canvas to protect it. On the other hand, my local Samy's service bureau has no spray booth and uses Premier Imaging Print Shield (the solvent-based, aerosol product), as opposed to the Eco Print Shield that Premier Imaging recommends. The non-elastic, solvent-based Print Shield is good for papers but cracks when stretched and bent over stretcher bars. One might want to stretch the canvas before spraying.

To do a good job with water based coatings, a HVLP sprayer and dust free spray booth is needed, particularly for large prints. On the other hand, the best "giclee" service bureau in my area now uses rollers to apply the coatings. To get an even and dust free rolled coating is tricky.

The most even and perhaps best overall roller-applied coating I've seen and made used a method shown to me by Premier Imaging. It involves 3 thin coats of the varnish. The first 2 are glossy; the third uses their satin Eco Print Shield. Foam rollers are used, and the print is taped to a smooth surface to keep it flat. After a heavy coat of varnish is applied, a dry roller is used to remove the excess. As little as 15 minutes can be enough time to wait between coats. This takes practice and the opportunity for dust is obvious.

Note that "Breathing Color" uses just a single heavy coat, decreasing the pressure as one goes over the print in all directions. Getting this even is not easy. I avoid all these roller-applied coatings.

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<sup>29</sup> See Atlex at <http://www.atlex.com/epson-exhibition-canvas-matte-natural-oba-free-36-x-40.html> for the 36" roll. Note that the Exhibition Matte Canvas that does not have the word "natural" in it is a very different paper, and not very good at all – low dmax, OBAs, thicker/more curl, heavier texture, odd matte with a touch of gloss finish.

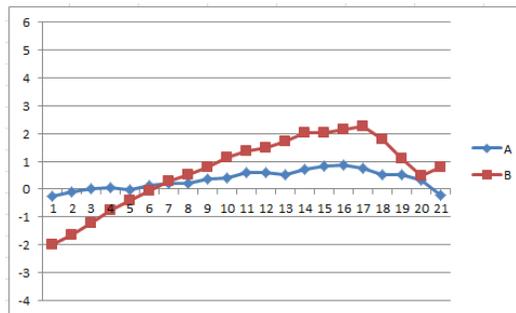
Frankly, I find that the matte canvas with no coating looks the best. Once there is even a satin coating on the print, the canvas texture picks up highlights and masks the dark & black areas. To keep the matte look and decrease the possibility of some rub off in the 100% black areas, my usual Lascaux Fixativ spray works just fine. If I were to use matte canvas now, this is probably what I will do, advising those who want more protection to have someone with a spray booth do the coating or use a frame with acrylic to display the image.

(In fact, I turned to glossy canvas for large, un-glazed display for a show that featured canvas. It still has too many issues for me to be entirely happy with it. Matte paper under acrylic, framed in a traditional manner is hard to beat and what I recommend above all the canvas approaches. For very large, un-glazed display I'm now inclined to use a satin finish paper.)

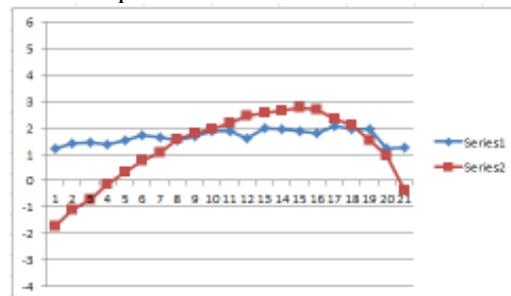
The canvas products I tried appear to have a rather normal tonal range with Eboni carbon. Of interest, however, is that, due to the pattern of the canvas, the neutral printing Eboni black only can be used as one of several profiles to make a less warm 100% carbon print or a neutral print that has a better very little color toner in it. Additionally, a profile using only the 30% MK inks (C and LK) and 100% MK (in K and Y positions) – what I refer to as C-K profiles – produces a print that is slightly less warm than when the full set of dilutions is used, while appearing essentially as smooth. As such, I made various combinations of profiles that can be used to balance smoothness, tone, and relative lightfastness.

With two black-only channels as well as a profile that uses both 30% Eboni inks, a 100% carbon print can be made that will look slightly warm and acceptably smooth for a large canvas print from normal viewing distance. Below are the Lab A and B graphs for this combination:

Generations Matte Canvas

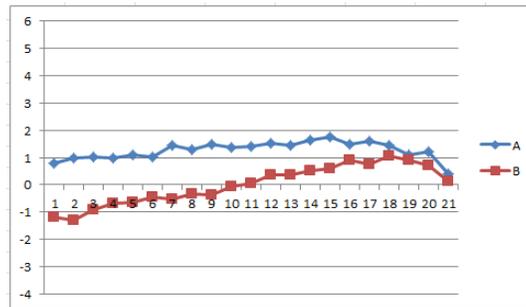


Epson Matte Canvas Natural



For a neutral print that might be looked at close up, a 30% Black Only, 70% Neutral profile mix seems like a good combination. The graph below shows the print tones. The use of the Y-position Black only appears to be just slightly smoother in this situation.

30% BO, 70% Neutral, Epson Matte Canvas Natural

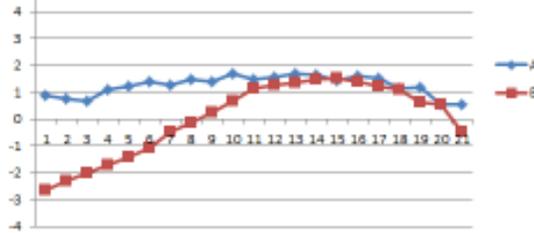


If viewers are not going to get their noses in the print, a 50% Black Only blend will work. For large prints viewed only at a distance, the two MK positions by themselves make a neutral print that is also as lightfast as possible.

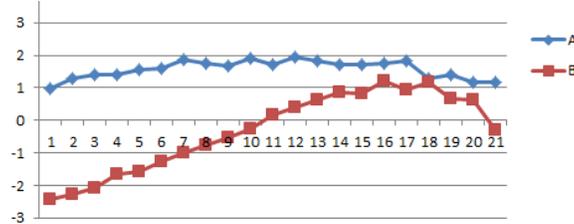
Using just a little 100% MK in the highlights to reduce the amount of color is a strategy that seems to have good application with canvas. The 100% Ebony dots in the highlights do not show up when in small amounts, which causes them to use the smallest droplet. This is a setup that I have found looks good:



This profile makes an image with a Lab B rise of 4. It looks neutral in the highlights and a bit warm in the shadows.



For a lower, about 3 unit Lab B rise and a bit smoother on very close inspection with bright light, the blending of the Neutral and 100% carbon db6 curve works. The split, from highlights to shadows in QTR is as follows: Neutral curve 100, 70, 50; db6 curve 0, 30, 50. The Lab A and B curves for this are below.



### Canvas Display and Framing

Although I used 44" rolls for much of the large canvas printing I did for my show that featured canvas, I prefer to work from a 36 inch roll of Epson Matte Canvas Natural. This size seemed the most manageable.

The "gallery wrap" or "museum wrap" is the current standard for canvas. I, frankly, think fine art photo needs to have some type of frame. If it is going to be displayed in an environment where damage may occur, then the framing type needs to be compatible with an acrylic or other glazing, or a coating of some type. Gallery wrap does not lend itself to glazing, and coating destroys the matte look that I think achieves the most depth and range in the image. Once the canvas has a sheen, the high point of each canvas thread picks up a highlight from some light source. Also, application of a coating by roller is not practical for large prints, and an HVLP spraying system and booth is not realistic for many printers. In my area (Santa Barbara and the California Central Coast), even the top "gliclee" printers do not use HPLV sprayers and spray booths.

Many professional photographers who print on canvas have found that gluing the canvas to Gator foam board is the best solution. I agree. It keeps the print flat and no one is likely to put a finger through it. Gator board, however, is not archival. It is composed of wood chips in a resin for its outside, hard coatings. It also cannot be easily cut with a knife. A table saw is recommended.

Foam core is very inexpensive, easy to obtain and cut. When adhesives are applied and the canvas glued down, however, most have found the warping unacceptable. I appear to have solved that problem by spraying a primer on the foam core side that will have the glue applied. Also, using two sheets of the foam core works and is not difficult or expensive.

Adhering the canvas to foam core allows one to make very large prints, but I have found the spray technique of gluing the canvas to the board is not particularly reliable. For 24x36" sizes and below, using a pre-coated board for hot pressing is a much more reliable approach.

### Framed, loose-hanging canvas

I tested an approach where, after the canvas had been laying out flat on a 32x40 piece of foam core for a couple of days to “relax,” I sewed the top of the canvas to standard acid free foam core that has been trimmed to the size of the print.

When complete, the canvas hangs loose from the top edge that has been sewn to the foam core. At three points along the right and left sides, threads go from the edge of the canvas, around the edges and to the back of the foam core. These are laced with string and allow an adjustable, slight tension to be put on the edges to flatten residual curl. The bottom of the canvas, appears to need no work.

The foam core with canvas is put into a standard black frame with a frame nailer. The overhang of the frame on the canvas hides the sewing and thread, which blends into the canvas structure and is virtually invisible to start with. Acrylic with a spacer can be put in first for protection if that is called for by the display location. For adult environments the Lascaux-sprayed matte canvas can be displayed without glazing. Lack of reflections makes this superior visually in most common display settings. Even with the Lascaux coating, however, the deep black areas will show some effect of being touched and a hard edge like the back of a fingernail will leave a mark that has a different reflective character. At an obtuse angle with light where it would be reflecting off the canvas, the area rubbed with a fingernail will show. In normal display, no one will see either of these effect, but the bottom line is that matte canvas is subject to some damage by handling if not protected.

I print on a border, leaving a half inch un-altered canvas area for signing. Also, viewers can come up close to see the substrate in this border area. The remainder of the border accentuates the canvas nature of the print. I want people to know this is canvas. What pattern, if any, to put on the printed part of the border is subjective and part of the creative process. The outer edge of the border is the cutting line. I use scissors to cut the canvas down to the edge of these borders.

Below is my first effort. Many viewers see this as a painting instead of a photograph.



The canvas can be taken out of this frame easily and undamaged. It can be rolled with a mylar interleaving and stored or shipped inexpensively in tube or 9x9x36 box. Another canvas can be sewed onto the same foam core and put into the same frame. The border part of the canvas is plenty durable to take the handling.

I make my own frames from stock that costs about \$1/foot. A local gallery will mark this up about 100%. The foam core is bought in standard 32x40 inch sizes. Cutting is easy on a cutting mat on the floor.

Wood frames are the easiest to deal with if you have a frame nailer, with is worth the price.

So far, I think this is the most archival, easily storable and shippable solution I've been able to come up with. Now unusual tools or skills are needed.

It is true that a critical viewer will be able to see that the canvas is not tight if the canvas is viewed from a very obtuse angle. If the canvas is poked, it is obviously loose.

### **Matte Inkjet Paper**

Frankly, I recommend most use standard matte inkjet paper and display them in the traditional manner, using a window mat to hold the print flat and acrylic to protect the image. The traditional display is hard to beat.

(That's it for now.)

## Appendix 1

### Carbon Pigment Lightfastness

#### Fade Test Data<sup>30</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 in 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>31</sup> values reported. Lower is better.

MIS Eboni carbon = 0.6  
Cone Carbon Sepia = 0.5  
Epson 3800 ABW = 3.6<sup>32</sup>  
HP Z3100 = 1.9  
Cone Piezo Neutral K6 = 3.5<sup>33</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>34</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>30</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>31</sup> Delta-e measures the total movement in Lab L, A and B – i.e., density fade as well as color shift.

<sup>32</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>33</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>34</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.