

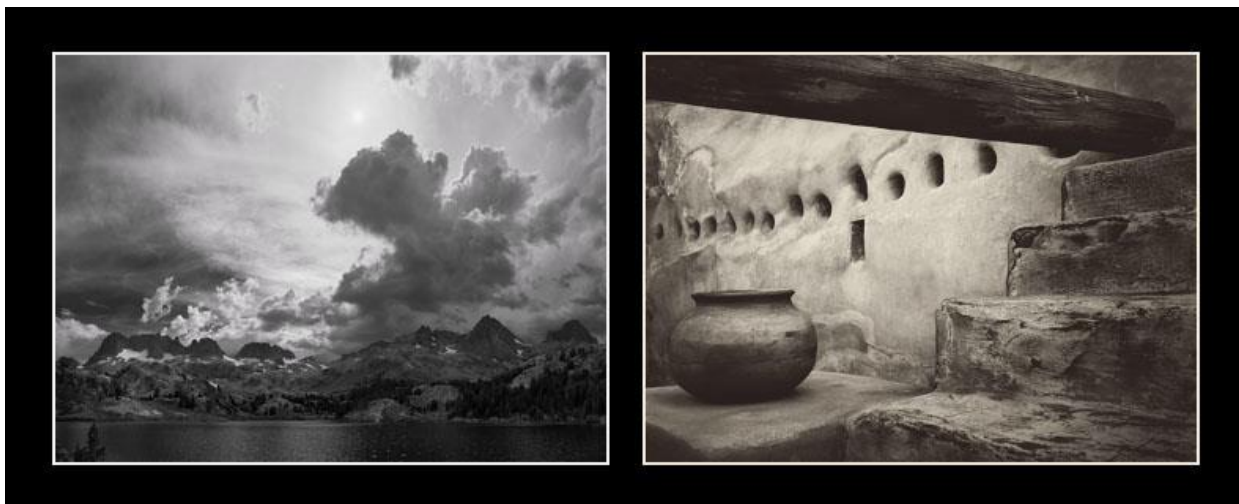
Eboni/Carbon Variable Tone Black and White Inkset for Matte paper for the Epson 1430

www.PaulRoark.com

2016-C draft

This PDF discusses an “Eboni-6”¹ type carbon inkset variation that uses a light blue toner in the Y-position to extend the range of the inkset to include totally smooth neutral and cool printing, while still allowing the 100% carbon printing of the Eboni-6 inkset. This is for matte papers only, including Arches and other watercolor papers.^{2 3} This inkset approach prints with both the Epson driver and QuadToneRip.⁴

The goal of the “Eboni Variable Tone” (“**EbVT**”) setup is to achieve the most archival and smooth, neutral or warm tone print, using the most carbon possible, as well as the least amount of and best color pigments available when needed for more neutral tone prints. The use of MIS “Eboni” carbon, the most neutral/least warm carbon, is a primary part of the strategy. The color pigments are OEM. The most useful range of the inkset is shown below, using inkjet and Stonehenge watercolor papers.⁵



¹ See <http://www.paulroark.com/BW-Info/Eboni-6.pdf>. The EbVT inkset tested used generic dilution base. See <http://www.paulroark.com/BW-Info/Ink-Mixing.pdf> at pages 6 – 7 for DIY formulas; available from MIS at <http://www.inksupply.com/roarkslab.cfm> pre-mixed. Eboni version 1.1, available now through MIS (also sometimes referred to as STS wj1082 during testing) was used. It has a deeper dmax and is a bit warmer.

² In the 7800 K3 version, I place the toner in a different position because I use QTR only. I also use dual MKs. A K3 printer could be set up the same as that discussed here, with the LK and LLK being either M and LM, or C and LC.

³ Another alternative I’ve explored is using a second MK in the Y position, See <http://www.paulroark.com/BW-Info/Carbon-Variable-Tone.pdf>. Note that the use of a black only channel to cool the dilute carbons can still be employed with EbVT via QTR. The new color toner was first discussed here: <https://groups.yahoo.com/neo/groups/DigitalBlackandWhiteThePrint/conversations/messages/108192>.

⁴ See <http://www.quadtonerip.com/html/QTRoverview.html>; for control with the Epson driver Photoshop curves can be used, and they can be embedded in ICCs using QTR’s Create ICC-RGB. For most uses I recommend QTR.

⁵ See <http://www.legionpaper.com/stonehenge> for the various Stonehenge tones. The print above was on their “Warm White.” I will test the “Kraft” soon. Stonehenge warm white has a paper Lab B = 10. With Stonehenge “Kraft” (acid free cotton) paper dark sepia is possible. See <http://www.DavidKachel.com/> for the website and style of the photographer/artist who introduced me to Stonehenge paper.

Fade Test Data⁶

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-e⁷ values reported. Lower is better.

MIS Eboni carbon = 0.6
Cone Carbon Sepia = 0.5
Epson 3800 ABW = 3.6⁸
HP Z3100 = 1.9
Cone Piezo Neutral K6 = 3.5⁹

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 many 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 = 1.2¹⁰

⁶ <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.

⁷ Delta-e measures the total movement in Lab L, A and B – i.e., density fade as well as color shift.

⁸ 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.

⁹ See <http://www.paulroark.com/BW-Info/Eboni-v-Cone-N-HPR-140hrs.jpg> to get a better feeling for what these numbers mean.

¹⁰ Part of the silver print's problem was that the paper contained some OBAs. If we look just at the Lab L values for the test patches, the changes were as follows: Eboni carbon = 0.1, silver print = 0.3.

Ink Arrangement

The carbon ink positions are the standard Eboni-6 (now at v. 1.1) positions, available from MIS¹¹ pre-loaded for the 1400/1430 or in bulk:

LM = Eb6-LM (6% MK)
M = Eb6-M (18% MK)
LC = Eb6-LC (9% MK)
C = Eb6-C (30% MK)
K = 100% Eboni MK

Y = Light Blue toner (5.5% Canon Lucia EX Blue, 4.5% Lucia EX Cyan, 90% clear base.)¹²

Note that in the most recent inksets I have used a less dilute toner. For glossy work 25% color to 75% base is preferable. The MIS toner that is now available is matched to this 25% toner. If that is used, the QTR profiles simply need the ink limits divided by 2.5 (25% color/10% color = 2.5). The more color in the pre-mixed MIS toner or the Canon based toner I now use for all requires a proportionately lower ink limit to achieve the same results.

With Eboni-6 v. 1.1, unlike the original, I do not see more neutral printing from the very dilute Eb6-Y (2% Eboni, 98% clear base). As such, I see no more need for that ink in this mix. It was unnecessarily dilute for modern printers. Additionally, there are significant advantages to having a toner in the Y-position. It allows direct control via Photoshop curves. The Blue curve controls the Blue toner and thus the print tones – very straight forward.

Because the Eboni carbon is relatively neutral on matte paper, very little blue is needed to offset its natural yellowish warmth. The high dilution of the toner makes it easier to control the toning via curves and profiles, and it is so light that no color dots are visible in a 2400 ppi scan of a 21-step test strip.¹³

¹¹ See <http://www.inksupply.com/eb6.cfm> . Most DIY ink mixers should use generic base C6b. C6c may have a slight advantage for Arches watercolor paper. See fn 1.

¹² Canon Lucia Blue (PFI-106B) and Cyan (PFI-105C or PFI-106C) 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-ipf6300-ipf6300s.html> .

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. The light blue toner that MIS now sells pre-mixed uses MIS color pigments. I have not fade tested it. I would assume it will be as lightfast as the older third party B&W inks. See <http://www.inksupply.com/roarkslab.cfm> for the toner.

¹³ With the 25% color toner mix the dots will not be visible in normal, even close viewing.

Toner & Color Pigments

The color pigments used in the toner mix are the best available for this purpose according to my analysis of the Aardenburg-Imaging tests and other sources.¹⁴ One significant factor in the choice of color pigments is the actual colors of the pigments and the goal of keeping the hue angle between them to a minimum. Both of these pigments could be considered different shades of blue, with only a 50 degree hue angle separating them. See the Lab Color Wheel below.¹⁵ I have placed the Canon Lucia Blue and Cyan colors on a color wheel that already included the usual colors. The colors of the blue and cyan 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 with a color meter.

The very narrow hue angle or distance on the color wheel between the Canon “Cyan” and “Blue” relative to the usual cyan and magenta is a significant difference from some past third party carbon toning practices.¹⁶

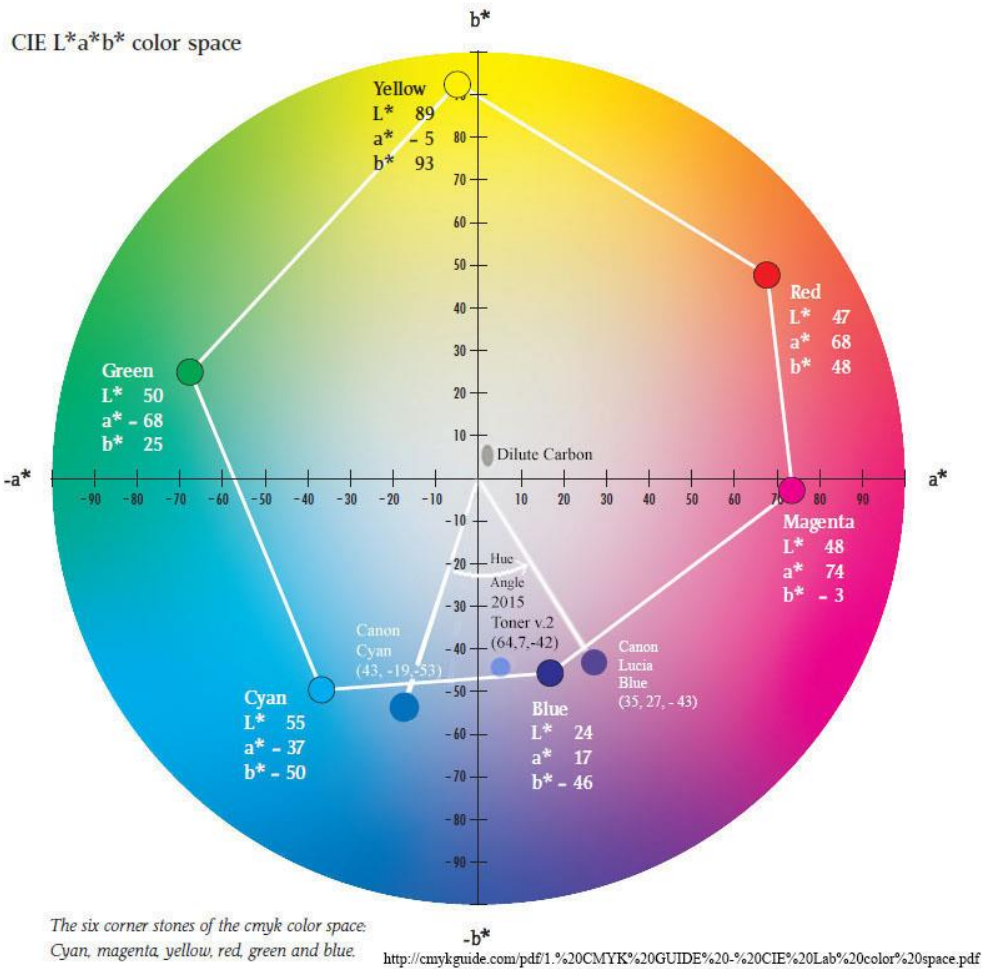
The use of color pigments with only a 50 degree hue angle between them makes for very efficient use of color and minimal risk of differential fade affecting the print tone over the very long potential life of the print. Note in the color wheel below the extent to which the traditional cyan and magenta are working against each other as much as, if not more than, against the (very low gamut) carbon yellow hue.

¹⁴ An earlier version of this toner used Epson cyan. However, while it did very well in initial testing, it ended up failing a longer term stability and centrifuge test. It may be that the Epson dispersion technology is incompatible with the generic base surfactants. Also, mixing pigments from different sources is risky. The earlier reason for the Epson pigment use was to achieve a 40 degree hue angle between the pigment colors – I felt it was worth trying.

¹⁵ The original color wheel image is from <http://cmykguide.com/pdf/1.%20CMYK%20GUIDE%20-%20CIE%20Lab%20color%20space.pdf> . I have added the spots for the Canon pigments, with the lines that show their hue angle difference.

¹⁶ What OEM neutralized carbon inks use is not known to me. In later MIS toned carbon inks, I used the Epson R800 “equivalent” Image Specialists/MIS blue ink. Note that the Epson R800 blue is not available in bulk. The HP blue does not appear to be quite as lightfast as the Canon blue.

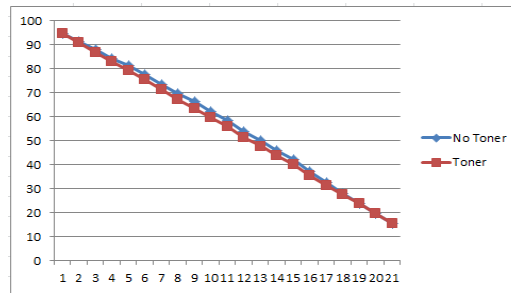
Canon Lucia Cyan and Blue



Dilute carbon is a very low gamut yellow, just to the right of and below Lab B=10. The range varies according to density, dilution and other factors, but in use it typically has a Lab B of between 2 and 7, and a Lab A of between 1 and 3. The toner color, like the Canon Cyan and Blue, was taken off a draw-down on non-OBA inkjet paper. It is a fairly directly below the dilute carbon tone, with a slightly elevated Lab A on inkjet papers (not Arches).¹⁷

¹⁷ One could use dilutions of the two color inks in separate positions, allowing adjustment of the Lab A values of the print. However this would come at a considerable cost in terms of difficulty in profiling. Ease of profiling is an important goal.

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



Overall, even the best color pigments used here have a fade rate of about 2 to 3 times that of the Eboni carbon.¹⁸ However, since the color inks' total contribution to the density of the print is only about 4.5%, a neutral print, mathematically, will only have a Lab L/density fade rate¹⁹ about 11% 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.²⁰ The difference is due to the combination of a more neutral starting carbon and a more efficient and 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.

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 – I have ever tested.²¹

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. Additionally, the Canon cyan and blue appear to have faded at close to the same rate, to the extent Aardenburg Imaging testing can show such.²² The toner is in fade testing now. Note that

¹⁸ I rely heavily on <http://aardenburg-imaging.com/> test reports. They are the best that are publicly available. Eboni and Canon Lucia EX 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 a good estimates of the relative performance of the pure inks as well as the carbon.

¹⁹ 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."

²⁰ 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/>.

²¹ I have loaded this toner into my 7800 (<http://www.paulroark.com/BW-Info/7800-Carbon-Variable-Tone-2015.pdf>) and a slightly higher concentration version into a 3880 (<http://www.paulroark.com/BW-Info/3880-Eboni-Variable-Tone.pdf>).

²² 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.

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 EbVT approach, much less color is used than in any OEM black and white approach.^{23 24}

The ideal carbon offset toner arguably might be composed of only a single blue pigment. 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 Cyan is only about 50 degrees. 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.

Print Tone Range Between Carbon Warm and Toned Neutral or Cool Prints

On typical inkjet papers the warm 100% “Ebony-6” carbon inks produce a maximum warmth of about Lab B = 6 units over the paper white. In the “Whaler’s Cabin” print, shown below, the tree (“lighted by the moon”) is “neutral” (equal to the paper tone, Lab b = 0). The cabin window and area behind the cabin (“lighted by the fire boiling the whale fat”) is printed with the warm carbon pigments only, Lab B = 6. With Photoshop curves, split-toning can be not only along the grayscale, but also by area.

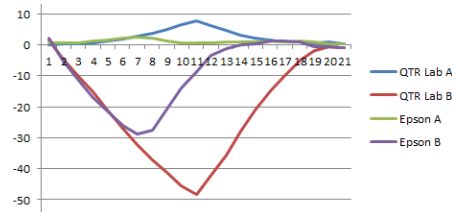


²³ HP Viverra PK and grays are a carbon-color blends that has done an outstanding job of controlling for differential fade, but HP still has to use much more color relative to the carbon due to the very small carbon particles it must use to be glossy paper compatible and stay in suspension in the less viscous thermal-printer inks.

²⁴ 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 cyan is still intact, and that is just not going to happen. The Lucia EX Cyan and Blue patches in the Aardenburg-Imaging test on H. Photo Rag at 140 Mlux-Hours of exposure both have a very impressive total delta-e of 1.9.

Along the grayscale, for example 21-step test strip, the paper sets the tone at the white end, and the MK sets the tone at the black end. For Ebony, that tone is, usually, from Lab B = 0 to -1. The toner allows a relatively straight line Lab B response between the paper white and 100% black point for all papers tested so far. Both the toner by itself and OBA cooled papers can pull the highlight and midtone Lab B values into the cold range, but the deep shadows cannot be made blue with this toner.

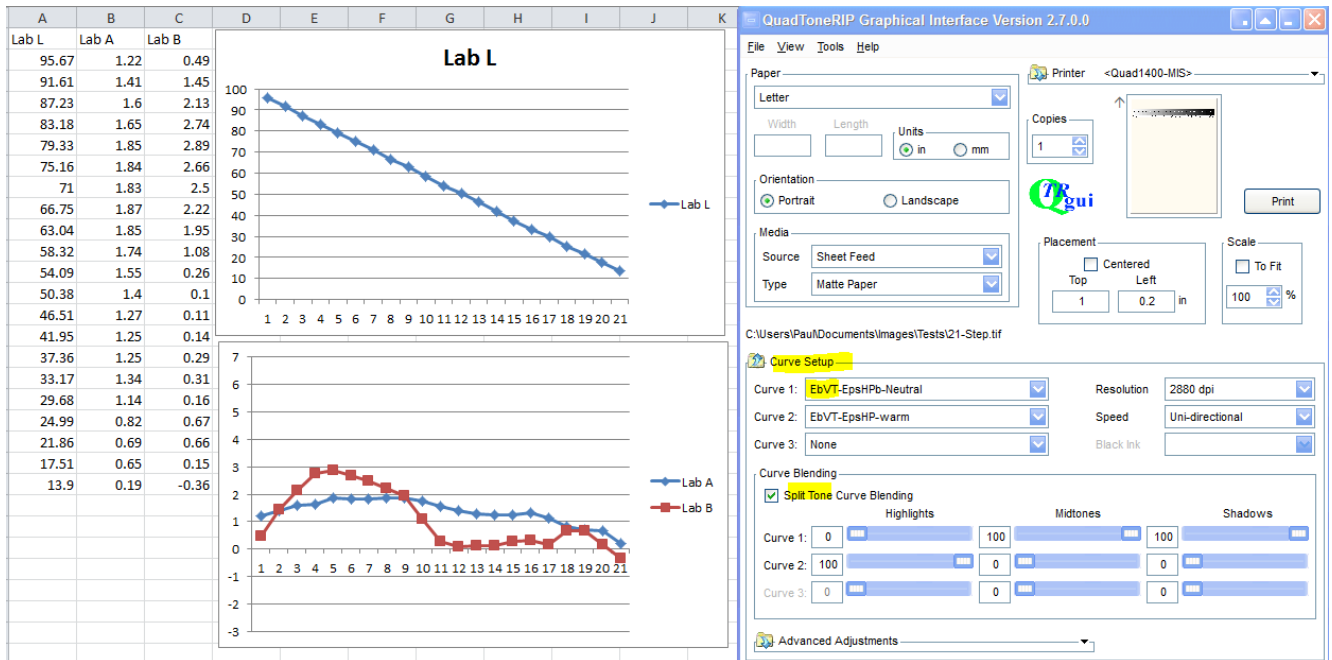
While my cool-end target for printing is usually neutral, this inkset is capable of stone cold printing. The graph below shows the limits of QTR and the Epson driver in terms of Lab A and B (B being the best single measure of warmth/coldness).



With QTR cold profiles will allow cold split toning with, for example snow and ice. With the Epson driver this inkset will be able to, for example, give blue moons in an otherwise warm or neutral-toned print. While the graph, above, shows the extreme blue that is possible, for “normal” looking prints I suggest keeping even the “cold” side to about 3 Lab B units below the paper tone.

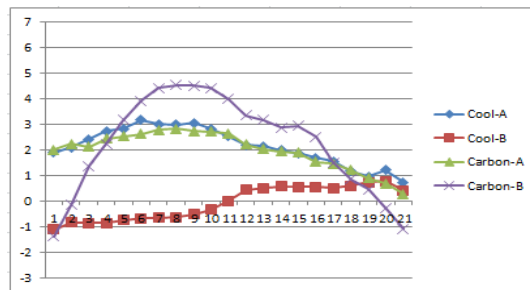
One very good result of controlling print tone via one light toner in an otherwise 100% carbon inkset appears to be that a blend of 2 profiles for the same paper in the QTR sliders gives a superior linearity compared to the blends of differently toned and partitioned gray inks. With the EbVT profiles, the carbon inks use the same exact curves and cross-overs from 100% warm carbon to cold tone. The only variable is the amount of a single light toner in the profile. Thus as one slides between the warm and neutral (or cool) tones, all that is changing is amount of toner and a very slight linearization offset for the minimal Lab L difference (shown in the graph on page 3). In short, the QTR sliders work very well with this inkset approach – better than I am accustomed to with the inksets I’ve used, where I generally recommended that people make a single profile with the tones they wanted to print. That way it could be linearized and avoid the blending artifacts.²⁵

²⁵ My experience has been mostly with inkset arrangements that use a number of carbon warm inks in one partition and a few cool blended inks in another partition, for example my Ebony-HP combination in my 7800. See, for example, <http://www.paulroark.com/BW-Info/7800-EbHP-2013.pdf> or older inkset <http://www.paulroark.com/BW-Info/UT14.pdf> .



In the split tone example above, Epson Hot Press Bright was used with QTR profiles for neutral and warm printing. While the warm highlights work in some situations, for me using the neutral in the highlights and half the midtones gives me the split tone I like best. The pigment cooling of the highlights does, visually, some of what we usually think of as cool OBA paper. Yet the cool pigments in the highlights will not fade quickly at all – a far superior approach to bright white clouds, snow and water.

Hahnemuhle Photo Rag has a coating that has a typical warm response to carbon. Below are the Lab A and B graphs for HPR when printed just with carbon and when the toner has been used to neutralize the carbon warmth.²⁶



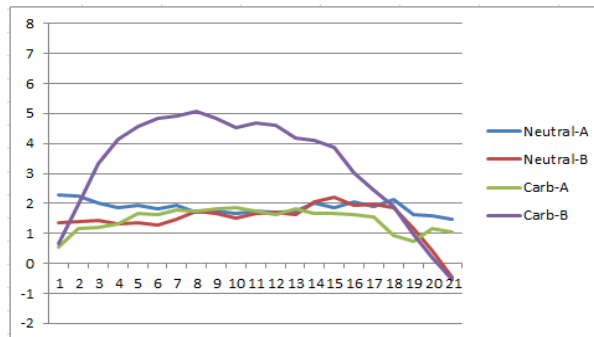
Having QTR use a “black only” profile (only the 100% Eboni MK cartridge used) can pull the Lab B of 100% carbon prints close to neutral, in the sense that the maximum Lab B is very close to that of the paper white. However, Black Only (“BO”) printing, having no dilute inks in the profile, is not as smooth

²⁶ Note that the white and black Lab A and B values can vary about 1 unit with my spectro from one session to the next, but the relative values are reliable.

as I like. On the other hand, blending profiles with QTR sliders so that the BO/MK ink carries about half of the image all the way into the highlights can make a very nice 100% carbon print that is only slightly warm on a number of papers. In short, this toner approach does not diminish the ability of Eboni-6's ability to print 100% carbon prints. While Eboni v. 1.1 is about one Lab B unit warmer than the original Eboni, the 1.5 pl printers like the 1400, 1430 and 1500 in Europe can blend a black only profile to a fully partitioned one in QTR with very good results. A toned channel can also be put into the mix to further neutralize the print and hold the amount of toner to a very small amount while still achieving a totally neutral print.

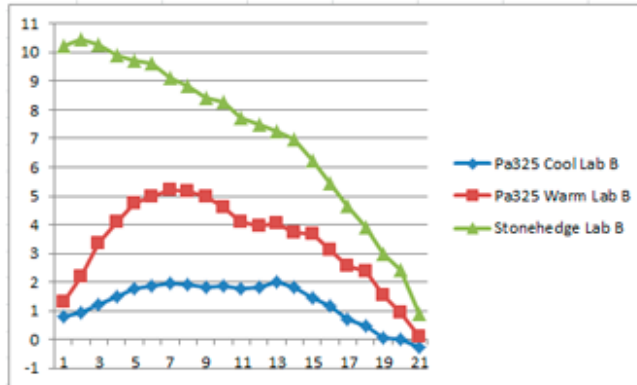
The Lab A varies somewhat among papers. The color blend I recommend – 5.5% Canon Lucia EX Blue, 4.5% Lucia EX Cyan – was chosen so that Arches would have an essentially flat Lab A graph when Lab B was also flat, that is, equal from the paper white to maximum black. With many inkjet papers, when the Lab B graph is flat (totally neutral print), Lab A rises one unit over a straight line curve. This gives those papers a slight selenium look.

The Arches BW Lab A and B curves for carbon and neutral profiles are shown below. Arches is a paper that tends to print carbon with less of a Lab B rise than most coated inkjet papers.



Print Tone Range with 100% Carbon

Note that while the toner allows very neutral and even cold prints, even with 100% carbon being used the print tone range is substantial.



The relative warmth in an objective manner is best shown by the Lab B measures of the papers and images. The graph above shows these for Premier Art 325 (Pa325) for “cool” and “warm” 100% carbon profiles, as well as for Stonehedge watercolor paper.

The Premier Art 325 paper is a non-OBA paper that has been a standard of mine for some time. It is the thicker version of a paper also known as Epson Premier Art Scrapbook paper, which has been identified by Epson as its most archival paper. The Eboni carbon image on this paper has turned in what I believe is the most lightfast image fade test results among the many reports published by <http://www.Aardenburg-Imaging.com/>.

Stonehedge watercolor paper is an uncoated paper that is widely available at art stores. While images on such 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 an uncoated watercolor paper. I use Arches uncoated watercolor paper for what I consider my top prints. Stonehedge watercolor paper provides a very interesting alternative for images that look best with a very warm tone.

For 100% carbon prints that are relatively more neutral, a QTR profile that has the 100% Eboni MK running the full length of the scale. One way to do this is to use QTR sliders and combine an “Eboni-5” profile with a “Black Only” profile. Black only (just the MK position firing) prints with a nearly neutral ink, but it’s rougher. When combined 50:50 with a dilute carbon profile, the warmth would be half way between what is shown, yet the 1400/1430 1.5 picoliter drop is so small that a 50:50 blend looks quite smooth. If cooler is needed, just a little toner will do it. Or if smoother is wanted, more toner and less Black Only will do it. This is a flexible inkset.

Many papers that are brightened with OBA’s (Optical Brightening Agents/dyes) may have lower Lab B measures and be preferred by some. With these papers and this inkset, stone cold prints are within range that will still be very high in carbon content and almost fade free.

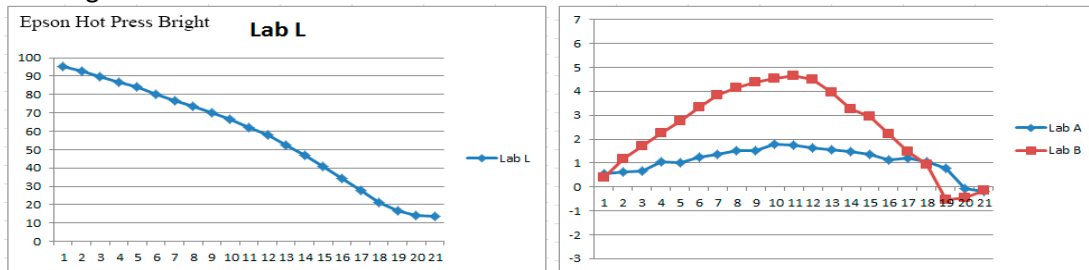
Printing Options and Characteristics

This inkset is Epson driver compatible and, as such, can be printed with either ICCs or PS curves (which allow variable tone within a single image). On the other hand, the best images are usually obtained using QTR.

My profiles and curves are and will be posted here:
<http://www.paulroark.com/BW-Info/Eboni-VT-Profiles.zip>

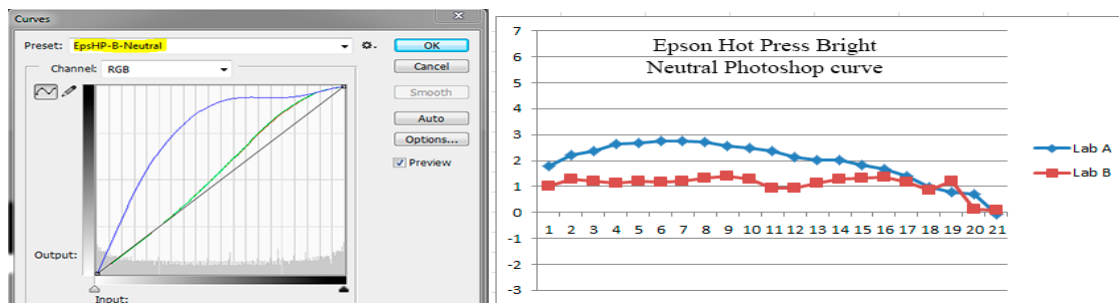
Epson Driver

This inkset will print a very presentable image with nothing more than the Epson driver set to Color Controls and gamma 2.2.



With no profile other than in the Epson driver at Color Controls, the image is light compared to a standard Gray Gamma 2.2 image. It is also warm. There is a little toner in it from the Y-position, but it is minimal in light of the toner's high dilution. In general, I have not found the controls in the Epson driver to be effective very effective. Either Photoshop curves or QTR are needed for proper control.

With Photoshop curves and an RGB version of the B&W file, very good control of the inkset is possible. With this approach, the Blue curve controls the Y-position, blue toner. The Red curve controls the Cyan channel (C and LC). The Green curve controls the Magenta channel (M and LM).



In the above example, the Blue curve was pulled up, increasing the amount of Blue toner. The Red and Green curves were also pulled up somewhat to straighten the Lab L response. The result is a print with a nearly flat/neutral Lab B and a slightly elevated Lab A, which gives a bit of a "selenium" look.

This curve also made a relatively neutral print on Hahnemuhle Photo Rag, though a bit more toner would be needed to totally flatten the Lab B value.

This suggests that people will be able to alter the Blue curve to make profiles for other papers. I recommend the values in the shadow area, where you see them coming together in the Curves graph above, be left as is. That area was carefully made to obtain a straight line response in the deep shadows.

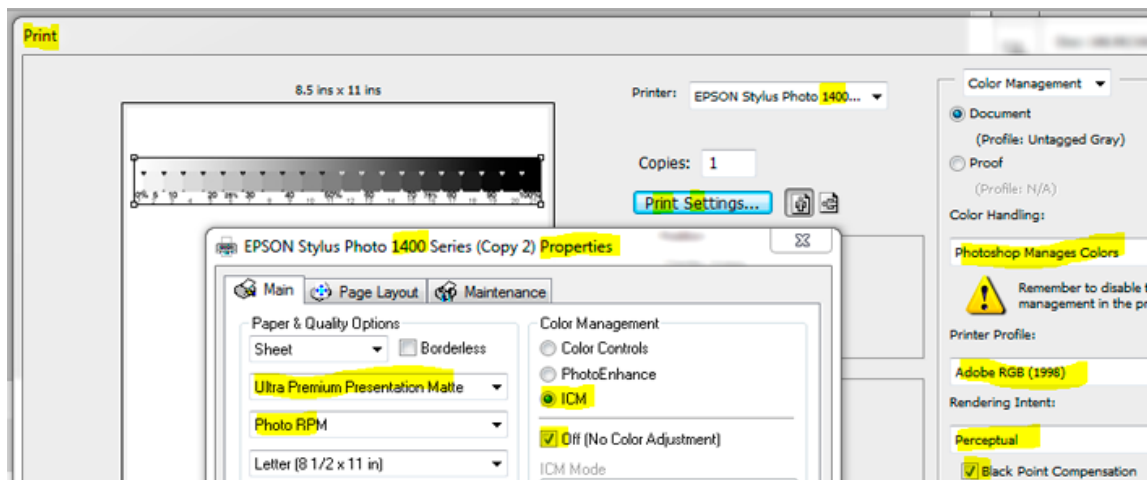
Once one has a set of curves that produces a print with the print tone desired and a relatively smooth Lab L gray ramp, the curve can be embedded in an ICC and linearized using QTR's Create ICC-RGB.

These ICCs allow a “color managed” workflow in the sense that, if the monitor is calibrated, the monitor and print should match with respect to relative densities without further work.

As noted previously, with PS curves and an RGB version of the B&W file, variable tones can be accomplished within a single file.

With an Epson driver compatible inkset and an ICC made with Create ICC, the “color managed” prints can be used as references to, in turn, manually adjust your monitor so that it will allow accurate editing of images that will print well and also look good on the many web-based platforms, which generally use Gray Gamma 2.2 as their gray space.

Epson Driver and PS “Print” Screen Settings when ICCs are going to be made²⁷



It’s convenient to save the Properties settings with a name that ties them to the approach being used.

²⁷ I use mostly Photoshop CS 5 for setting up this inkset because ICC’s are easier to make by using Adobe RGB (1998) as both a workspace and printing profile. PS Cloud and probably CS6 do not allow this (or the old “No Color Management” option). Adobe has a printer utility that allows the file to be passed through without the values being changed.

I just leave my system set up this way for both making ICCs and printing from curves. ICCs made with the system are pulled up where “Adobe RGB (1998)” shows in this screen grab.

QuadToneRip (QTR)

While the Epson driver is convenient to have available for printing, I use QTR for the vast majority of my serious photo work.

The basics of QTR are the same for all ink setups. I apologize that I was not able to write up a special version for this inkset, but my very old 1400 head finally gave up before the task was done. However, for a good overview of using QTR on the Windows platform, see <http://www.paulroark.com/BW-Info/Eboni-4-Plus.pdf> starting at page 11. I start at page 11 with a simplified way to make QTR profiles. For printing with existing profiles, start with page 16. (Note that the Eb4+ inkset used the original Eboni. As such, the section on print tones is obsolete.)

Mac users might want to search <https://groups.yahoo.com/neo/groups/QuadtoneRIP/conversations/messages> for any questions they have.

(That’s it for now.)