

## 6K + LC & LM Inkset

### Epson 4000

(& Other Epson 8-ink printers with QTR support)

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(July 2012 update: Due to the weak 4000 matte dmax and the dearth of glossy papers without OBAs, I've pulled the Ebony MK and replaced it with a yellow ink for OBA control. This next step for me is written up at <http://www.paulroark.com/BW-Info/4000-5K-Plus-cmy.pdf>. All glossy profiles are interchangeable, but no more matte profiles are anticipated for this setup at this time.)

This carbon-based black and white inkset approach stresses maximum carbon pigment use, but with flexibility and print tone control. It gives full Lab A and B control from sepia to neutral-cool, allows printing on both matte and glossy papers, and, importantly for me, prints a 100% carbon-pigment image on Arches watercolor paper ("carbon on cotton") with the same image tone as Ebony-6 printed with an Epson 1400.<sup>1</sup> It does all this in a rather convenient and economical package.

All of the carbon inks are "off the shelf" MIS Associates/InkSupply.com carbon, and the color inks are standard LM and LC – open source and readily available. This setup uses very stable inks<sup>2</sup> and can produce the most stable output.<sup>3</sup>

The approach will only work with a "rip" ("raster image processor" – printer utility). QuadToneRip (QTR)<sup>4</sup> is the logical one for most B&W printers. I use a Windows 7 computer, and the PC/Windows QTR interface and method of printing are a bit different than that with Macs. My comments in this PDF are with respect to using QTR in the Windows environment.<sup>5</sup>

Note that this inkset approach and profiling are consistent with the standard K3 color inkset arrangement if MIS carbon is used. That is, any k3 printer that uses MIS glossy carbon inks as well as LM and LC inks that are similar to the Epson versions will

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<sup>1</sup> Ebony-6 remains the top choice for the most neutral 100% carbon inkset on matte inkjet paper. The glossy carbon used in the 6K+ inkset is quite warm on coated papers. Note also that the larger-drop printers make slightly more neutral carbon-pigment prints than do the 1.5 pl printers such as the 1400. See <http://www.paulroark.com/BW-Info/Ebony-6.pdf> for Ebony-6.

<sup>2</sup> Unlike Ebony-6, no agitation is needed in wide format printers. The MIS LK was more stable in my centrifuge testing than was the Epson K3 gray ink.

<sup>3</sup> Carbon pigments make the most stable image, and cotton based paper is the most stable substrate.

See <http://www.paulroark.com/BW-Info/Carbon%20on%20Cotton.pdf>

<sup>4</sup> See <http://www.quadtonerip.com/html/QTRoverview.html>

<sup>5</sup> For support with using QTR, see <http://tech.groups.yahoo.com/group/QuadtoneRIP/messages>. Note that Mac users can take advantage of the Windows GUI for making their own curves by running the QTRgui in a windows virtual machine such as VMware Fusion.

probably be able to use the QTR profiles that are generated, with only minor position changes and re-linearization. This inkset will simply have more carbon pigment positions for smoother printing. The basic approach, however, is to have a 100% carbon pigment core or backbone to the image and then tone as needed with standard, open source LM and LC inks, using the least possible color to maximize print lightfastness and color constancy.

### **Epson 4000, 6K Plus Ink Setup<sup>6</sup>**

Six 100% **carbon core** inks in descending order of density:

<i>Ink</i>	<i>Position</i>
Eboni MK <sup>7</sup>	MK
K4-PK <sup>8</sup>	PK (The 4000 has separate K positions but no LLK position)
UT7-C <sup>9</sup>	C
K4-LK <sup>10</sup>	LK
UT7-LC <sup>11</sup>	M
K4-LLK <sup>12</sup>	Y

Plus **color toners**:

<i>Ink</i>	<i>Position</i>
- LC <sup>13</sup>	LC
- LM <sup>14</sup>	LM

Ink location was influenced mostly by where pre-loaded, standard carts would fit.<sup>15</sup> Because the Epson driver will not work with this setup, being compatible with that driver was not a factor in determining ink position. Five of these inks are available in pre-

<sup>6</sup> See <http://www.paulroark.com/BW-Info/4000-5K-Plus-ver-1.pdf> for the version that uses an EZW ink and only 5 carbon inks. This version expands the carbon ink count to 6.

<sup>7</sup> [http://www.inksupply.com/ut7\\_7600.cfm](http://www.inksupply.com/ut7_7600.cfm)

<sup>8</sup> <http://www.inksupply.com/product-details.cfm?pn=K4-4-PK>

<sup>9</sup> [http://www.inksupply.com/ut7\\_7600.cfm](http://www.inksupply.com/ut7_7600.cfm)

<sup>10</sup> <http://www.inksupply.com/product-details.cfm?pn=K4-4-LK> or <http://www.inksupply.com/product-details.cfm?pn=MP-T5437-LK> for pre-loaded cart.

<sup>11</sup> [http://www.inksupply.com/ut7\\_7600.cfm](http://www.inksupply.com/ut7_7600.cfm)

<sup>12</sup> <http://www.inksupply.com/product-details.cfm?pn=K4-4-LLK>

<sup>13</sup> <http://www.inksupply.com/product-details.cfm?pn=MP-T5435-LC> for MIS LC;

<http://www.atlex.com/epson-ultrachrome-ink-light-cyan-110ml-for-stylus-pro-4000-7600-9600.html> for Epson version.

<sup>14</sup> <http://www.inksupply.com/product-details.cfm?pn=MP-T5436-LM> for MIS version;

<http://www.atlex.com/epson-ultrachrome-ink-light-magenta-110ml-for-stylus-pro-4000-7600-9600.html> for Epson K3.

<sup>15</sup> Newer Epson K3 printers may want the LLK in the LLK position. QTR profiles can usually have the positions of inks switched and work with a re-linearization.

loaded cartridges for the Epson 4000 (which uses 7600 carts). The others must be loaded into empty carts.<sup>16</sup>

There are no blends of more than one type of pigment in any position. Blends have been known to separate in wide format printers.<sup>17</sup>

This inkset approach is an update of one used successfully on the 7500 and 7600 in the past. As such, it is not an untested approach.<sup>18</sup>

The original purpose for this inkset was to be able to print neutral B&W images on glossy papers. No practical 100% carbon solution exists that can do this. The glossy carbon pigments that form the backbone of this inkset are, generally, warmer than the Eboni-based, matte paper pigments used in Eboni-6.<sup>19</sup> To offset the warmth of these glossy carbon pigments, Light Cyan and Light Magenta pigments are needed. These are open-source positions where any number of LC and LM inks can be used. For economy, MIS is recommended. For best longevity Epson LC and LM pigments are recommended.<sup>20</sup> I have the Epson pigments installed in my 4000.

The primary weakness in terms of lightfastness and longevity relates to the differential fading of the color pigments used. Carbon pigments are extremely lightfast. In selecting the Epson LC and LM, I relied on, among other things, accelerated light fastness tests conducted and published by Aardenburg Imaging & Archives.<sup>21</sup> The Epson pigments appeared to do extremely well on the papers that are the primary targets of this inkset.<sup>22</sup>

## Printing and Profiles

The only workflow I will use with this inkset relies on QTR. My QTR profiles will be posted at <http://www.paulroark.com/BW-Info/4000-6K-Plus-Profiles.zip> . I use the 4000 UC folder in QTR for the profiles.

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<sup>16</sup> See [http://www.inksupply.com/printer\\_products.cfm/p/Epson\\_Stylus-Pro\\_4000.html](http://www.inksupply.com/printer_products.cfm/p/Epson_Stylus-Pro_4000.html) for empty cartridges.

<sup>17</sup> See <http://www.paulroark.com/BW-Info/Wide-format-tone-shifts.pdf>

<sup>18</sup> See <http://www.paulroark.com/BW-Info/4K+.pdf>

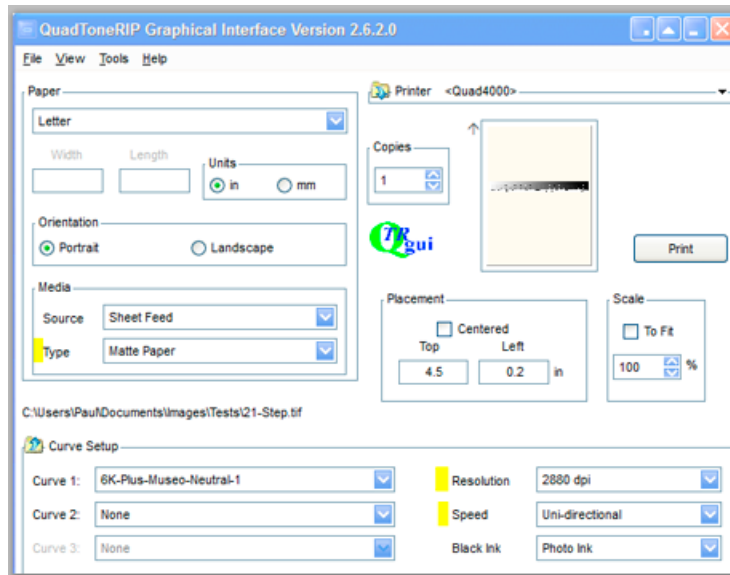
<sup>19</sup> Note however, that these MIS glossy carbons on Arches un-coated watercolor paper (my top fine art choice) are less than one Lab B unit warmer than Eboni-6 images on Arches. They are very similar, but only on Arches. (I have not tested other non-coated papers.)

<sup>20</sup> The generic pigment base mix will probably dilute the Epson M and C to make a more economical source of the LM and LC toners. See <http://www.paulroark.com/BW-Info/Ink-Mixing.pdf> and <http://www.inksupply.com/searchresults.cfm?q=c6b+base&x=12&y=4> for the pre-mixed base.

<sup>21</sup> See <http://www.aardenburg-imaging.com/>

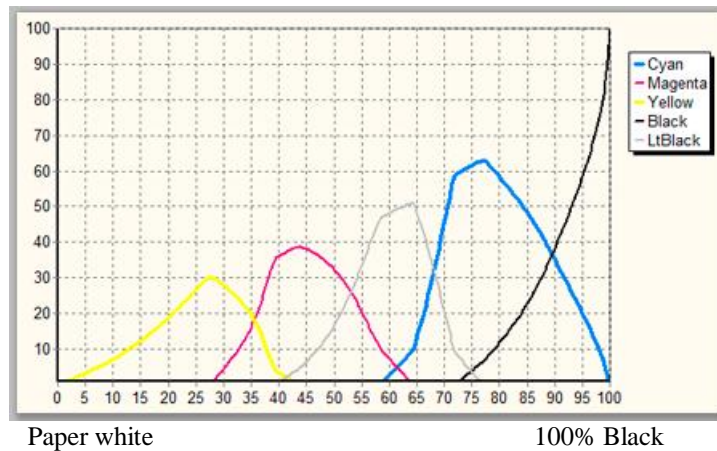
<sup>22</sup> On Museo Silver Rag paper, the Epson 4800 Magenta and Cyan test patches had I\* Color ratings of 100.0 (the top possible) after 100 Mlux-hrs of light exposure. As far as I know, this is the best performance for color pigments after that amount of exposure. There was no evidence of a green shift, as seen with third party neutralized carbon + color blended inksets. See Aardenburg-Imaging test sample # AaI\_20071218\_SN005.

The following highlighted settings are assumed for all profiles I make:

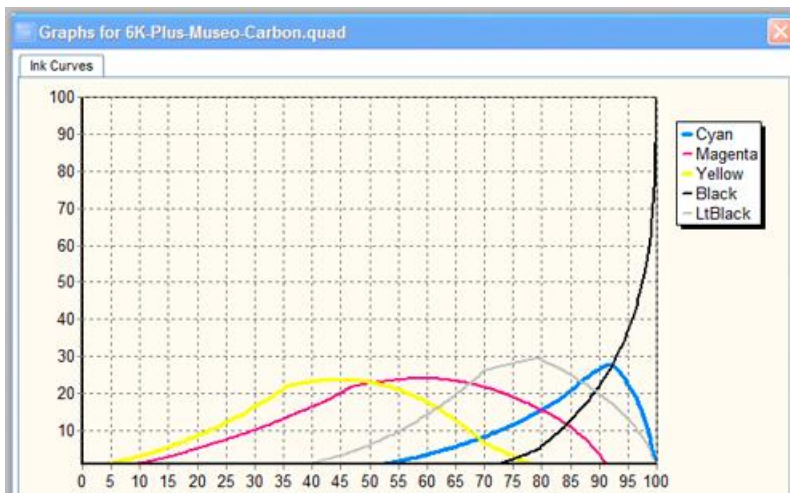


## Carbon Core Partitioning

I use two different styles for partitioning the carbon core or backbone of the inkset. The standard, single-channel, serial partitioning results in an ink distribution like the one below, which is for Arches watercolor paper.



On glossy papers, however, where printing artifacts may show more easily, I find that 2 parallel channels of carbon inks can often make a smoother print. The partitioned carbon core of such a profile, shown below, looks complex, but is actually rather easy to make. The first half of the carbon core is composed of a standard LLK (yellow position), LK, and K progression. The second half of the carbon core, the UT7-LC (M position in the 4000 setup) and UT7-C (C position) inks, are profiled as a “toner.”



The LLK-LK and UT7 LC-C parts of the carbon core must have their ink limits adjusted, as QTR does not automatically limit the total of the Gray and Toner channels (or manual curves) so that they do not overwhelm the paper. Simply cutting the dilute carbon ink limits in half is the simple way to do this. The ink limits can be further manually tweaked if necessary to get a reasonably good pre-linearization grayscale ramp, which is recommended.

### Color Toner Controls

Although the use of the standard QTR toner curves might work well for some papers and tones, for even, neutral color across the grayscale ramp I have found manually drawn color toner curves are usually needed. Specifically, for neutral prints, it is hard to get the deep shadows neutral with the built-in QTR toner shapes.

For simplicity, I recommend simply copying the toner curve points from a similar paper. From this starting curve the ink limits and minor individual point moves often appear to be sufficient.

Initially and sometimes for the final profile also, I just have the LM curve be a copy of the LC curve.

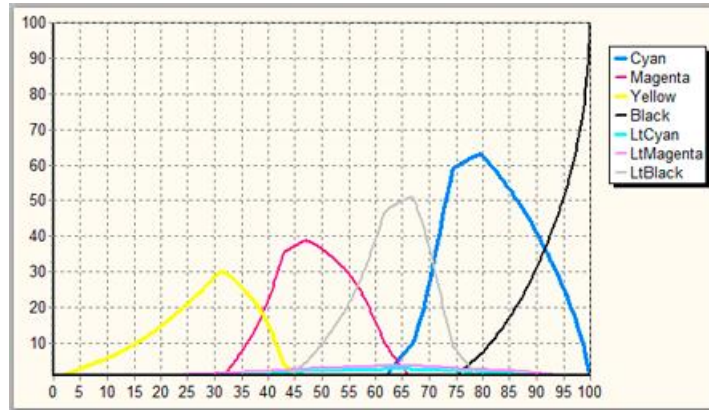
In profiling, I adjust the Lab B values first. Adding more LM and LC by increasing their ink limits cools the print – that is, it lowers the Lab B values.<sup>23</sup>

The Lab A values are initially controlled by the relative ink limits of the LM and LC. If the Lab A value is too low, increase the LM ink limit and lower the LC ink limit by the same amount. If the values need local adjustment, both of the color toner curves can be

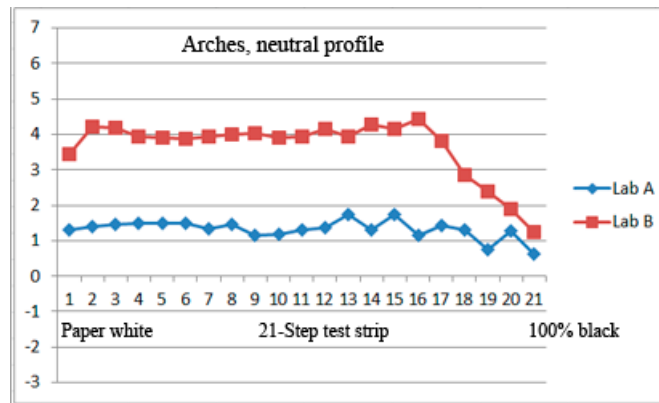
<sup>23</sup> If the QTR toner curves are used, the lower the “Density” number of the toner curve, the more the peak of the toner curve moves toward the paper white; higher Density values move the curve’s peak toward the black end of the scale.

separate point lists. That way individual points on the curves can be adjusted to correct local variances.

The amount of warmth and thus the need to use color pigments varies with paper type. On Arches watercolor paper the MIS glossy carbon is barely warmer than Ebony-6. It only takes a tiny amount of color in an Arches print to make a neutral looking print, and one that would be very stable. The QTR graph below shows the amount of color that is used in the Arches neutral profile. The LC and LM curves barely show.



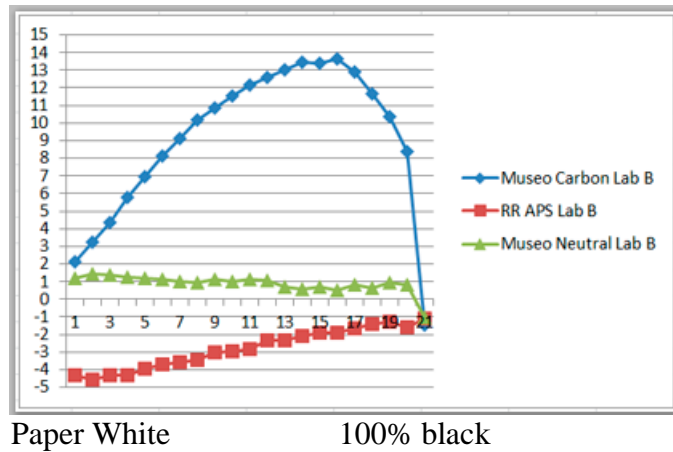
The print tones for this profile are shown below.



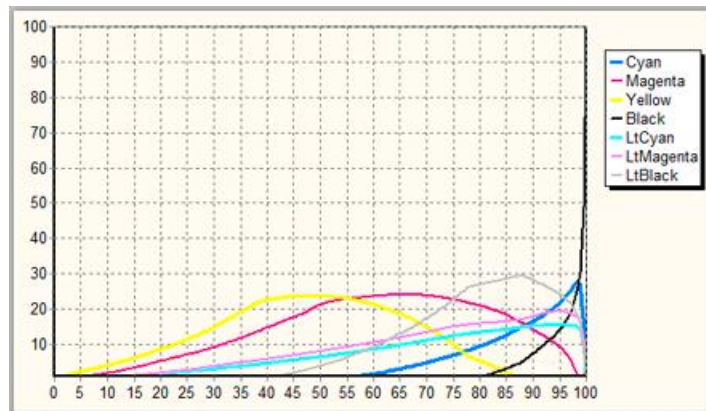
With most matte inkjet papers the 100% carbon images will be distinctly warm at about a Lab B = 8. The amount of color needed to neutralize these might have a proportionately higher likelihood of problems associated with color inks.

With glossy papers the 100% carbon image is a light sepia tone, with a Lab B = 14. So, the glossy papers need the most color to be neutral. So far, my profiling suggests that the standard LM and LC inks have sufficient gamut to neutralize the glossy carbon warmth on most papers. See the Lab B graphs, below, comparing the Museo Silver Rag 100% carbon profile, as measured by Lab B, with a Museo test strip make with a neutral QTR profile for Museo, and finally with the Lab B of a Red River Arctic Polar Satin neutral test strip, representative of a good paper with a brighten (high OBA) base. In each case the LM and LC were able to control the print tones without any sign of

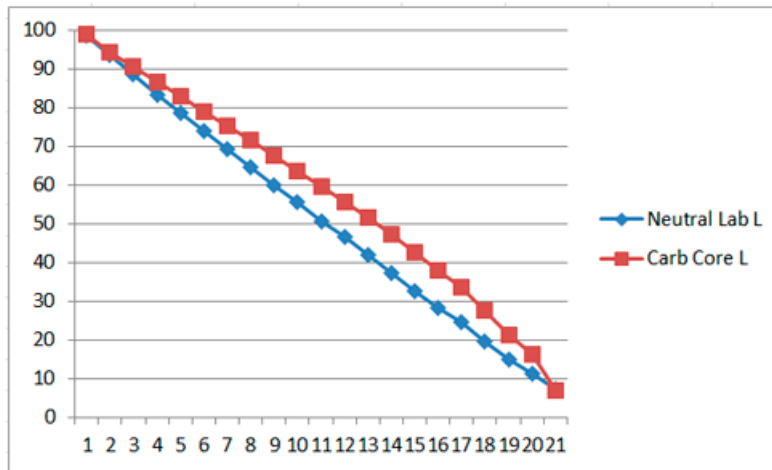
overloading the paper. As the graph, below, shows, glossy papers are capable of a huge range of tones with this inkset.



To get the neutral tone on a glossy paper, such as Museo Silver Rag, a fair amount of LM and LC is needed. See the QTR graphs below for the Museo neutra profile. The LM and LC ink lines use those colors. The LM peaks at an ink load of about 20 (vertical axis) at 95% black (horizontal axis).



The graph below compares the Lab L values of Museo test prints with and without the color toners in the profile mix .



Although the LM and LC density fade, by itself, may not be much of a risk, the tone shift due to differential fading of the two color toners could be significant over time. If the LM fades faster than the LC, the print will take on a green hue that most viewers find rather unpleasant. How well matched the LM and LC color pigments are in terms of their rates of fading becomes a significant issue for image stability.<sup>24</sup>

## Printing

My digital or scanned originals are either Adobe RGB or Gray Gamma 2.2, which is a subset of Adobe RGB. I prefer to keep my files in this most popular workspace. Because QTR is not a “color managed” workflow and uses a linear workspace that is different than Gray Gamma 2.2, the files I edit must be converted to QTR’s space in order to have the prints match the monitor’s relative density display. Although there are a number of ways to handle this issue, I use a Photoshop curve to convert the image. This curve, “GG22-to-QTR.avc,” is in the profiles zip file. I simply apply it to my final Tiff file for printing only, and save that file to the Desktop. There it can be dragged and dropped into QTR for printing (Windows platform). After printing I recycle that printing-only copy of the image file.

<sup>24</sup> Some black and white test prints have shifted into a negative Lab A (greenish) after the equivalent of only 3 years of typical commercial gallery light exposure. Repeating fn 14, on Museo Silver Rag paper, the Epson 4800 Magenta and Cyan test patches had I\* Color ratings of 100.0 (the top possible – no visible change) after 100 Mlux-hrs of light exposure. As far as I know, this is the best performance for color pigments after that amount of exposure. Paper and other factors can make a difference, of course. See Aardenburg-Imaging test sample # AaI\_20071218\_SN005.



## **Summary and Comparison to Eboni-6**

This glossy carbon plus standard color toners is a very flexible approach to both matte and glossy B&W printing. While it cannot print 100% carbon images on coated matte inkjet papers that are as neutral as Eboni-6, the coatings on these papers are likely to be the limiting factors in their longevity. On Arches or other non-coated papers, the glossy carbon is almost as neutral as Eboni-6. With a very small amount of color, a truly neutral image can be printed, and it will probably be more archival and stable, overall, than any coated matte papers. With the toners and being glossy compatible, this inkset can print any traditional B&W photo tone on any paper.

Other factors that affect practicality are that while Eboni-6 carts (but not MIS glossy carbon carts) must be hand agitated in wide format printers, the glossy carbons are not likely to be as clog-free as the dilute Ebon-6 inks, which do not need the binders that glossy papers require.

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