

“Ebony-4 Plus” B&W Inkset for the Epson 1400

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“Ebony-4 Plus” is a variation on MIS Associates’ Ebony-6, 100% carbon pigment black and white inkset.¹ Ebony-based carbon pigment inks in a somewhat traditional “quadtone” (4-ink) format provide the printing quality needed for fine art, 100% carbon pigment printing. This Ebony-4 arrangement, however, leaves room for two ink positions (LC and C) where cooler-tone inks can be installed. This, in turn, allows the inkset to print more neutral images on most matte papers. They can also print glossy photos.

MIS’s UT14 LC and C inks are readily available, compatible, cool glossy inks that work well in these positions and are the default starting inks for those who want to try this approach.²

I. Background - Lightfastness

MIS Ebony carbon remains at the core of my fine art printing largely because carbon pigments are the most lightfast, by far. See the table, below, summarizing comparable Aardenburg-Imaging fade test data.³ “Delta-e” measures the degree to which density and color have changed from the beginning of the fade test.⁴ Lower is better.

A. Delta-e at 60 Mlux-hrs Light Exposure

	Average	50% test patch
Ebony 3-MK, PA 205, Print Shield spray	0.2	0.2
Ebony 3-MK, H. Photo Rag (HPR)	0.3	0.2
Cone Carbon Sepia, Museum K, HPR	0.4	0.2
Epson ABW, HPR	1.0	1.6
HP Vivera, HPR, neutral only	1.1	1.4
Cone Neutral K6, HPR	2.2	2.9

The “Average” values, above, include the carbon black and paper white, which are more stable than blended carbon-color midtone inks. The midtone values, like the 50% test

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

² In addition to cool ink for more neutral printing, the two non-Ebony ink positions can also be filled with glossy compatible MIS PK and LK for sepia printing. Other alternatives are also discussed, below.

³ See <http://www.aardenburg-imaging.com/> for full reports. See also <http://www.paulroark.com/BW-Info/R1800-Lightfastness.pdf> for general information relating to carbon pigment lightfastness.

⁴ See http://www.colorwiki.com/wiki/Delta_E:_The_Color_Difference

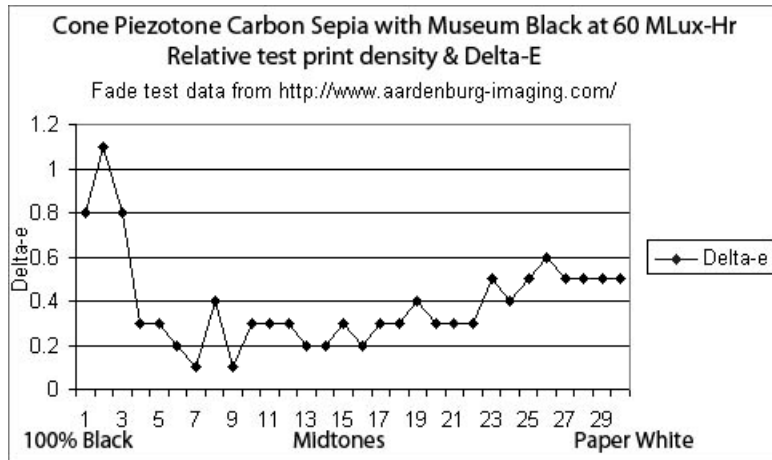
patch, are more representative of the relative degree of visual fade and tone change that will occur.

While Eboni-6 or Eboni-4, as such, have not been tested by a sophisticated third party tester, the 3-MK Eboni inkset appears to make the most stable images tested so far by Aardenburg-Imaging. Eboni-6 and Eboni-4 should be essentially the same, as it is simply Eboni carbon pigments at different ink loads/dilutions.

Unlike dyes and perhaps some color pigments, the more dilute versions of carbon pigments appear to be as stable as the denser suspensions. The chart below shows the delta-e values for Cone Carbon Sepia, which uses a full set of carbon inks at different dilutions.

B. Carbon Delta-e for different dilutions

From Aardenburg-Imaging test of Cone Carbon Sepia, with Museum black



Above, the “Museum” MK is the weakest ink in terms of hue and density stability.⁵

The paper white appears to be relatively weak compared to the midtone carbon pigments. The pattern suggests the changes in the paper are primarily responsible for the changes through the midtone and light values.

Among carbon pigments, Eboni has been my choice because it is the most neutral carbon pigment I’ve found. While carbon pigments are warm by nature, Eboni allows a range of print tones on matte papers from near neutral to medium warm, depending on the paper used.⁶

⁵ Cone Museum 100% black Lab L faded from 15.5 to 16.1. Eboni MK on PA 205 darkened from 20.5 to 20.3. On H. Photo Rag Eboni faded from 14.7 to 14.8.

⁶ Paper selection is how image tone is controlled with Eboni. On Epson Hot Press Natural the Eboni-6 Lab B, where an ICC is used with the Epson driver, has a Lab B rise from the paper white to the maximum Lab B of only 1.3 Lab B units. A one unite color difference in the Lab color scheme is “barely

Note that even if color toners are added to cool the carbon image, the more neutral the carbon core, the less color will be needed to achieve the final image tone. Thus while Eboni-4 on, for example, Epson Hot Press Natural has a hint of warmth, when C and LC are HP pigments⁷ the resulting print with the Epson driver and its default use of the color channels for a grayscale file result in an absolutely neutral print that would have stability about half way between 100% carbon and the HP results shown above.

“Carbon on cotton” (100% carbon pigments on buffered rag papers) remains my preferred medium for fine art printing. Any blended carbon + color pigment ink will have a lower display life because the color pigments fade faster and at different rates, causing tone shifts. On the other hand, while all of the popular, relatively neutral, dedicated B&W third-party inksets will tend to green-shift with age, they should last long enough for most uses aside from fine art and museum quality printing.⁸

The Eb4+ approach allows a very convenient structure for the type of printing that emphasizes matte prints that can vary between being the most stable possible to more neutral ones that will still be quite good. The inkset can also make glossy, neutral-cool prints for cards and brochures, where I think glossy works the best.⁹

Many of the workflows I use rely on QuadToneRip or ICCs made with QTR’s “Create ICC-RGB.”¹⁰

perceptible.” The Epson Hot Press and selected Premier Art papers are somewhat unique in their ability to print relatively neutral 100% carbon pigment images.

⁷ Hewlett Packard Vivera PK-based pigments from large Z3100/3200 carts are recommended for those who want the most lightfast glossy compatible or blended carbon-color prints.

⁸ The Cone Neutral K6 50% patch on HPR had shifted to a negative (greenish) Lab A in 30 Mlux-hrs of exposure, which is about 3.4 years of commercial gallery light level. On the other hand, assuming the the MIS UT14 inks are about the same as the Piezo, then averaging that with the Eboni results puts the combined inkset close to the OEM solutions. The neutral, blended carbon + color ink that shows the least color shifting, at least in the short and medium term, is the HP Z3100/3200 PK and its dilute forms. The Epson ABW approach is also about as stable as the HP inks. Eventually the color pigments in all blended ink approaches will fade, causing the image to warm.

⁹ If the very best fine art glossy prints are a primary goal, consider the use of HP Z3100 PK diluted with MIS Gloss Optimizer. This “HpGO” quadtone setup has worked well in an Epson 1100. See <http://www.paulroark.com/BW-Info/1100-HpGO.pdf>. For k3 printers, including my 7800, this could be set up with a “Dual Quad” ink arrangement. Standard HP ink could be used, but the HpGO setup eliminates the bronzing and is less expensive.

¹⁰ See <http://www.quadtonerip.com/html/QTRoverview.html>

II. Ink Positions

The standard Eboni-4 Plus setup¹¹ uses four Eboni-6 inks and two neutral-cool inks, which in the default setup are from the MIS UT14 inkset.¹² These inks are available from MIS pre-loaded for the Epson 1400 or in bulk.

K = Eboni (The standard MIS Associates carbon matte black ink)¹³

Y = EB6Y (A very light “LLLK,” 2% Eboni)¹⁴

M = EB6M (Similar in density to standard LK, 18% Eboni)¹⁵

LM = EB6LM (Similar in density to standard LK, 6% Eboni)¹⁶

C = UT14-C (A neutralized PK)¹⁷

LC = UT14-LC (A neutralized LK)

Note that the pre-loaded carts can be refilled from bulk bottles.¹⁸ If one is new to inkjet printing, starting with pre-filled carts is a good idea.

(Be sure to remove the tab – usually yellow – on MIS cartridges that block the air intakes before installing the cartridges.)

For alternatives to this standard ink setup, see Appendix A, at the end of this PDF.

¹¹ In addition to this 1400 setup, the Epson WorkForce 1100 has an Eboni-4. The 1100 is less expensive, but it is not supported by QTR, which is needed for some uses, such as printing Arches uncoated watercolor paper. Note also that the 1100-Eboni-4 inkset uses different positions & names for the 2 medium dilution inks. Eb6-LM (6% Eboni) = 1100 Eb4-M. Eb6-M (18% Eboni) = 1100-Eb4-C.

¹² In my personal 1400 I have also used Eb4 + Noritsu-Epson dyes in the C & LC positions for high gloss prints. See <http://www.paulroark.com/BW-Info/BW-Dye.pdf>.

¹³ See http://www.inksupply.com/partnumber.cfm?action=search&search_part_number=EB6-T0791-K for a cartridge of Eboni K. UT 14 K is also Eboni.

¹⁴ See http://www.inksupply.com/partnumber.cfm?action=search&search_part_number=EB6-T0794-Y

¹⁵ See http://www.inksupply.com/partnumber.cfm?action=search&search_part_number=EB6-T0793-M

¹⁶ See http://www.inksupply.com/partnumber.cfm?action=search&search_part_number=EB6-T0796-LM

¹⁷ For UT14 inks, see http://www.inksupply.com/ut14_black_and_white.cfm

¹⁸ For bulk Eboni-6 see <http://www.inksupply.com/eb6.cfm>; for UT14 see http://www.inksupply.com/ut14_black_and_white.cfm

III. Printing Workflow Options

For 100% carbon Ebony-4 prints QuadToneRip (“QTR”) is needed. QTR can also optimize the ink limits and thus maximum blacks better than the Epson driver can. On the other hand, the Epson driver, particularly when used with ICCs made with QTR’s “Create ICC-RGB,” makes a very easy workflow that can handle almost all situations aside from the 100% carbon printing, and even here, a profile that cuts out the blended C and LC positions as much as possible uses very little of them and is a lot easier for most people.¹⁹ Using these ICCs is the recommended printing procedure or workflow for those who are not familiar with QTR.

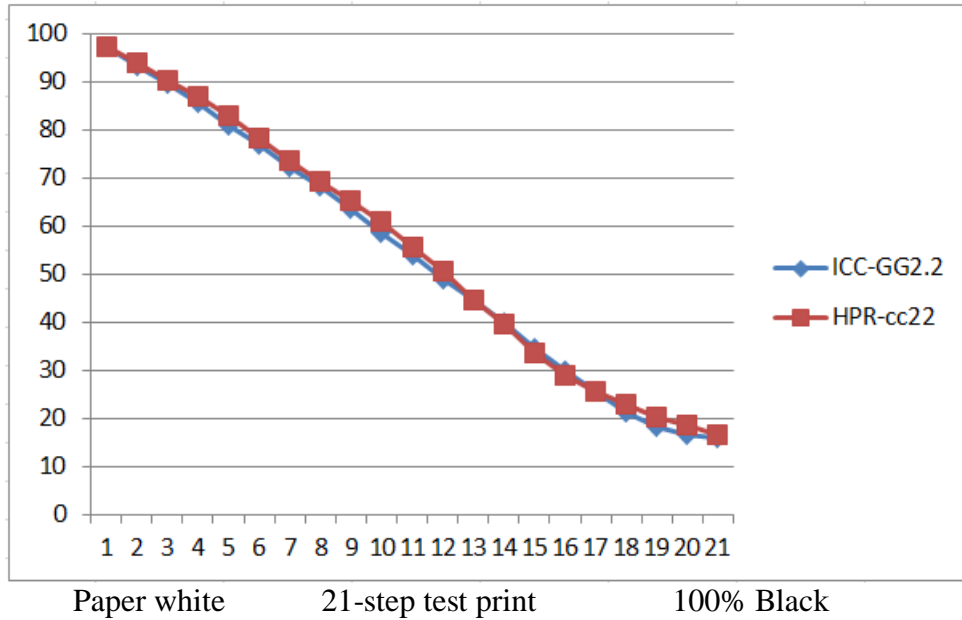
A. Epson Driver Workflows

1. Matte Paper, Epson Driver, Color Controls, Gamma 2.2

If one uses no special profile, curve, or ICC, the Epson driver with its built in “Color Controls” prints quite well. If one edits in workspace Gray Gamma 2.2, which is the most common and a subset of Adobe RGB and sRGB, the Epson driver will make a print that corresponds closely, in terms of relative densities, with how the file is displayed on the monitor. ICCs in a “color managed” workflow do this more precisely. We can graphically compare the Lab L readings of 21-step test prints where one used just the Epson driver set to “Color Controls” and “Gamma 2.2” and the other test print used an ICC, which can be considered the ideal for comparison. The results of such a comparison are shown below. They look very much the same.

¹⁹ I have attempted to determine the amount of color ink in the image when the Epson driver is used to print an image with as much carbon as possible. I thought that I could simply look at the Lab B results of an Epson driver print compared to a QTR 100% carbon print. If a significant amount of color ink was in the Epson driver image the Lab B would be lower in the deep shadows where the “red” curve (which controls the cyan channel, where the color inks are blended into the UT14 C and LC) must be used to turn on the black ink. The Lab B graphs are at <http://www.paulroark.com/BW-Info/Eb4+MaxCarb-EpsDr-v-QTR.jpg>. There is no evidence in these graphs of any color ink being used. Obviously there must be some, but the amount may be so little as to be outweighed by the other variables. As such, I’d say the effect of the small amount of color pigments in the deep shadows will have no significant effect on the image.

Lab L, H. Photo Rag, Epson Color Controls, Gamma 2.2 (HPR-cc22)
 Compared to ICC and Gray Gamma 2.2 (ICC-GG2.2)



The driver settings used for the non-ICC print included:
 Paper type = Ultra Premium Presentation Matte,
 Quality setting = Photo RPM,
 High Speed Not checked,
 Color Management = Color Controls, Gamma 2.2,
 Sliders at default zero position.

Note that in the latest Photoshop software the “Print” screen will need to be set to “Printer Manages Colors.” Check the driver settings to be sure they did not revert to ICM/No color adjustment.

The print tones for the matte papers will vary somewhat depending on how those papers react to carbon pigments. With most papers there will be a slight split tone, with light mid-tones being quite neutral and shadows being cooler.

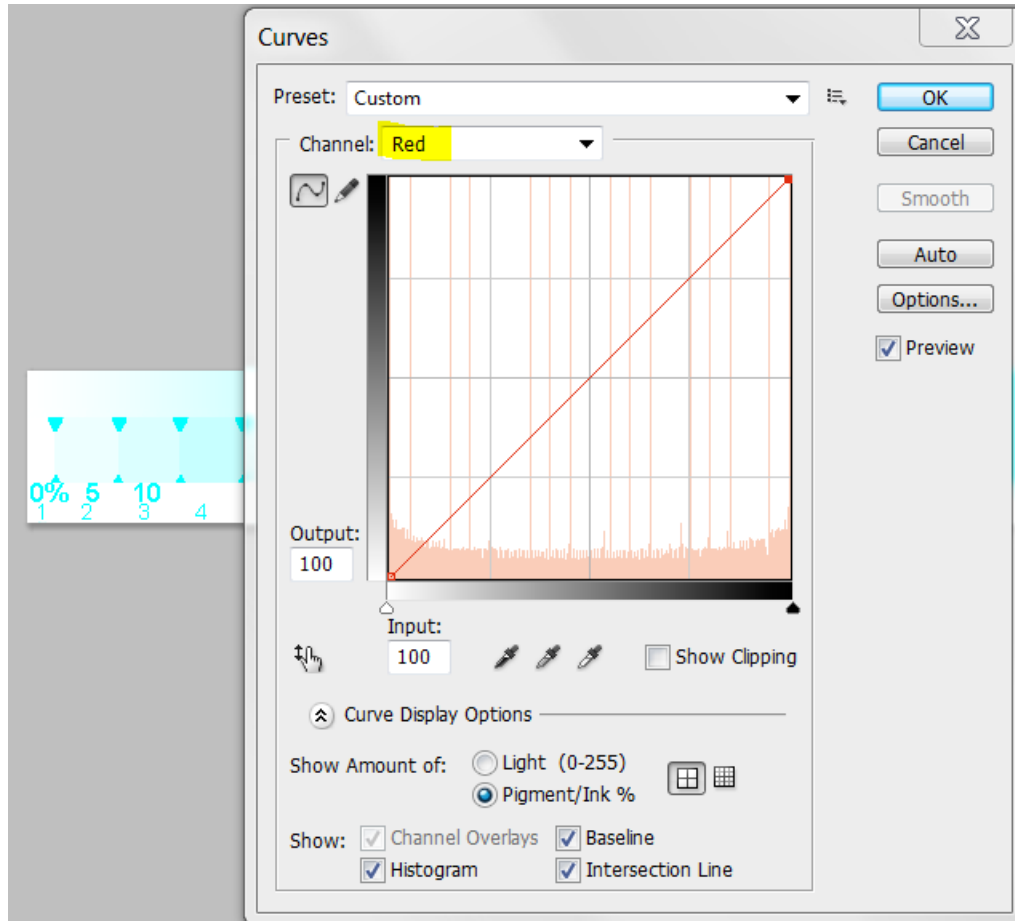
The bottom line, however, is that this inkset will print a good neutral-cool image on most matte papers with no profile at all aside from what is in the Epson driver itself.

2. Glossy Paper, Epson Driver, Photoshop Curve

Glossy paper cannot be printed without some profile aside from the Epson driver controls. Since the glossy-compatible inks are limited to the cyan channel – C and LC

positions – a Photoshop curve that prints only those inks is required. When an ICC is used, such a curve is simply embedded in the ICC and then linearized.²⁰

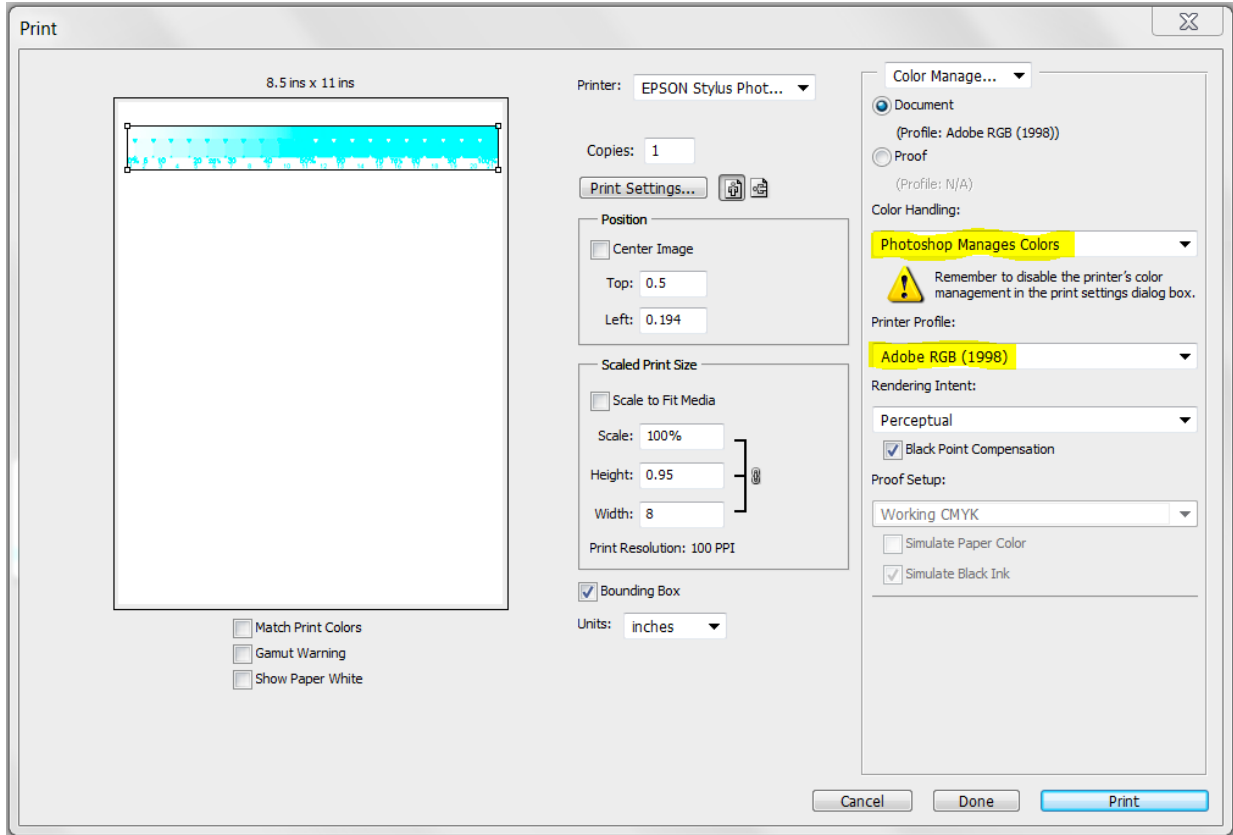
The basic Photoshop curve is shown below. The file must first be converted to Adobe RGB. (In an ICC, this is done automatically. So, if an ICC is used, the working file would normally be a grayscale file.)



The green and blue curves are pulled down from the top right to the bottom right to turn those channels off. All that is left is a straight line red curve. This results in a cyan image that will print with only the cyan inks – which in the case of the default Eb4+ arrangement are neutral-cool, glossy compatible UT14 C & LC inks.

²⁰ See http://www.paulroark.com/BW-Info/Embedding_Photoshop_Curves_in_ICCs.pdf

In the Photoshop print preview, the following settings are needed if only a curve is going to be used to print the image. (If an ICC were used with a grayscale file, the ICC would be pulled up in the Printer Preview box where Adobe RGB (1998) is shown.)



The appropriate Epson driver settings for glossy printing include:

Paper type = Premium Photo paper Glossy,
Quality = Photo RPM,
High Speed Not checked,
Color Management = ICM, “No Color Adjustment” checked.

With these settings, Epson Premium Photo Paper Glossy prints with a ramp that is not exactly the same as an idealized Gray Gamma 2.2 ramp, but is nevertheless quite good.

With the Epson driver pigment inks have a somewhat modest but still acceptable d_{max} . QTR would be able to achieve a better d_{max} .²¹

²¹ With the Epson-Noritsu dye inks in the C and LC positions the d_{max} is outstanding. The printer driver was, of course, designed for Epson Claria dyes, and I believe the Epson-Noritsu dyes are the same as Claria.

3. Epson Driver – ICC in Print Preview

The use of an ICC that is specifically made for the paper and target print tone results in a “color managed” workflow that produces a print that will have the same relative densities as are displayed on the calibrated monitor.²² To use these ICCs, Photoshop (PS) or Elements image editors are recommended.²³ The ICCs are loaded in the Print Previews of PS or Elements. These ICCs are easy to make using QTR’s “Create ICC-RGB.”²⁴ This program is part of the QTR download. To download this program, go to <http://www.quadtonerip.com/html/QTRdownload.html>. The QTR software is not needed to use the ICCs. However, learning to make custom ICCs is a very good route to improving one’s B&W printing skills, and it’s easy.²⁵

When ICCs are used, Photoshop CS5 and other new software often require that the printer driver be set to “ICM/No Color Adjustment.” At this setting, if no profile is used, the gap between 95% and 100% black is too large. To adjust for this a generic curve has been made that will allow most matte papers to print a good grayscale ramp with the “No Color Adjustment” (“NCA”) setting in printer driver. This “Matte-GS” curve (version 2 is best when UT14 C and LC are used) results in a curve that linearizes well in Create ICC-RGB. (The “GS” indicates that in the RGB curves set, R=G=B.)

With this curve most papers have cool shadows. To get a tonal response that does not have this cool shadow area, curves and ICCs with the “N2” through “N5” designations should be used. They are in the Profiles Zip file, noted below.

ICCs are made for specific print tones and papers, and the printer driver must use the same settings as were used when the ICC was made. As such, the name of the ICC should include the printer, inkset and paper name, as well as the critical Epson driver settings if they are not standardized. All of the ICCs and curves I’ve made for this inkset use the best (“RPM”) quality settings and “No Color Adjustment.” As such, these settings will not be in the ICC name. However, the ICC name may include the paper type, although “Ultra Premium Presentation Matte” is assumed for all matte papers.²⁶

²² ICCs can also be used to “soft proof” the print tones, depending on how they are made, but that is beyond the scope of this article.

²³ I am not certain what other applications may or may not be able to use these ICCs. I use Create ICC-RGB in all cases, in part, because the RGB ICC should be recognized by more applications.

²⁴ Briefly, the simplest ICCs are made with Create ICC-RGB by printing a 21-step test strip and taking the Lab L or density readings from that test strip to, in effect, tell the printer how to match the monitor. Most of the ICCs I make, however, also contain a PS image adjustment curve to control how the inks are used.

²⁵ See http://www.paulroark.com/BW-Info/Making_B-W_ICCs-GrayCard.pdf

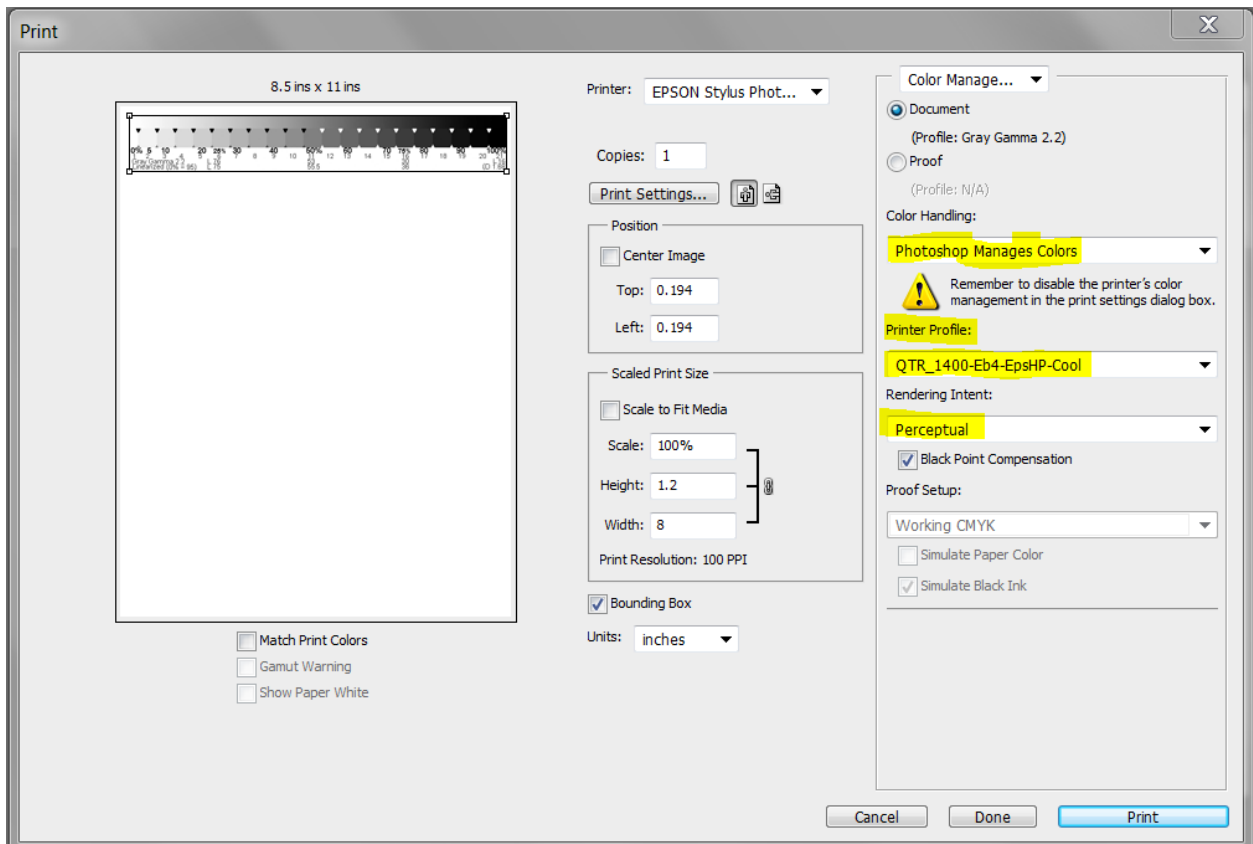
²⁶ “Premium Photo Paper Glossy” paper type is assumed for all ICCs for the Noritsu C-LC inks.

The **printer driver settings for matte papers when an ICC is used** generally include the following:

Paper type = Ultra Premium Presentation Matte,
Quality = Photo RPM,
High Speed Not checked,
Color Management = ICM, No Color Adjustment checked.

My Eb4+ profiles, including ICCs as well as QTR profiles and some ACV Photoshop curves, are posted at <http://www.paulroark.com/BW-Info/Eboni-4-Plus-Profiles.zip>. While these PS curves may specify a specific paper, they are usually flexible enough to be used with other similar papers. The linearization step in making an ICC takes care of most of the differences between, for example, matte papers.

The ICCs are loaded in the print preview, as shown below (Photoshop CS5).



Note that whether “Black Point Compensation” is checked or not does not appear to make any difference. Elements does not even have the option.

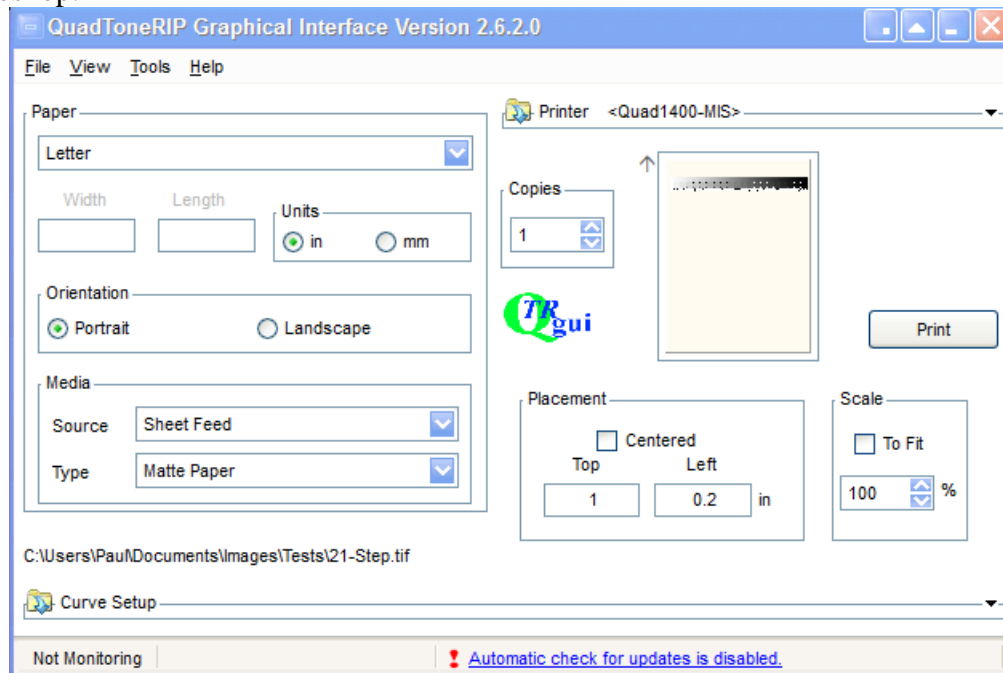
When one makes an ICC the use of a spectrophotometer to read the test strip is ideal, but one can also use a flatbed scanner for this purpose,²⁷ and possibly even a digital camera.²⁸ I use a ColorVision Print Fix Pro spectro.²⁹

As noted previously, I most often embed PS curves in the ICCs to control the inks. For example, the Epson Hot Press Cool ICC shown in the example above has the Eb4HP-Uppm-N.acv curve embedded in it.³⁰

B. QuadToneRip (QTR)³¹

QTR provides the most control and flexibility. It is the only way to print Eb4 with 100% carbon, and its ability to fine tune ink limits also often results in a slightly better dmax. For printing on uncoated watercolor paper, such as the classic Arches uncoated Hot and Cold press papers, the use of QTR is essential. As noted further below, the ability to blend different profiles allows QTR to print with tones that cannot be duplicated with the Epson driver.

I use Windows, so the following is based on the Windows QTR interface/GUI. With Windows, QTR must be used as a separate program as opposed to printing directly from Photoshop.



²⁷ See http://www.paulroark.com/BW-Info/Making_B-W_ICCs.htm

²⁸ See <http://www.paulroark.com/BW-Info/Linearization-with-camera.pdf>

²⁹ See <http://www.paulroark.com/BW-Info/Spectro.pdf>

³⁰ See http://www.paulroark.com/BW-Info/Embedding_Photoshop_Curves_in_ICCs.pdf for information on embedding Photoshop curves in ICCs. See also <http://www.paulroark.com/BW-Info/Eb6-C6-curves.pdf>

³¹ <http://www.quadtonerip.com/html/QTRoverview.html>

1. Making QTR Profiles

The Eboni-4 Plus inkset can be thought of as three separate monotone inksets: medium warm matte (Eboni-4 only), cool-neutral matte (LC, C, and Eboni), and cool-neutral glossy (LC and C). For matte papers, the medium warm and cool-neutral profiles can be combined in a flexible manner via the QTR “Curve Blending” sliders.³²

For each of the three separate “inksets,” above, multiple inks are used, and they must be “partitioned” such that only the lightest inks are used to print the lightest image values. The “cross-overs,” where a lighter ink reaches its maximum density and turns over the task of printing darker values to the next denser ink, have to be coordinated carefully. QTR includes a semi-automated system to do this based on the relative printing densities of the inks. While manually drawn curves can do this, QTR’s approach makes the job vastly easier and usually better than manual curves can accomplish.³³

Profiling an inkset for a specific paper requires three basic steps: first, determine the ink limits; second, rate the lighter inks’ printing densities relative to the black ink at its ink limit; and third, linearize the initial profile to perfect and smooth the final printing curve or grayscale “ramp.”

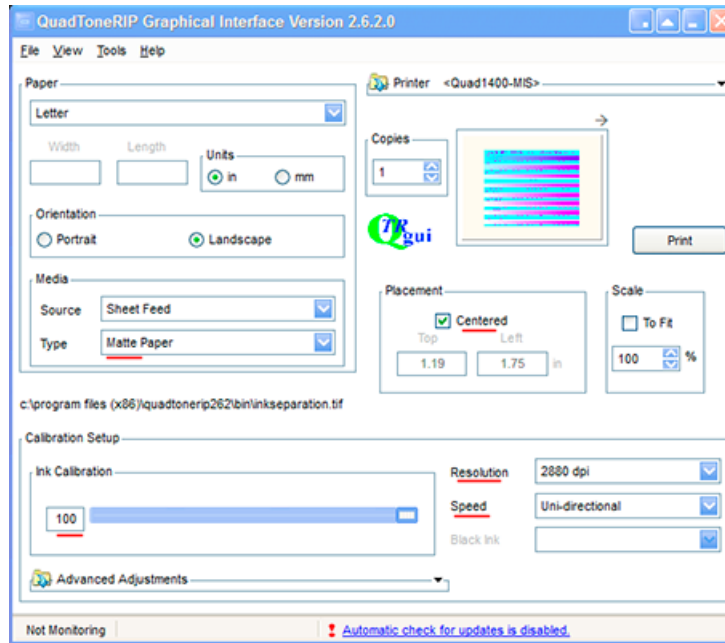
a. Ink Limits

As more ink is put onto the paper, the incremental increase in print density per unit of ink declines and actually decreases as the ink receptor coating is flooded or pores clogged. Well before the peak density an ink can achieve on a paper, the quality of the printing starts to decrease. Where one decides to set the “ink limit” for a particular ink on a particular paper is a judgment call. I often use a shortcut, described further below.

The first step in determining the ink limits is to make a “Calibration mode” print (Tools>Options>Calibration mode). The “Ink Calibration” slider should be at 100. I use 2880 Uni-directional for the quality settings.

³² The Eboni MK or C-position inks can also be profiled with a one-ink “black only” profile, but I prefer the smoothness that the more dilute inks provide. The toner channels could also be used. However, they are probably better used when color inks are used to make a warm carbon K3 inkset more neutral. With low gamut monotone inksets the coordination of the ink limits with the slider approach becomes more significant. With monotone inksets the toner channels can also be used to obtain more overlapping inks. There the ink limits can be manually split among the channels. One advantage of using the toner channels is that re-linearization is done with a single test strip.

³³ I make manual partitioning curves in Photoshop where QTR does not support the printer with the RIP part of the download package. The PS curves can be embedded in an ICC with QTR’s Create ICC-RGB. See page 3 of <http://www.paulroark.com/BW-Info/1100-HpGO.pdf> for an example.

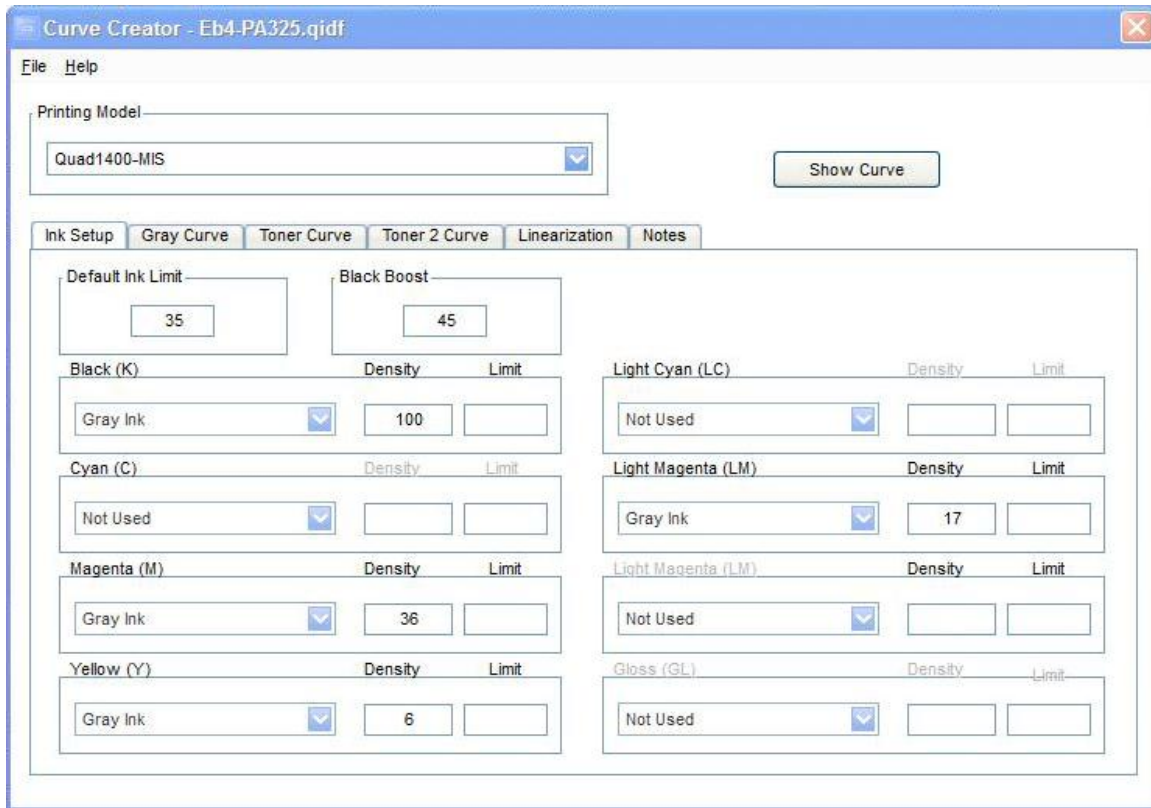


I determine the black ink limit first and use that as the default in limit, which will be used by all other inks if no specific ink limit is set for the other inks.

Once the print is thoroughly dry, measure the Eboni MK steps (for matte papers) or C-position steps (for glossy papers) to see which one is darkest.³⁴ That determines where the d_{max} (maximum print black density) is reached. One can use this number or, because there is always a relatively low final slope, one might use 10% less as the ink limit and then set the “Black Boost” to the patch number that resulted in the maximum density. The Black Boost puts a steeper slope at the end of the black ink curve. This often results in a straighter initial curve and better linearization. It also allows one to adjust this boost without affecting the rest of the profile.

In the “Curve Creator” (Tools>Curve Creation) screen grab shown below the densities of the black ink Calibration mode print increased only slightly from 35% to 45%. So, 35 was set as the default ink limit and 45 was put in the Black Boost box. Because no separate ink limit number was put in the Black in Limit box, the Default Ink Limit will be used for it.

³⁴ A spectrophotometer or similar instrument (“spectro”) is the preferred method, but a scanner or even a digital camera can be used to compare densities.



For the midtone inks, the ink limits are a judgment call. Inspect each one carefully to see where artifacts start to appear. Too much ink will bleed and can cause roughness and micro-banding. In general, I try to keep the midtone ink limits low enough that the inks are still well separated and not into the final, relatively flat parts of their curves. With a printer like the 1400, heavy use of the midtone inks is not needed for smoothness. It often works well to simply use the K ink limit or dmax point as the midtone ink limit. That is, just set that as the default ink limit and leave the midtone ink limit boxes blank. Denser ink virtually always hit their ink limits before more dilute inks, so using the black ink limit for the others is safe and well below what could be used. It's an easy and fast shortcut that works well with the 1400. On the other hand, sometimes the use of more light Eb6-Y ink makes the final print more neutral. One the Epson Hot Press Natural profile, for example, I use a Y-position ink limit of 75.

b. Densities

The “Densities” entered in the Curve Creator are the relative densities compared to those of the black ink when the black ink is printed at its ink limit. To print the black ink at its ink limit, one can print a second Calibration mode print, but this time with the Calibration slider set to the black Ink Limit number (not the Black Boost).³⁵

³⁵ Alternatively, one can print a 21-step test file (<http://www.paulroark.com/BW-Info/21-step.jpg>) with a straight line curve that uses the black ink limit. See, for example, the K-0-34 profile in the Profile Zip file.

The black ink density is always 100.

For glossy papers, set the C ink density to 100. The K (Ebony MK) ink is not used. QTR will recognize that the C is now the black ink.

So, the first step is to print a black ink test file with the black ink set to its ink. This gives us patches of black at the 5% steps. This test print is what the midtone ink limit test patches will be compared to.

Measure the densities of the midtone inks at the limits selected for them. For this, look at the first Calibration mode print, the one made with the slider at 100. These densities are compared to the K densities. The number entered in the Curve Creator is the K test strip patch number or, usually, a number between patches that is derived by estimating what K percentage would have resulted in the density that matched the midtone ink's density at its ink limit. For example, in the sample above the M ink at default ink limit 35 was just slightly above the K density at its 35% patch. So, "36" was entered as the density number for the M ink.³⁶

When all the relative densities have been filled in, and the profile is saved with an appropriate name (inkset and paper indicated in the name), the partitioned curves can be seen by clicking on the "Show Curve" button on the Curve Creator.

c. Linearizing

The final step in this profile building is to linearize the initial curves set. To do this a 21-step test file is printed with the profile, and the Lab L values from this test strip are entered into the Curve Creator's Linearization tab boxes.³⁷

As discussed with respect to ICC linearization, I use a ColorVision/DataColor Print Fix Pro spectro to read test strips.³⁸ It outputs a text file³⁹ with a Lab L column that I can simply copy and paste into QTR's linearization tab. I usually open the text file with Excel so that I can graph (Insert>Chart>Line) the results to see if the pre-linearization

Open that curve in the Curve Creator and push the "Curve" button next to the K ink to see how these curves are made.

³⁶ I have not measured the accuracy that QTR requires in these relative density calculations. The system appears to be rather tolerant of estimates. I suspect 2-digit accuracy is sufficient.

³⁷ Be sure the boxes in the Linearization tab are empty when the initial 21-step test print is made.

³⁸ As discussed on page 11, a flatbed scanner and maybe even a digital camera can be used for linearization. See <http://www.paulroark.com/BW-Info/Spectro.pdf> for a brief discussion of how I use this instrument.

³⁹ The text file is saved to C:\Users\Paul\AppData\Roaming\Datacolor\Spyder3Print\Data\Export. To make it easier to get to this folder, I put a shortcut on my Desktop.

Lab L curve is relatively smooth. A sharp bend in the graph often means the linearization will not be very good; there is some problem with the profile.⁴⁰

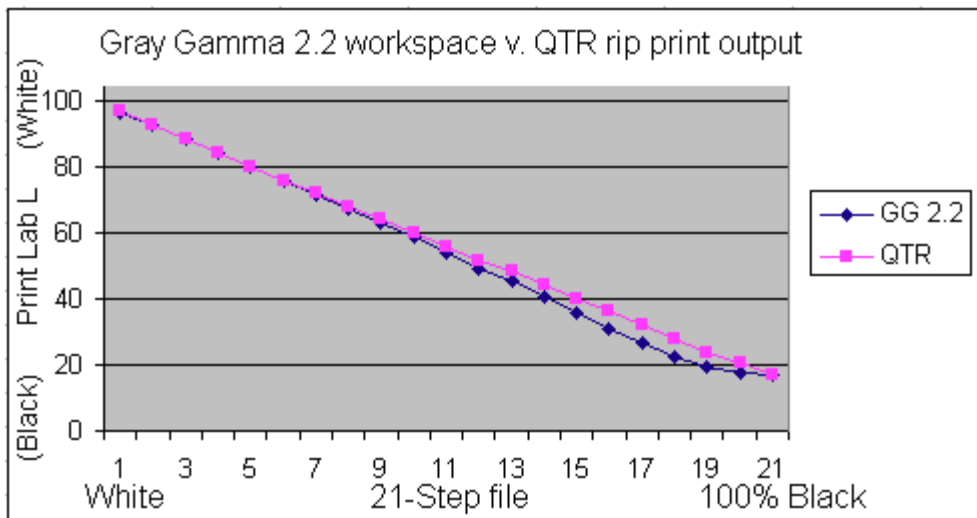
2. Printing with QTR – Windows

I use exclusively Windows computers. With Windows, QTR acts as an independent printer utility. Macs have different printing workflows.

a. Matching the Monitor and Print

QTR is not, in and of itself, “color managed.” That is, it does not automatically adjust the output to match the working space or embedded profile of the image file such that the relative densities displayed on the monitor will be reflected in the print.⁴¹ QTR prints with a straight-line response or characteristic curve. None of the common working color spaces use this density distribution. I usually save a Tiff file to the desktop that has the print size and other final printing adjustments to it. QTR prints only grayscale Tiff files (and Jpegs for later QTR versions). Files are flattened, profiles ignored, and 16 bit files are converted to 8 bit for printing.

As discussed earlier, the most common gray working space is Gray Gamma 2.2. The graph below shows the difference in relative densities between how a Gray Gamma 2.2 (“GG 2.2”) file will look on the monitor and print with a color managed system, versus how it will print with QTR.



⁴⁰ Also, ample deep shadow information (i.e., compressed shadows) helps the program result in a smooth final curve. The shadows are often where most difficulties exist; actual information down there, as opposed to interpolation, helps.

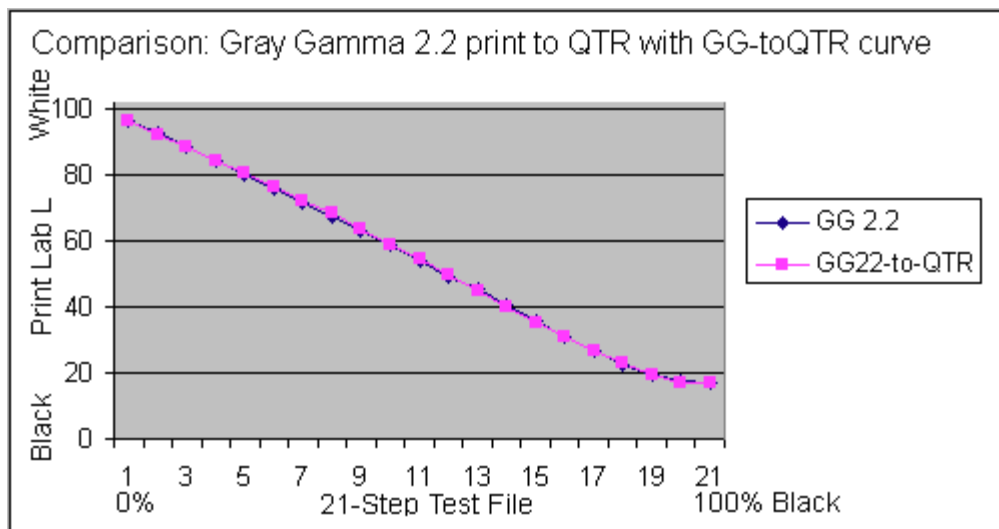
⁴¹ Mac users can insert matte or glossy QTR ICCs in the PS Print Preview to get the advantages of color management with QTR. Windows does not support this type of printing.

If a file is edited in Gray Gamma 2.2 it will not result in a print from QTR that looks like the monitor. Because the GG2.2 shadows are compressed and QTR shadows are linear, a GG2.2 file will appear lighter and perhaps lacking in good blacks when printed with QTR.

There are two basic approaches to matching the monitor’s display and QTR print. First, if QTR printing is the primary objective one has in editing a file, it may make sense to edit the file in a manner that it will print with QTR and look like it did on the monitor with no further conversions or modifications to the file. The QTR download includes ICCs that can be used for this purpose. These are located in the /QuadToneRip/ICC folder. There is also a Readme file in the /QTR/ICC folder that explains the use of the ICCs. When I was editing only for printing with a rip like QTR, I used the soft-proofing approach (View>Proof Setup>Custom). I no longer use these approaches.

Second, if QTR printing is just one of several expected uses of the file, it might make sense to edit the file using the, de facto, standard working space – Gray Gamma 2.2 – and then adjust a copy of the file as needed to print with QTR only when ready to print. One method of doing this is to convert the file (Edit>Convert to)⁴² to the Gray Matte or Gray Photo spaces, for matte or glossy papers, respectively, with the QTR ICCs.

Alternatively, one can apply a Photoshop image adjustment curve that makes this conversion. This is what I do. The graph below compares the matte paper print densities (Lab L, technically) resulting from, first, a color-managed workflow where the file used the Gray Gamma 2.2 working space and the printer was color managed with a custom ICC with, second, a QTR workflow where the “GG22-to-QTR.avc” curve was applied to the file before printing with QTR. They are virtually identical. In short, the GG22-to-QTR curve replicates the Gray Gamma 2.2 output characteristics for matte papers, allowing one to edit in that standard working space and match the output to the monitor when QTR is used to print the file.



⁴² Use Perceptual and Black Point Compensation. Note that the dmax might be slightly affected.

The “GG22-to-QTR.avc” curve can be downloaded along with various other relevant curves and profiles at <http://www.paulroark.com/BW-Info/Eb-1400-Profiles.zip>

Note that as good as color management is, variations in display lighting cannot all be accounted for. One advantage to using a PS image adjustment curve, which can be on a layer, is that the user can modify it to also account for individual variables.

IV. Papers & Print Tones

A. Eboni-4, 100% Carbon Inks Only

As noted above, the print tones produced by the Eboni-4 inks range from relatively neutral to medium-warm, depending on the paper and printer used. The UT14 C and LC, however, can print cool tone prints. So, there is quite a good range available with this inkset.⁴³ The tones of the blended inks are discussed further below.

A graph of the Lab A and B values is the most objective way to describe and compare print tones. In general, the maximum Lab B value (yellow-blue axis) indicates the warmth of the print. The higher the Lab B value, the warmer the print will appear.

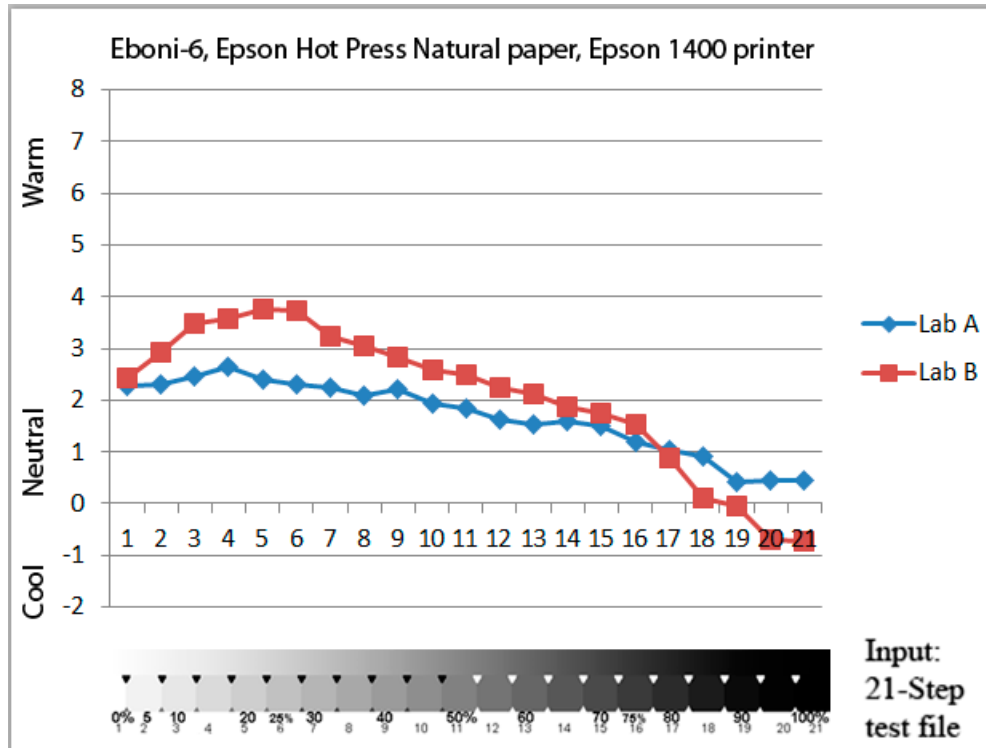
The difference between the paper white Lab B and the maximum midtone Lab B also significantly affects the sense of warmth, as the eye tends to do an automatic white balance on the paper white or other white reference that is close to what is being viewed – such as the mat board.

With just the Eboni-4 part of the inkset, the increases in Lab B have ranged from 1.5 to about 7. Black only printing on some papers can cut this down a bit more – i.e., is more neutral. In the Lab color model, one Lab unit is barely perceptible to the human eye. As such, the 1.5 Lab B increase over the paper white exhibited by the Epson Hot Press Natural paper makes it appear just slightly warmer than neutral. The Hot Press Natural paper itself, of course, is creamy white, but on the wall, it will simply look white and the print with Eboni-4 will look like a neutral B&W print.

Note that computer monitors are usually very “bright white” (bluish, 6500 K) and copy paper is brightened (bluish). It is best to remove yourself from that environment to view test strips and prints. Creamy natural paper and the most neutral carbon prints on that paper will look warm next to the monitor and brightened paper. View the test prints against the mat board you use and with the lighting that is expected. The whiteness (color temperature) of the light sources will also affect how the prints look.

⁴³ Note that my serious fine art prints are printed with the Eboni-4 inks, which is why that part of the inkset has most of the positions. The Eb4 setup prints perfectly smoothly. If just the UT14 C and LC positions are used, for example on a glossy print, some microbanding might be seen under magnification. The HP PK & LK are somewhat smoother than the UT14 inks. The Noritsu-Epson inks make the smoothest glossy prints – perfectly smooth on my 1400.

Lab A also affects tone, but it is essentially set by the paper and remains relatively constant through the most important light midtones. A slightly positive Lab A (red/magenta) is generally preferred to avoid the print taking on a green tint; thus all of the papers show this characteristic to some extent.



Because the Lab A is generally rather uniform, to simplify print warmth comparisons, just using the Lab B values of a 21-step test print works quite well.⁴⁴

When the Epson driver is used to print Ebony-4 with as little of the cyan channel inks as possible, the resulting Lab B is slightly less from about 60% to 90%, with a maximum difference of about 1 Lab B unit at 75% black (which would be at number 16 in the above graph).⁴⁵

⁴⁴ Note that I have seen significant variance in the paper white Lab B readings depending on the spectro used and the substrate that is under the paper at the time it is measured. I believe the paper whites I'm now reading are a bit warmer than one usually sees for the papers.

⁴⁵ The blended cyan channel inks are needed in the Photoshop curves to turn on the black ink. As such, they start at about 60%, and the "red" curve, which controls the cyan channel, becomes the, de facto, black ink curve. The Epson driver cannot print a 100% Ebony4 carbon print. How much of the blended inks are actually in the print is uncertain, but I estimate it is at most about 20% blended ink at the print's 75% black point. If HP PK is in the C position, the reduction in lightfastness would be minimal.

The graph below shows the Lab B measure for several important papers when printed with just the Eboni-4 part of the inkset. Note that the green curve is for a paper printed with the Epson 1100, not the 1400.

Premier Art Smooth BW is a paper that generally makes what I think of as the most neutral-cool print possible with 100% carbon inks. These look very good next to a cool tone silver print. Under glass, most do not see the difference (glazing hides the matte surface). Although not shown here, the paper has a slight selenium tone, which is a slight elevated Lab A. PA Smooth BW is a brightened paper that contains OBAs. These are dyes that will fade, increasing the warmth of the paper with time. I have used it regularly and like the way it looks next to my silver prints. However, for fine art or uses where print tone stability is a top priority, a non-brightened paper is, generally, recommended.

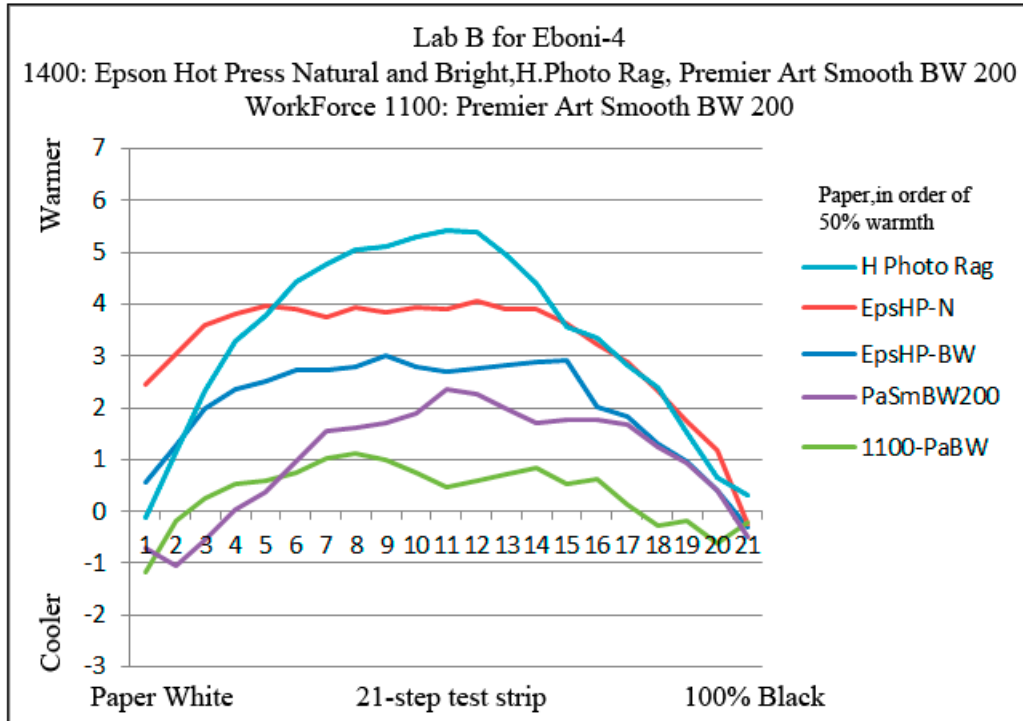
Note that the Premier Art Smooth BW printed with the 1100 is more neutral than that printed with the 1400 even though the same inks were used. The 1100 has a more normal 3 picoliter drop size, whereas the 1400 uses a smaller 1.5 picoliter drop. In general, many papers print more warmly with carbon inks in printers that have smaller drops. This varies with paper, however. The Epson Hot Press papers do not print much differently from one printer to another.

Hahnemuhle Photo Rag (HPR) is a well-known paper and had, until recently, the best dmax of any matte paper. While it has some brighteners in it, they are minimal, may be in the paper as opposed to the coating, and have held up very well in tests. Many consider the paper white of HPR to be neutral. The print tone on HPR with Eboni-4 by itself, however, would be considered warm or medium warm.

Epson Hot Press Natural is an un-brightened paper (no optical brightening agents/“OBAs”). It has the lowest rise in Lab B from the paper white to the maximum Lab B point, and is the natural paper I recommend most for a relatively neutral fine art print.⁴⁶

The brightened version of the Epson Hot Press paper has a modest amount of brighteners in it. While these will fade, making the paper closer in tone to the natural paper, the natural paper itself will bleach. As such, both papers will ultimately have a paper white that is probably about half way between where they are shown on the graph, below.

⁴⁶ I buy much of my paper from <http://www.atlex.com/>



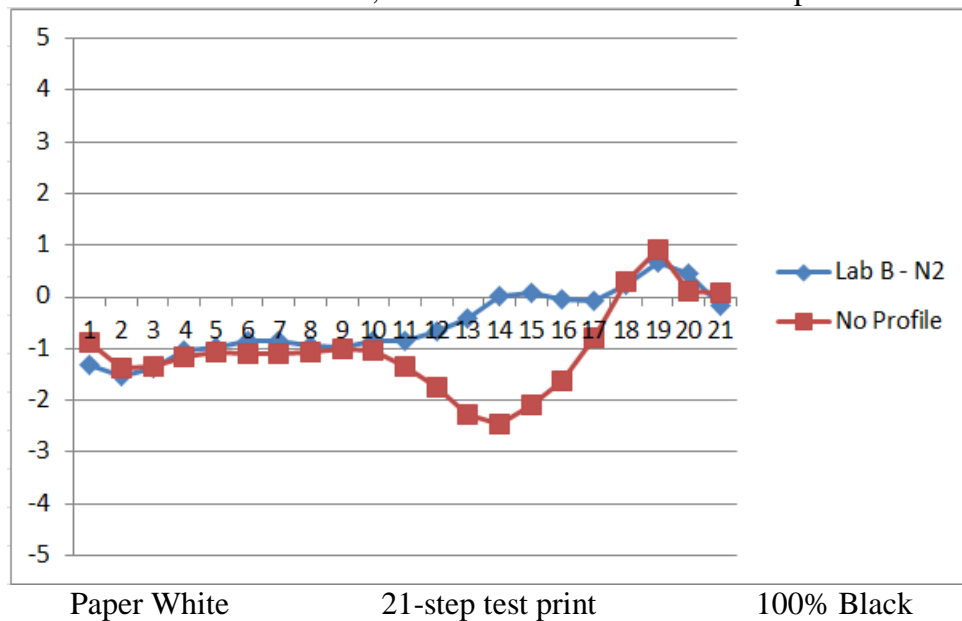
B. Cooler Prints Using the C & LC Inks

While most matte papers, print with a medium warm image tone when 100% Eboni-4 is used, the cool C and LC inks allow these papers to be profiled to print very neutrally.⁴⁷

As noted previously, with no curves or profiles aside from the Epson driver with its built in “Color Controls” and gamma 2.2, most papers print with cool shadows. However, when a profile is used, which here means an ICC with an embedded Photoshop curve, the tonal response can be made much more even. The best indicator of warmth is the Lab B, with a higher Lab B being warm and a lower one being cool. Below is a graph of the Lab B values taken from 21-step test prints using Red River’s Aurora white paper. The “No Profile” curve is where just the Epson driver with Color Controls was used. The “N2” graph shows the tonal response where this curve – embedded in an ICC – was used.

⁴⁷ Note that UT14 LC is the coolest (lowest Lab B image tone) of the recommended inks for this type of blended carbon-color printing. HP Gray is more neutral (a higher Lab B), and HP diluted with MIS Gloss Optimizer usually prints with a slightly higher Lab B image tone than the HP Gray.

Red River Aurora W, Lab B with and without the N2 profile



C. Glossy Printing with the LC and C Position Inks

The LC and C position inks, such as UT14 LC and C, allow one to make prints on glossy papers. Eboni is a matte-only ink that will rub off glossy papers unless a spray is used as a fixative, and I do not recommend this.⁴⁸

The print tones will, of course, depend on the glossy ink used and the paper. As noted previously, among the neutral-cool pigments recommended, the MIS LC has the lowest Lab B and the HP PK diluted with MIS Glop has the highest, but the differences are not great. MIS LK, on the other hand, is very warm. This warm MIS carbon is what I used to make sepia prints for the recent museum historical photo restoration show.

With the neutral-cool inks the print tone is mostly a function of the paper tone. Most of the glossy papers are cool. Museo Silver Rag is the non-brightened paper I used for the sepia museum show, but it would not be my top recommendation for neutral glossy prints. There, the surface textures and other subjective criteria are more important. The “Baryta” type papers by Canson and others are favored by many. Epson Premium Semi-

⁴⁸ Eboni black only on glossy paper, where it is sprayed to hold it down, can make a neutral-tone print that is probably more lightfast than any other process. It takes a heavy spray in the deep shadows, however. Alternatively, a carbon PK can be used with the Eboni, where the PK is used in the deep shadows and 100% black position.

matte paper was my top choice in the past for neutral glossy printing. Red River UltraPro Satin has a very similar look.⁴⁹

When it comes to the subjective look of the paper, special note must be made of the Red River Polar Pearl Metallic paper⁵⁰ with the Noritsu-Epson dyes. For cards and snapshots this combination is currently my favorite. Pigments that sit on top of the paper cannot compete well with dyes on high glossy papers. On the other hand, for display, a lower gloss surface and pigments are more appropriate.

One final note on glossy printing is that if the highest quality glossy output was needed, I'd recommend that more than just two ink positions be devoted to the task. On the other hand, because my most important output is fine art matte paper printing, the ability to print very good glossy cards and brochures makes this the printer and inkset very flexible.



[All donations to the cause of free inkset designs and profiles are appreciated.](#)

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www.PaulRoark.com

⁴⁹ See <http://www.redrivercatalog.com/browse/68lb-ultrapro-satin.html>

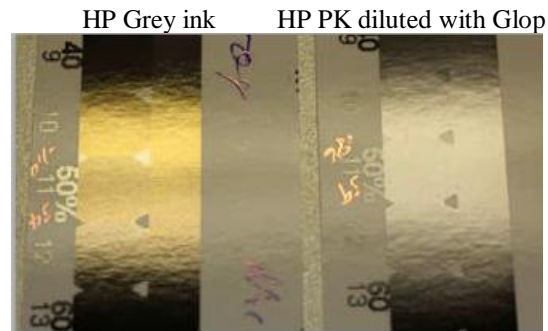
⁵⁰ See <http://www.redrivercatalog.com/browse/66lb-polar-pearl-metallic-inkjet-photo-paper.html>

Appendix A: Alternative Ink Arrangements for the C and LC Positions – Not Recommended for Beginners

Given my penchant for experimenting with other inks, the C and LC positions of my 1400 often have a variety of other inks in them. The following are the ones that I recommend for the C and LC positions, in addition to MIS UT14 C and LC:

1. HP Z3100/3200 Vivera PK and an LK version made by diluting HP PK with MIS R800 Gloss Optimizer (“GO” or “Glop”) – This “HpGO” inkset approach has been used in an Epson WorkForce 1100 for months and periodically in the 1400 with very good results.⁵¹ This combines the most stable neutral glossy pigment with the best base in terms of reducing reflective artifacts, including particularly bronzing. It produces neutral glossy prints that do not need post-printing sprays or the like to eliminate bronzing. The HP pigments also make possible very neutral matte prints on a wide variety of papers, using either the Epson driver or QTR. While this approach requires some ink mixing to make the LK, it is a simple 2:1 mix of off-the-shelf products (2 parts MIS Glop and 1 part HP PK). This is the best neutral glossy pigment approach I’ve tested so far, and one I’m sufficiently confident of that it will be installed in my 7800 for fine art printing.

2. HP PK, above, and HP Z3100/3200 Gray (LK) – HP makes a pre-mixed LK, which HP calls simply “gray,” that, like the above, would give the most lightfast neutral glossy results – in this case, without the need to do any mixing. However, the glossy prints suffer from significant bronzing. Note that the standard, default MIS UT14 inks results in prints that are most similar to the HpGO test strip on the right, below.



⁵¹ See <http://www.paulroark.com/BW-Info/1100-HpGO.pdf>

3. Noritsu-Epson (Claria) dyes – This approach requires more effort to mix the LK, as the clear dilution base must also be mixed.⁵² However, for those so inclined, the results on glossy cards and brochures are quite impressive. The negatives aside from the mixing are that even Claria dyes fade relatively quickly unless protected by a spray such as Premier Art Print Shield,⁵³ and there is some metamerism with fluorescent lights.

Realistically, most users should stick with the standard arrangement that uses the UT14 inks as the cool/glossy additives. While the HP pigments are more stable than any third party blended carbon-color inks, the MIS blended inks I've fade tested were at least equal to the Cone B&W Piezotone inks that they were tested with.

⁵² See <http://www.paulroark.com/BW-Info/BW-Dye.pdf> . To control the greenish tone of the Noritsu black dye, 13% magenta (Noritsu or Claria) is mixed with the black before it is diluted (30% dye: 70% base) for the LC position. A 400 dpi, grayscale scan of a 17mm high 21-step test strip printed with the 2 positions of dye printed on Red River Polar Pearl Metallic paper is posted at <http://www.paulroark.com/BW-Info/Noritsu-C-LC-400dpi-scan.jpg> .

⁵³ The Claria dye black only tests indicate that the dyes do much better when sprayed with Print Shield. With such a spray, they are arguably more stable than Cone neutral B&W pigment inks, un-sprayed. For example, the Cone Neutral K6 40 Mlux-hrs HPR 50% test patch delta-e was 2.4. The Claria Black Only 50% test patch on Canson Baryta, sprayed with Print Shield, after 40 Mlux-hrs of exposure had a delta-e of 1.6, the same as the Epson ABW on HPR, unsprayed. (The Claria BO unsprayed 50% delta-e was 5.4).