Epson 7800
&
Carbon-6
www.PaulRoark.com
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[Note that in light of the stability of the Carbon-6 in the printer tubes, I'm swapping out 3 positions of Carbon-6 to make room for HP's Z3100/3200 PK along with two C6 dilutions of that ink to allow neutral and glossy printing. This will effort will be summarized at http://www.paulroark.com/BW-Info/7800-Eboni-Carbon-HpPK.pdf .]

The purpose of this effort is primarily to optimize a version of the "Carbon-6" inkset for the 7800. Briefly, Carbon-6, as well as its commercially available twin Eboni-6, are 100% carbon pigment inkset approaches for matte paper that are more neutral than other 100% carbon pigment approaches. Carbon-6 is also open source approach, with MIS Associates' Eboni-6 being the commercially available, pre-mixed version. The information in this PDF is, for the most part, equally applicable to the Eboni-6 inkset.[1]

Using 100% carbon pigment appears to be the most lightfast, tonally stable, non-toxic, environmentally friendly printing approach we have for black and white photography today.[2] It can also be very economical.

The Carbon-6 version I'll be using here uses my latest "C6c" clear base formula to dilute MIS's Eboni MK carbon pigment.[3] I am using the generic C6 generic dilution base approach, in part, because of its low cost. Aside from the personal economic interest in holding down my costs, I think it is important to the B&W photo market to have a "home darkroom" type of alternative to the commercial approaches.

Eboni-6, on the other hand, is a good and still economically attractive alternative for those who do not want to mix inks. All of the profiles, etc. that I develop for the C6 approach should work equally well with Eboni-6 similarly set up. I have used them interchangeably for several years.[4]

While any matte paper can be easily used with the C6/Eb6 approach, I'll concentrate on 2 papers in this PDF: Premier Art Smooth BW for a neutral-cool coated paper and Arches un-coated watercolor paper for medium-warm fine art. There are many alternatives.

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[1] See http://www.paulroark.com/BW-Info/Ink-Mixing.pdf for general information on Carbon-6, and http://www.paulroark.com/BW-Info/Eboni-6.pdf for more on Eboni-6. They are essentially interchangeable, using the same profiles.

[2] See http://www.paulroark.com/BW-Info/R1800-Lightfastness.pdf for information on carbon ink lightfastness.

[3] This 3rd version of my C6 generic base is incrementally smoother than the previous version, particularly on Arches uncoated paper, which is a specific target of this effort. The previous versions of the C6 base continue to be viable alternatives for those who do not have the stronger surfactants readily available. See http://www.paulroark.com/BW-Info/Ink-Mixing.pdf for more information on these open source dilution bases.

[4] See http://www.inksupply.com/eb6.cfm for MIS's Eboni-6.

Inks & Positions – "C6-Dual" Variation

While the standard Eboni/Carbon-6 setup will work fine in Epson k2 and k3 printers, I wanted to see if other arrangements and mixes would be better on Arches.[5]

My current ink dilution and placement in the 7800 are listed below. While I'll be using the C6c generic base, I've listed the MIS Eboni-6 equivalents in parentheses.

K = 100% Eboni[6]

LK & C = 30% Eboni (Eb6-C)[7]

LLK & M = 13.5% Eboni (Eb-EZ)[8]

LC & LM = 6% Eboni (Eb6-LM)

Y = 2% Eboni (Eb6-Y)[9]

This ink arrangement is compatible with the Epson driver. With the driver set to Color Controls and Gamma 1.8 the 7800 makes prints on most matte papers that are close to the monitor display when the most standard Gray Gamma 2.2 workspace is used. While I often if not usually use QuadToneRip[10] for my fine art printing, it is very handy to have the Epson driver option available.

Ink Carts, CIS/CFS Options

The options with respect to carts and workflows must take into consideration the ease with which the inks can be agitated. All pigments settle. The Eboni dilutions settle faster

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[5] One factor was also the anticipation that a modification of the 7800 may be useful for printing consistency. The modification I have in mind requires that most of the dilute Eboni ink be used by 2 positions. This "dual" position use of the midtones would allow a circulating ink system that can refresh the ink lines without wasting ink or wearing out the printer. This could be necessary if the carbon ink settles in the 7800 tubes. So far in the only 3 ½ week idle period I've had, the ink appears not to have settled in the tubes.

[6] All inks can be purchased pre-mixed from MIS as bulk Eboni-6. The EZ 13.5% requires that 2 bottles be mixed together. See http://www.inksupply.com/eb6.cfm

[7] Two positions of the same density often result in the same benefits as more different densities. The number of jets firing is often the issue. Here two 30% inks printed smoother than one 30% and one 18% -- the old M/LK density. The starting points of curves of the 2 identical inks can be altered by ink limit and other profiling variables. By having the 3 relatively unstable midtone inks doubled up, a return ink system using the spare line can be designed if necessary. The Y and K positions are relatively stable.

[8] See http://www.paulroark.com/BW-Info/C88-C13-5.pdf . 13.5% was chosen, in part, because 2 bottles of Eb6 inks (LC-9%, and M-18%) can be easily mixed to make it. The C88 with C6 brings the most stable B&W printing to the least expensive platform. No other printing system is as cheap, easy, or lightfast.

[9] 2% Eboni is a stable suspension. Because the 6% LC and LM make for smooth highlights, the Y position could also be a dilute HP PK for more neutral prints. Or, Y could be a very warm carbon, e.g,, based on MIS PK or Cone K6 Carbon Sepia.

[10] See http://www.quadtonerip.com/html/QTRoverview.htm. "QTR" is shareware written by Roy Harrington.

than most. As such, agitation of the midtone dilutions is necessary. The exception is the 2% Eboni mix, which is quite stable. Similarly, the black (K – 100% Eboni) has proved to be relatively consistent in printing. Agitation of these positions is still recommended, however, as it is with all pigments.

I am currently using cartridges purchased from MIS ($18 each, empty).[11] These carts are most easily agitated by removing and shaking them. How long the seals will last is unknown.   I expect the k2 and k3 seals to hold up better than the old 7500 seals, which tended to leak after too many removals and re-insertions. I am not certain, however, if the seals will tolerate frequent removal of the carts for agitation.

Funnel fill carts are also available from MIS. These can be removed, but they might also be agitated by means of a syringe inserted into the fill hole.[12]

CIS/CFS systems may be the easiest to agitate on wide format printers. MIS at one time made a CFS for the 7800,[13] and it appears easy to make these from used Epson 7800 carts.[14]

Epson Driver Workflow

I work in Gray Gamma 2.2 space, which is a subset of Adobe RGB (1998) and sRGB, the most common color spaces. With the print preview setting "No Color Management" selected[15] and the printer driver set to UltraSmooth Fine Art paper type, Color Controls, gamma 1.8, and the highest quality settings, Premier Art Smooth BW and other matte papers print with a ramp that is close to how the monitor displays the image. The Lab L distribution of such a Premier Art print 21-step test file is shown in the graph below.

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[11] See http://www.inksupply.com/inkjet_cartridges.cfm?search_getmodel=460
[12] See http://www.inksupply.com/funnelfill.cfm. Ink should be kept in the dark to avoid the possibility of algae, which has been reported to be a problem in some CISs in sunny climates.   These clear carts might best be covered by a black plastic sheeting.
[13] See http://www.inksupply.com/cfs_7800_new.cfm
[14] As usual, regular use of the printer is recommended. Use of the MIS auto-print software may help when the printer is going to sit idle for a while.
[15] With CS4 and a grayscale file have the print preview set to PS Manages Color with Print Profile = Working Space (Gray Gamma 2.2) or Printer Manages.

Lab L
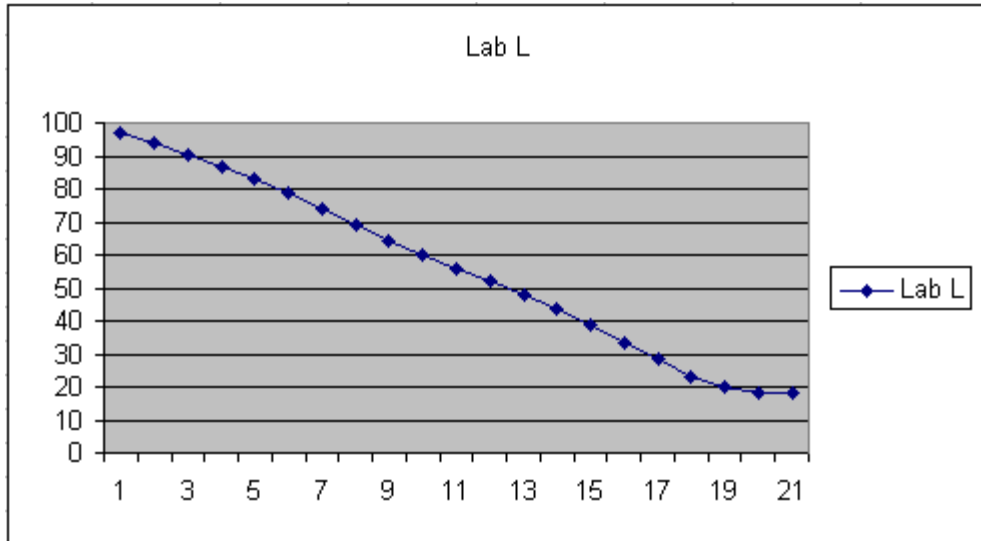
An ICC made with QTR's Create-ICC usually is all that is needed for a very good, "color managed" workflow.[16] The graph below shows the results of an ICC with Gray Gamma 2.2 workspace. This also shows the idealized Gray Gamma 2.2 relative density distribution that is shown on a calibrated monitor.

Lab L

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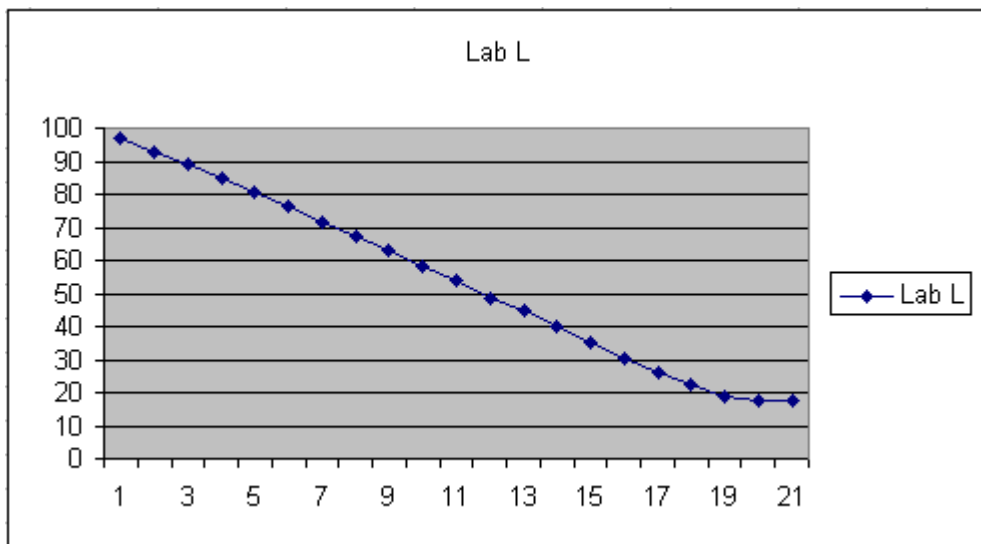
[16] In this context a "color managed" workflow will result in print relative densities that match those seen on a calibrated monitor.

The best Epson driver workflow uses QTR's Create ICC-RGB with an embedded Photoshop curve. This provides not only a "color managed" workflow, but also results in a high bit depth pipeline to the printer, overcoming the 8 bit limitations of most B&W workflows.[17] The curve below, by using the light 2% ink in the highlights, produces the smoothest prints and works with most matte papers. This curve and other profiles will be posted at http://www.paulroark.com/BW-Info/7800-C6-Dual-Profiles.zip. The curve is intended to be used with Create ICC-RGB.[18]
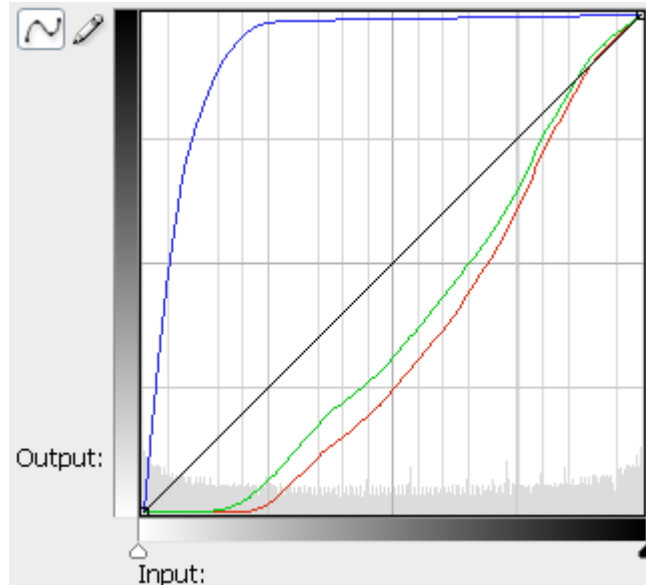
Arches Hot Press will also print with the Epson driver, but not well. The dmax with the Epson driver is a bit low, and the Epson driver midtone ink limits are too high. So, for the best results on Arches Hot Press I recommend the QTR rip.

QTR Profiling for Arches Watercolor Paper

Although coated papers can often be profiled to print with a very slightly higher dmax with QTR relative to the Epson driver, the final prints are so close that in actual images there will probably be no visible difference. As such, the advantages of using the Epson driver with an ICC will probably cause me to use that workflow for most coated papers.

With Arches Hot Press uncoated watercolor paper, however, the QTR rip is much better. Arches is one of my primary targets for fine art printing due to its very good reputation,

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[17] Note that whether one needs more than 8 bits of printing information is questionable. What is important is that curves are applied in a 16 bit environment, and this is done in the QTR rip even though it restricts the input file to 8 bits. Always work with 16 bit per channel (or greater) files in Photoshop.

[18] Briefly, one first prints an RGB version of the 21-step test file with this curve and reads the Lab L values of the test strip. These values and the curve, placed on a special file in the QTR download, are then dragged and dropped into the Create ICC-RGB app on the Desktop. This gives the program the information is needs to produce a custom ICC.

predicted long term stability, cost, availability in sheets, and other favorable characteristics.[19] [20]

I use Window XP, so the following is based on the Windows QTR interface.

Black Ink Limit & Boost

Ink limits can vary somewhat from paper batch to paper batch. As such, checking the Eboni ink limit for different paper batches may be advisable. In part to keep changes in the black ink limit from affecting the entire profile, I use the Black Boost. This puts a very steep slope on the very end of the black ink curve. The value put into the Black Boost box is that which gives the best dmax. When this Black Boost is changed, it does not affect the rest of the profile. In the Curve Creator K "ink limit" box I put the value where the additional density in adjacent patches is very small – that is, where the slope of the Lab L curve becomes very low. This point will be well below the dmax point used for the Black Boost and does not usually need to be changed from paper batch to paper batch.

For Arches HP I find the slope of the curve levels off substantially at about 70%. As such, that is where I've set the K ink limit, even though the dmax is usually not hit until 100.

Arches Midtone Ink Limits

Because it is an un-coated paper, Arches is prone to bleed and look "blotchy" (rough) at fairly low ink loads. This is hidden in the deep shadows, but for the midtone inks bleed can significantly reduce smoothness. As such, I opt for low midtone ink limits that reduce the bleed. An ink limit of about 30 for most midtones works well; 50 for the 30% ink seems to work well because the bleed is sufficiently hidden by the time those inks reach that level.

Arches Ink Densities

QTR ink densities are usually set by measuring the density of the midtones at their ink limits and comparing these densities to a black 21-step test print that was printed at its ink limit, here 70. If, for example, the cyan position ink at the limit selected for it is equal to the black (limit 70) ink test patch at 35%, then the cyan ink would have a density value of 35 in the QTR Curve Creator. Usually some interpolation is needed to hit the exact density value.[21]

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[19] Arches papers have been made and used by artists for close to 500 years. It is widely available at art stores in 22 x 30 sheets. I use "140 pound" (about 300 gsm) thickness "Hot Press" (smooth surface) "Bright White" (no OBAs and not much brighter than the standard Arches). A "cold press" with more of a texture prints the same as the hot press. There is also a "rough" surface available that I have not tried. I recommend http://www.dickblick.com/categories/watercolorpapers/#artistwatercolorpapers as a source.
[20] Some of the material in this section is repeated at http://www.paulroark.com/BW-Info/Arches.pdf.
[21] I am not certain how accurate these density figures need to be. I've found that often the "densities" of the identical inks used in, for example, the C and LK positions vary slightly. For simplicity I usually

Dual Use of Midtone Inks

For the C6-Dual inkset, where three of the midtone inks are used twice, special QTR profiling procedures are needed. QTR cannot directly partition a "gray ink" series where some of the inks are the same density. There are at least 2 ways to deal with this.

First, one can partition the gray inks with only 5 inks used, where each has a separate density; the three duplicate midtone densities are "not used" in this initial partitioning. Next, manually split the position between the 2 duplicate inks, cutting the ink limit of each in half and having the second position simply use the curve of the first one. QTR has the option to "Copy curve from" another ink position. So that the duplicate inks have slightly different slopes, one can set an ink limit split between the channels that is not equal, but the total will be the same.

A second method to deal with duplicate densities, and what I prefer, is to have them in a "toner" channel. With this approach the Y ink limit is also cut because the LM goes all the way to the paper white. The resulting curves for this approach are shown in the graph below.
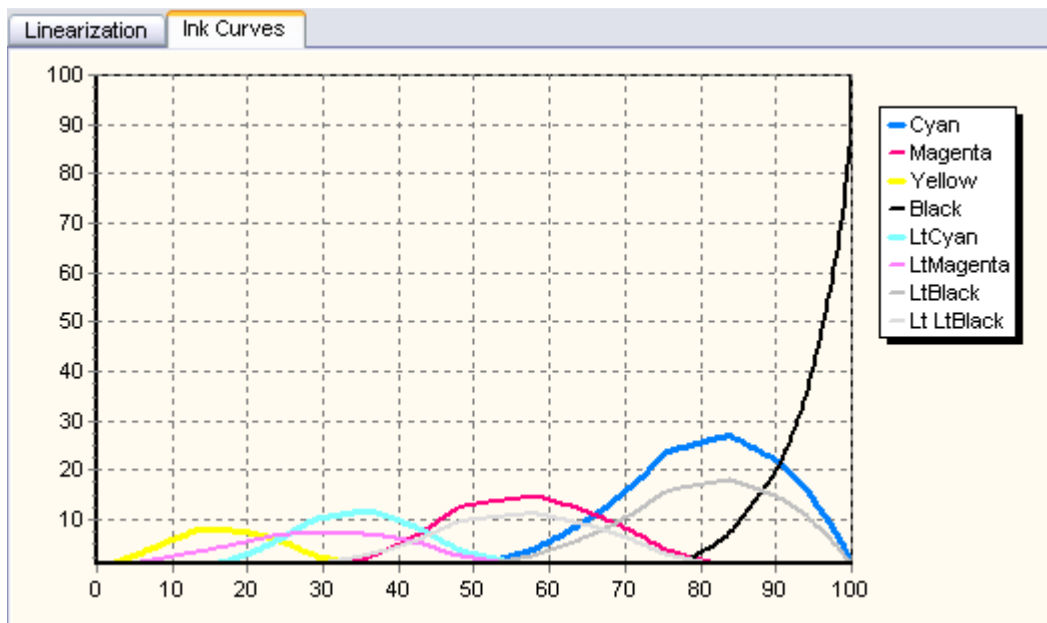

This approach may have the advantage of mixing up the starting points of, particularly, the LM and LC. The LM (6%) is light enough that it is visually dotless in the highlights.

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average them. On the other hand, having them be different might help with separating the starting points of some of some of the duplicated ink densities. I doubt more than 2 digit accuracy is ever needed here, and considerable slop appears to be tolerated by the QTR partitioning system.

I'm not sure anyone will ever notice the slight differences between the approaches above.[22]

The Curve Creator for the "toner" version of the Arches QTR profile is shown below.
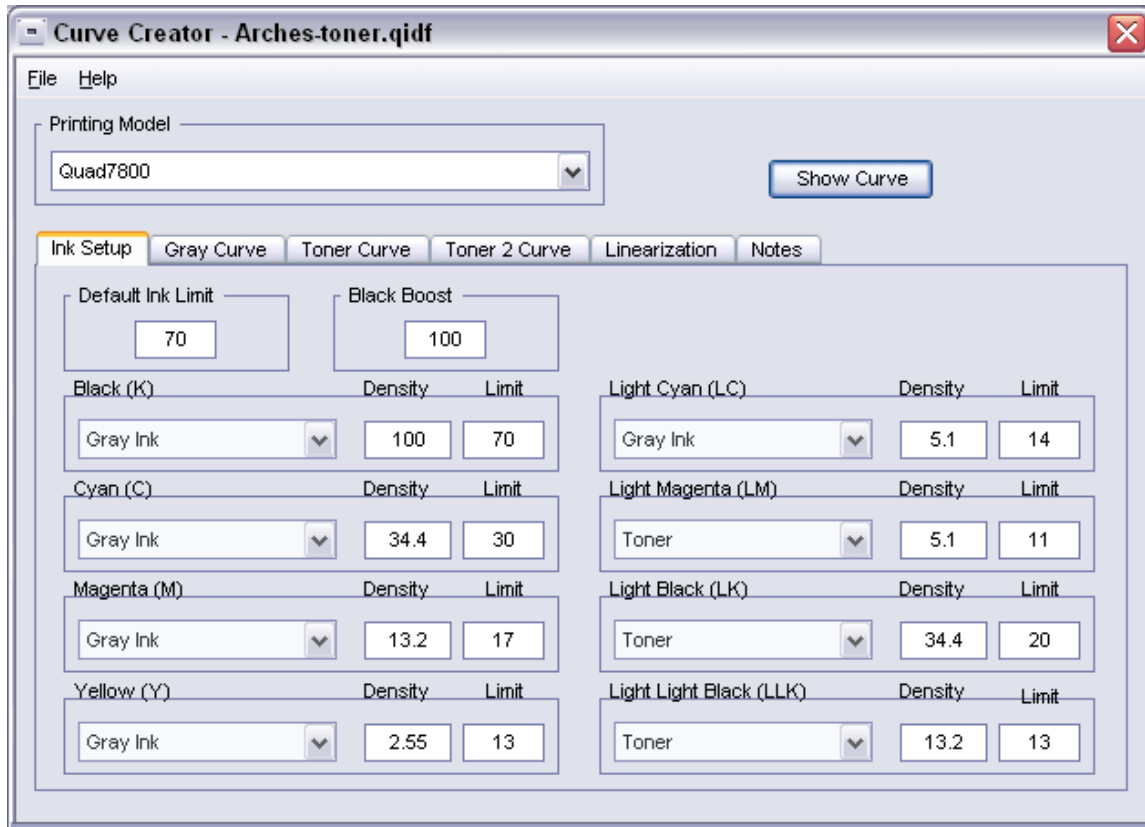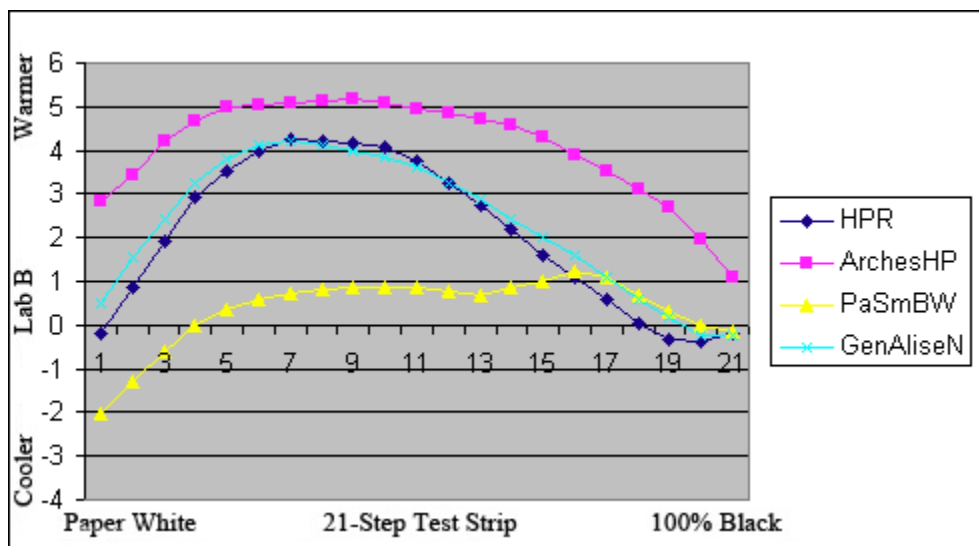

Print Tones

The print tones with Carbon-6, as is typical of all monotone inksets, are varied primarily by paper choice. The graph below shows the Lab B values for 21-step test strips.[23] The coated papers were printed with the Epson driver and the matte rgb curve (sometimes in an ICC). Premier Art Smooth Bright White (PaSmBW) is my standard paper for the most neutral-cool prints. Hahnemuhle Photo Rag (HPR) is a popular paper that prints with a distinct split tone and a high dmax. Premier Art's Generations Alise Natural

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[22] In the past I've recommended making multiple profiles where each uses only part of the inks. These can then be combined by using the sliders in QTR. This approach is probably the most flexible, but it also requires more work when re-linearizing.

[23] Lab B is the primary variable with respect to image tone. Lab A values are always positive and vary much less, following the trend of the Lab B values but with little actual change. As such, for simplicity, the Lab B values "show" the relative image tones of the various papers with good accuracy.

(GenAliseN) prints similarly to HPR, has no OBAs in it, and is about the only paper that can top HPR's dmax. The split tone gives the appearance of greater warmth on these papers; some think it also gives the appearance of greater depth and tonal separation.

Arches Hot Press BW was printed with the QTR profile, above. Note that while its Lab B is relatively high, the delta-B is low. That is, from the paper white to the maximum Lab B is only about 2.3 units. Our perception of warmth is as much from the change in Lab B as the absolute values. The eye will do a "white balance" on whatever references are around. If no bright white reference is close to the Arches print, it will look only slightly warm, based on the white balance of the paper and matte board and the relatively low increase in Lab B within the image.

In general, the relative print tones of this approach are similar to those described with the other Eboni/Carbon-6 inskets.[24]

[This is a work in progress. More will be added as I get more experience with the approach.]

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[24] For more information on tones, see http://www.paulroark.com/BW-Info/Eboni-6.pdf, http://www.paulroark.com/BW-Info/C88-C13-5.pdf, and http://www.paulroark.com/BW-Info/Eb1400.pdf.