

## Eboni-6 Plus HP LK and LLK

“EbHP-2013”

Epson 7800

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

11-30-2013b

### A. Background

This approach is aimed at making the best possible matte prints in the neutral to medium warm range. It combines Eboni-6, the most neutral (least warm) dilute 100% carbon inkset, with HP Z3100/3200 neutral/cool gray pigments (the best blended carbon + color gray inks) to give a variable-tone inkset that, based on multiple tests of the underlying pigments, likely makes the most lightfast prints within that target range.<sup>1</sup> With 8 gray inks being used, prints are very smooth, and with the HP pigments in the mix, most papers can print with tones from near neutral to medium warm.

Combining Eboni-6 with HP Z3100/3200 pigments has been used successfully in a number of other inksets and is well tested.<sup>2</sup> No high gamut color inks are used; as such, profiling is very easy. The inkset is Epson driver compatible, printing with either the Color Controls or ICCs. However, QuadToneRIP gives the most precise control, and that is what I use the most for the best prints.<sup>3</sup>

I have made both 100% carbon pigment Eboni-6 (“Eb6”) as well as HP midtone “cool” QTR profiles for a number of papers. Most recently, I’ve updated the Premier Art Smooth Hot Press 325 profiles. QTR sliders can be used to blend the profile types. Eb6 profiles are the warmest. In general, when the Eboni and HP/cool profiles are blended 50/50, most matte papers print with a maximum Lab B rise over the paper base of about one Lab B unit. This is barely perceptible, and, in my opinion, makes an outstanding approach to making neutral appearing B&W prints. An alternative route to a relatively neutral print is to also use the BO profiles. When combined with the others, the graininess can be reduced to barely visible amounts while the carbon content of the print can be increased. When Eboni-6 is used by itself, the Lab B values can be up to about Lab B = 6. My profiles for this inkset approach installed in the Epson 7800 printer are at <http://www.paulroark.com/BW-Info/7800-EbHP-Profiles.zip>.

This inkset approach should work on all Epson K3 type printers and would include glossy neutral printing with the HP based inks on printers with both matte and photo blacks. My target, however, is just the 7800 and matte paper.

**Note regarding lightfastness** -- Based on Aardenburg-Imaging tests,<sup>4</sup> among other sources, it is clear that carbon pigments are the most lightfast we have available to us. The HP pigments are not as

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<sup>1</sup> See Appendix A at the end of this PDF for fade test information.

<sup>2</sup> A somewhat similar 7800 setup using HP neutral and MIS Eboni carbon pigments was used in 2010. See <http://www.paulroark.com/BW-Info/7800-EbHp.pdf> Additionally, for the Epson 1400 the combination of Eboni plus HP cool inks has been used in a few inksets, including <http://www.paulroark.com/BW-Info/Eboni-4-Plus.pdf> and <http://www.paulroark.com/BW-Info/Eb1400.pdf>

<sup>3</sup> For QTR, see <http://www.quadtone RIP.com/html/QTRoverview.htm>

<sup>4</sup> See the 1800 MIS Eboni tests at <http://www.aardenburg-imaging.com/>

lightfast, but they appear to be the best blended carbon plus color, neutral/cool gray pigments we have. An image made with the HP pigments will fade a bit faster than a 100% carbon pigment image, and it will warm over time. However, HP has matched the fade rates of the color pigments used in the gray inks so well that there does not appear to be a significant risk of an undesirable green shift due to differential fade. On the other hand, for the most stable print, the use of carbon pigments should be maximized. See Appendix A, at the back of this PDF, for details.

Bottom line, the ultimate lightfastness of 100% carbon pigment print is compromised slightly to make more neutral prints. With a 100% carbon pigment inkset the pigments will probably outlast the inkjet paper. So a 50-50 blend with the best carbon + color pigment, if it makes a more pleasing print, seems like a reasonable compromise for most cases. A blend of Eb-6, Eb-BO, and HP profiles can make a neutral print while reducing the color pigment content even further. While I have promoted the 100% carbon pigment approach, the ability to still have that available but also have outstanding neutral printing on a wide variety of papers makes this a very convenient and flexible inkset approach. 100% carbon sets a benchmark, but it is not the ultimate goal. The overall quality of the printed image, including ink and paper lives as appropriate for the circumstances, is the goal, and this inkset does extremely well in that regard, and with ease and economy.

## **B. EbHP 2013 Ink Arrangement**

The Eboni-6 components:

Y = Eb6-Y (2% Eboni)<sup>5</sup>  
LM = Eb6-LM (6% Eboni)  
LLK = Eb6-LC (9% Eboni)  
M = Eb6-M (18% Eboni)  
LK = Eb6-C (30% Eboni)  
K = Eboni MK

The neutral/cool HP components:

LC = HP Z3200 Light Gray or user mixed "HP LLK" (9% HP PK)  
C = HP Z3200 Gray or user mixed "HP LK" (30% HP PK)

I dilute the Z3100/3200 PK to make the LK/gray and LLK/light gray components,<sup>6</sup> but these could also be purchased as stock HP inks.<sup>7</sup> The HP grays may be slightly denser (and cooler) than the diluted PK, so the "cool" QTR profiles that I make probably should be re-linearizing for a perfect ramp.<sup>8</sup>

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<sup>5</sup> To order Eboni-6 from MIS, go to <http://www.inksupply.com/eb6.cfm>.

<sup>6</sup> I used dilution base C6b or C6c to mix my own HP gray and some Eboni positions. It is possible C6c, which prints more smoothly on Arches watercolor paper with the 1400 is a better choice, but I'm not sure it matters in 3.5 pl printers. See <http://www.paulroark.com/BW-Info/Ink-Mixing.pdf> MIS also sells this generic base pre-mixed.

<sup>7</sup> See [http://www.atlex.com/ink-and-toners/hp/designjet-ink?ink\\_printer\\_series=1358](http://www.atlex.com/ink-and-toners/hp/designjet-ink?ink_printer_series=1358) for Z3200 Gray and Light Gray inks.

<sup>8</sup> MIS UT14-LC could be used as an economical substitute for the HP LK equivalent, but MIS does not have a neutral LLK substitute.

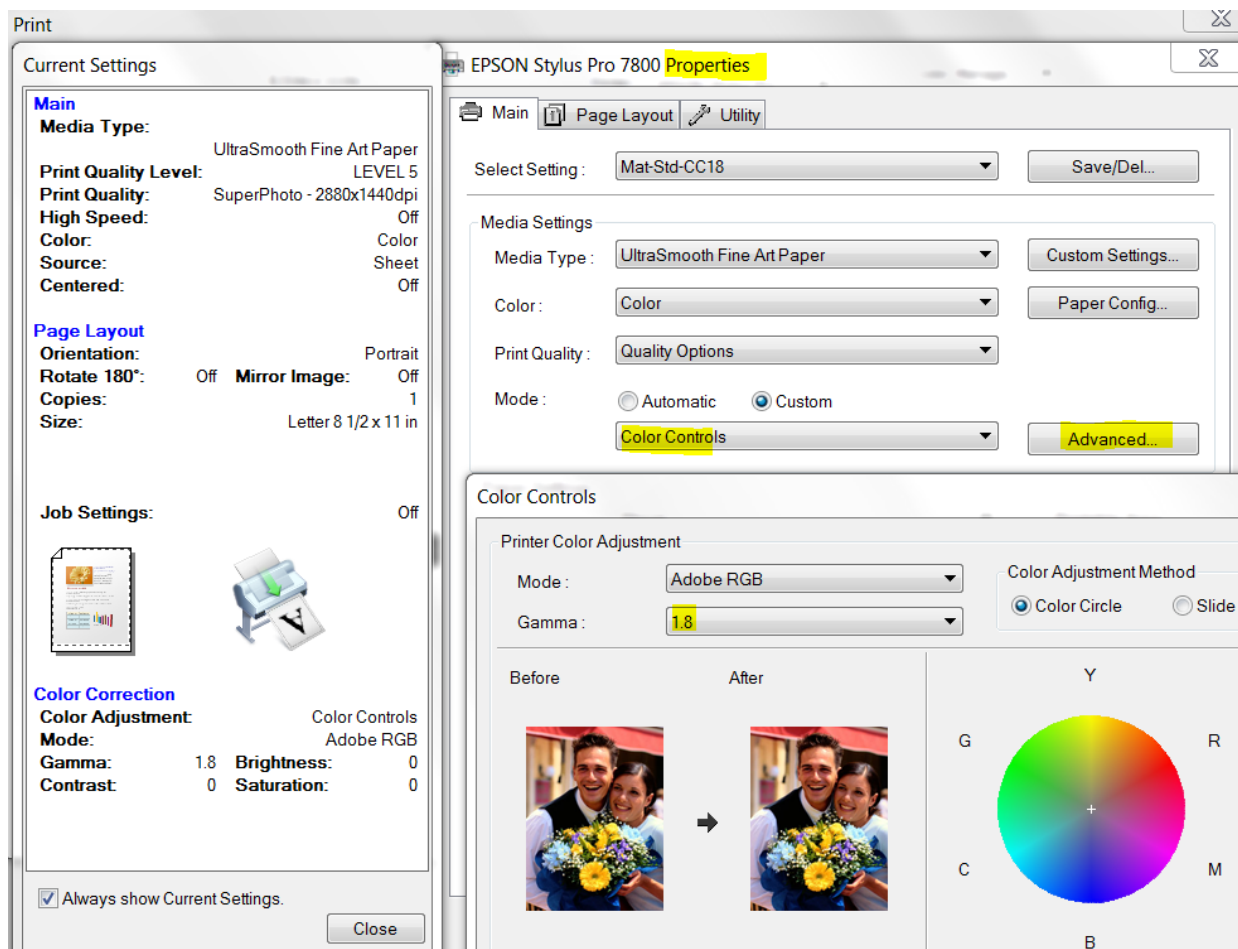
I am currently using cartridges purchased from MIS.<sup>9</sup> I have used the Epson-style carts for several years, typically removing the carts for agitation if the printer has sat for more than a week.<sup>10</sup>

### C. Printing Workflow Options

This inkset is compatible with the Epson driver. Of course, QTR<sup>11</sup> can also be used for maximum control, and is required for Arches Hot Press Bright White watercolor paper, which is an important target paper for me. For Epson Hot Press Natural, another primary target paper, however, the Epson drive works very well.

#### 1. Epson Driver – “Color Controls” Checked, No ICC

This is the simplest workflow, and, of course, also the one that offers the least sophisticated controls. It works, however, and can make fine prints. The Epson driver settings are shown below.

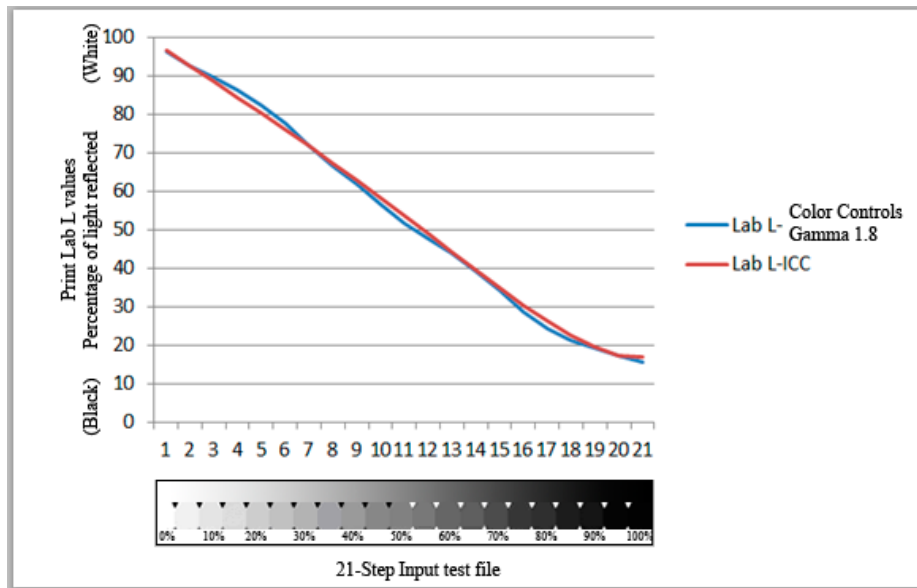


<sup>9</sup> See, generally, [http://www.inksupply.com/inkjet\\_cartridges.cfm?search\\_getmodel=460](http://www.inksupply.com/inkjet_cartridges.cfm?search_getmodel=460); the empty Epson style carts are no longer stocked by MIS, but may be available via special order.

<sup>10</sup> Eboni-6 does require more agitation than typical OEM inksets. I agitate bi-weekly when not in use.

<sup>11</sup> See <http://www.quadtonerip.com/html/QTRoverview.htm>. “QTR” is shareware written by Roy Harrington. It costs \$50.

Having the print match the relative density of a calibrated monitor is one of the goals in a printing workflow. I edit my images in Gray Gamma 2.2 workspace, which is a subset of Adobe RGB (1998) and sRGB, the most common color spaces. This determines how the print is displayed on the monitor. With the Photoshop (CS5) printer dialog box set to “Printer Controls Color”<sup>12</sup> and the printer driver set to UltraSmooth Fine Art paper type, Color Controls, Gamma 1.8, and the highest quality settings, prints made on Epson’s Hot Press Natural paper match the monitor reasonably well. This is shown graphically below by comparing the Lab L distribution of a 21-step test file printed on Epson Hot Press Natural paper with the Lab L for a test strip printed with an ICC, which makes an ideal Gray Gamma 2.2 ramp.<sup>13</sup> The ICC ramp is a bit straighter, but, but they look much alike.



## 2. Epson Driver – ICC in Print Preview

The use of an ICC in the Photoshop or other printing application has significant advantages. An ICC “color manages” the workflow, in the sense that a calibrated monitor will automatically give a good match to the print’s relative densities.<sup>14</sup>

Grayscale ICCs are easy to make using QTR’s “Create ICC” or “Create ICC-RGB.” I recommend the latter version for greater compatibility with current image editors. The RGB version also allows one to embed a Photoshop curve in the ICC for image tone control. Create ICC-RGB is part of the QTR download.<sup>15</sup>

<sup>12</sup> This would probably be “no color adjustment” in older PS versions.

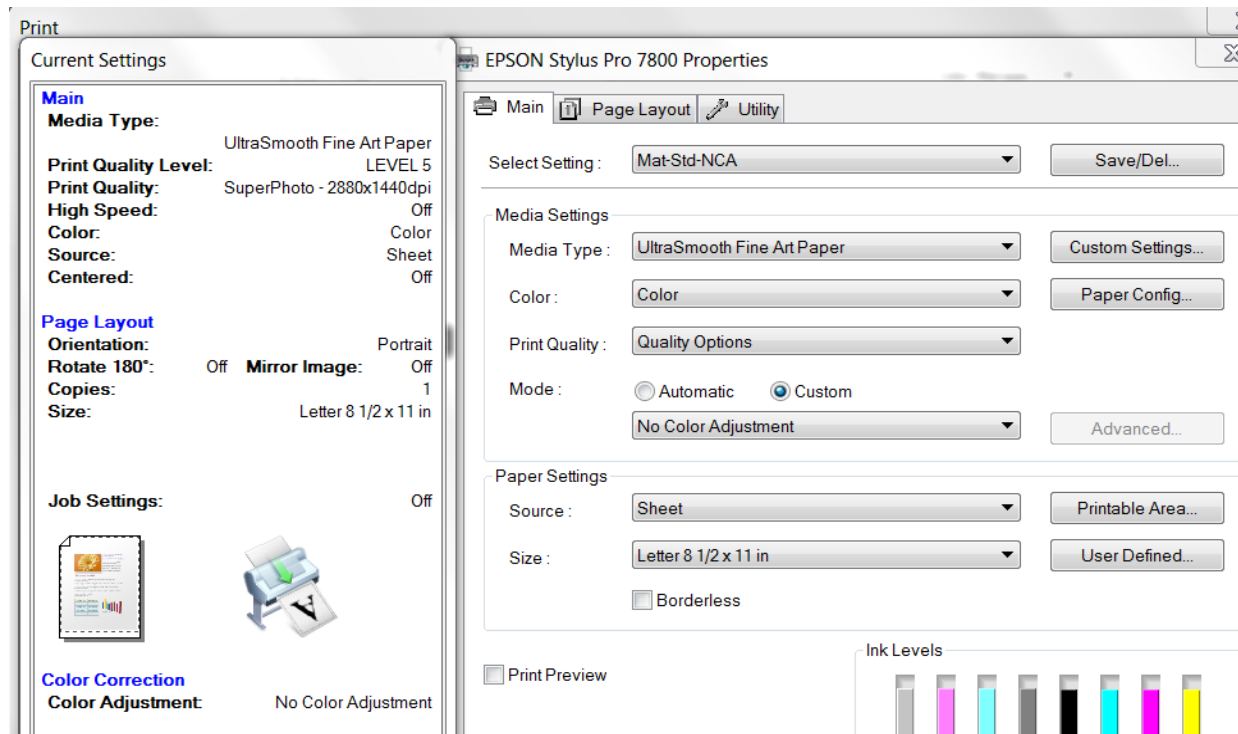
<sup>13</sup> The print has a Lab B that increases a maximum of just under 2 units over the paper base Lab B. This would appear slightly warm.

<sup>14</sup> ICCs can also be used to “soft proof” the print tones, but that is beyond the scope of this article. For relatively neutral B&W, I don’t see much point in soft proofing the “colors” (or lack thereof). The print tones are best seen in actual samples and test prints.

<sup>15</sup> To download this program, go to <http://www.quadtonerip.com/html/QTRdownload.html> .

Briefly, 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, instruct the software and printer how to match the monitor.<sup>16</sup>

ICCs are made for specific printers, papers and inksets, and the printer drivers must use the same settings as were used when the original test strip was made. As such, the name of the ICC should include the printer, inkset and paper for which the ICC is meant. For my ICCs I always use the same settings for the printer. In the Photoshop Print screen, select “Photoshop Controls Colors.” The PS print screen is where the ICC is pulled up. From there, one must also go to the printer Properties settings. The assumed printer driver properties settings are shown below.



I have made a Photoshop image adjustment curve that results in about a 50-50 split between the Ebony and HP inks. This can probably be used to make ICCs for most matte papers that will then print quite neutrally, with a maximum Lab B rise of about 1 unit above the paper base. The curve is in my Profiles Zip file: <http://www.paulroark.com/BW-Info/7800-EbHP-2013-Profiles.Zip>

### 3. Printing with QuadToneRip (QTR)

QTR provides the most control and flexibility, best dmax, and smoothest prints. For printing on uncoated watercolor paper, such as the classic Arches uncoated Hot and Cold press watercolor papers, the use of QTR is essential. Particularly for this inkset, the ability to blend different profiles – here the

<sup>16</sup> I have 2 PDFs on making ICC: [http://www.paulroark.com/BW-Info/Making\\_B-W\\_ICCs-GrayCard.pdf](http://www.paulroark.com/BW-Info/Making_B-W_ICCs-GrayCard.pdf) and [http://www.paulroark.com/BW-Info/Embedding\\_Photoshop\\_Curves\\_in\\_ICCs.pdf](http://www.paulroark.com/BW-Info/Embedding_Photoshop_Curves_in_ICCs.pdf). Additionally, for flatbed scanners QTR now has a StepWedge tool that automates that approach and a Readme file that explains how it works. See the QTR download page, noted in the last fn.

“Ebony-6,” “cool” HP, and Ebony “BO” profiles -- allows QTR to control print tones and maximize carbon content to a degree that cannot be duplicated with the Epson driver. The QTR sliders and split toning provide unmatched ease and flexibility of print tone control. In short, this is my normal workflow approach.

That said, the availability of the Epson driver is handy and allows printing from many applications.

This is not a tutorial in QTR, so I will just mention a few specific points that apply to this inkset.

My Profiles Zip file -- <http://www.paulroark.com/BW-Info/7800-EbHP-2013-Profiles.Zip> -- contains a number of QTR profiles. There are usually both an “Eb6” (100% carbon Ebony-6) profile and a separate “cool” (HP LK & LLK with Ebony MK) profile. There are also “Black Only” (BO) files that use only the Ebony MK. They print very neutrally, but also do show dots. As noted above, the QTR sliders can be used for blending the 3 profile types. Note that if a BO profile is just a small percentage of the total, and the print is for wall display, the use of a BO profile can increase the carbon content of a neutral print with a very minor decrease in smoothness.

Multiple profiles could be combined into a single profile for a paper. For example, take the density values for the HP inks from the cool profile and activate the HP inks in the Eb6 profile. Call the HP inks a “toner.” Then cut the midtone ink limits in half so that the “toner” and the Ebony dilute “gray” inks each carry half the weight (or other distribution you’ve found pleasing with the sliders). The K limit is not altered. This single profile can then be re-linearized and should work just as well as having the two separate ones. It may make re-linearizing simpler, but if you also want to do spit toning, I’d stay with the sliders.

Note that I do not recommend printing with just the HP inks in the midtones. (Ebony MK is always used.) Three inks are not enough to make a top quality print. I vastly prefer to have Ebony-6 carry at least half the load, and most recently I’ve used 40% HP to 60% Eb6. Assuming the HP inks are about half carbon themselves, this makes all parts of the print have at least 80% carbon. It makes for an outstanding print.

#### **D. Papers & Print Tones**

As noted above, the print tones produced by this inkset range from neutral to warm, depending on the blend of Ebony and HP pigments, as well as the paper used. In general, the maximum Lab B value (yellow-blue axis) indicates the warmth of the print.<sup>17</sup> The higher the Lab B value, the warmer the print will appear. The maximum Lab B values have ranged from neutral (0) to about six, depending on the paper used.<sup>18</sup>

The difference between the paper white Lab B and the maximum image Lab B also strongly affects the sense of warmth, as the eye tends to do an automatic white balance on the paper white or other white

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<sup>17</sup> Lab A also affects tone, but it is essentially set by the paper and remains relatively constant. 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.

<sup>18</sup> See <http://www.paulroark.com/BW-Info/Color-basics.jpg> and [http://en.wikipedia.org/wiki/Lab\\_color\\_space](http://en.wikipedia.org/wiki/Lab_color_space) for some basic information on the Lab color model.

reference (like the mat board) that is close to what is being viewed.<sup>19</sup> The differences between image maximum Lab B and the paper white have ranged from negative (HP inks only – not recommended) to about 6 (Ebony-6 only on a warm printing paper). With a 50-50 blend of Ebony-6 and HP inks, the Lab B rise is often if not usually close to one Lab B unit – barely perceptible and very pleasing from my perspective. The optimum degree of this “split tone” effect is subjective, and this inkset with QTR allows considerable room for this creative control.

For relatively neutral prints, it makes sense to start with a paper that prints relatively neutrally with just Ebony-6. That allows the least amount of the HP and its blended color pigments to be used. Additionally, however, some papers seem to react slightly more to the HP cooling inks than others.

I like to display the print tones via graphs that show, in a very objective manner, the Lab B (warm yellow positive and blue negative) values for each of 21 density steps of a 21-step test file. I think these graphs of the Lab B values are the most objective and simple way to describe and compare print tones. The graphs below are generated in Excel from the text output of the DataColor Spyder3Print spectro. I have put the text files for the papers profiled at <http://www.paulroark.com/BW-Info/7800-EbHP13 Tones.zip>. Below are a few examples of these curves.

I’ve been impressed with the low Lab B rise of the Epson Hot Press Natural paper. That plus its high dmax makes it a serious contender for near neutral fine art. On the other hand, while I’ve used it in rolls for prints larger than 17x22 inches, I do not like working with roll paper. Thus for my large prints an old favorite, Premier Art Smooth Hot Press 325 is being used. It is not only available in 24x30”,<sup>20</sup> but it can be custom cut to other larger sizes. The thinner (205) version of this paper has turned in the best fade test results at Aardenburg-Imaging,<sup>21</sup> and the Epson version – Epson Premier Art Scrapbook paper – has been referred to by Epson as its most archival paper.<sup>22</sup> I have specified these papers for museum projects and particularly like the higher dmax and thickness of the 325 version for my large display prints.

Note that with the 50-50 Eb6-HP profile blends, some papers that would not have been considered neutral printing with Ebony-6 and the 1400 turn out to respond so well to the HP pigments that they are very good options. The Red River Aurora Natural is a high value paper that fits this description.<sup>23</sup> And, as usual, for the coolest carbon prints the Premier Art Smooth Bright White takes the prize, but it has OBAs (optical brightening agents) that will fade, causing the paper to warm. See the Lab B values for a 50/50 Ebony/HP mixes, below. That said, images on this paper that have been on my walls for years still look great. As far as I know, the warming of the paper to its natural paper tone does not affect the archival nature of the image.

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<sup>19</sup> 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 neutral 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.

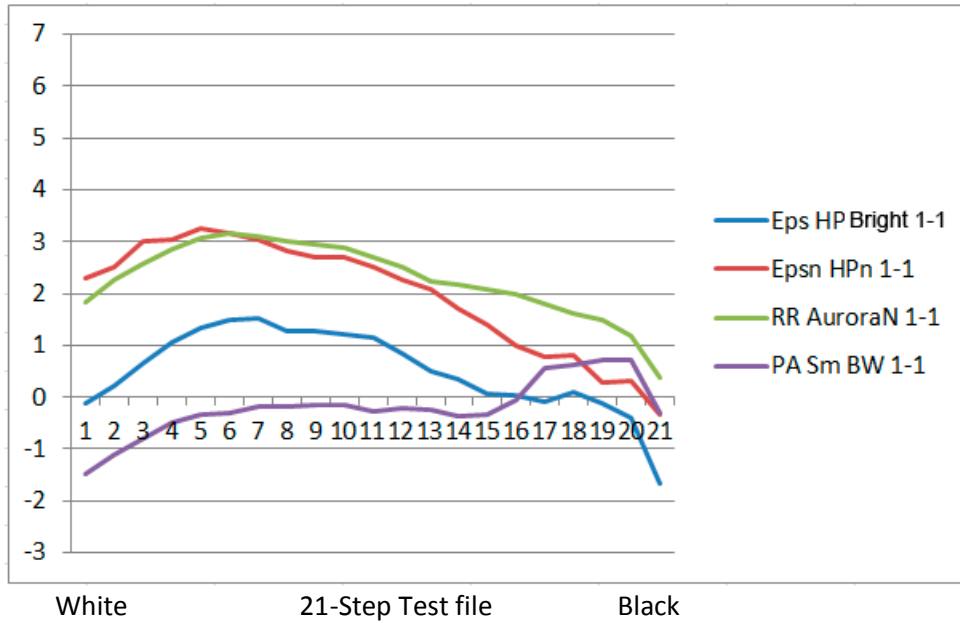
<sup>20</sup> See <http://www.ultrafineonline.com/pr325gmshw2s8.html>

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

<sup>22</sup> See [http://www.epson.com/cgi-bin/Store/ProductMediaSpec.jsp?BV\\_UseBVCookie=yes&oid=-12346](http://www.epson.com/cgi-bin/Store/ProductMediaSpec.jsp?BV_UseBVCookie=yes&oid=-12346)

<sup>23</sup> See <http://www.redrivercatalog.com/browse/auroranatural.html>

Epson Hot Press Natural and Bright, Red River Aurora Natural and Premier Art Smooth BW  
Lab B values for 50/50 ("1-1") blend of Eboni-6 and HP inks



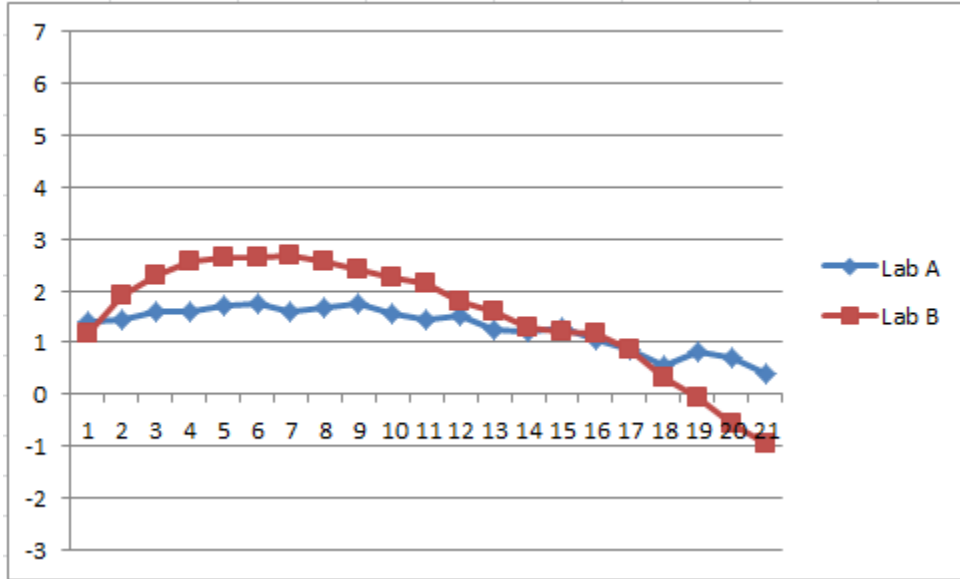
With QTR one can also use the sliders to have different percentages of inks in the highlights, midtones and shadows. One approach I've found to give very smooth highlights, yet limit the amount of color ink in the mix used the following profile and QTR slider blend:



This keeps the highlights free of black dots, starting to slowly introduce them in the midtones where they cannot be seen. It results in just slightly warm highlights and a nice split tone effect overall. In no part of the print are the color pigments more than 15%, and the percentage is reduced slowly to 0%, with a print that, overall, 90% carbon. This "90% compromise" looks good on Arches and PA325.



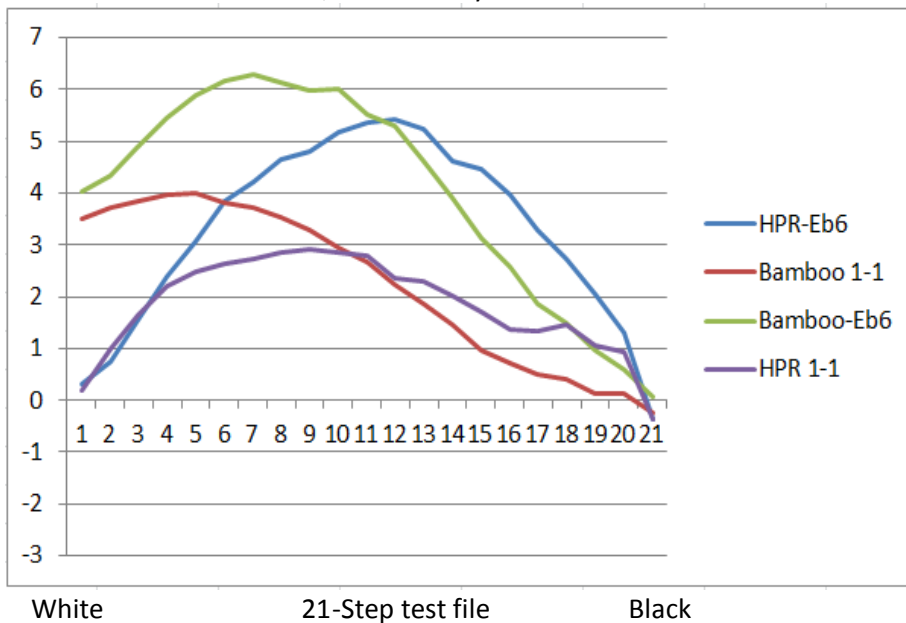
Premier Art 325, 70% Eb6,  
30% HP Highlights and Midtones, 30% BO shadows



The old standard Hahnemuhle Photo Rag, as expected, prints warmly and remains medium warm even with the HP at 1-1. I would use HPR only if a warm image on a brightened paper was the goal.

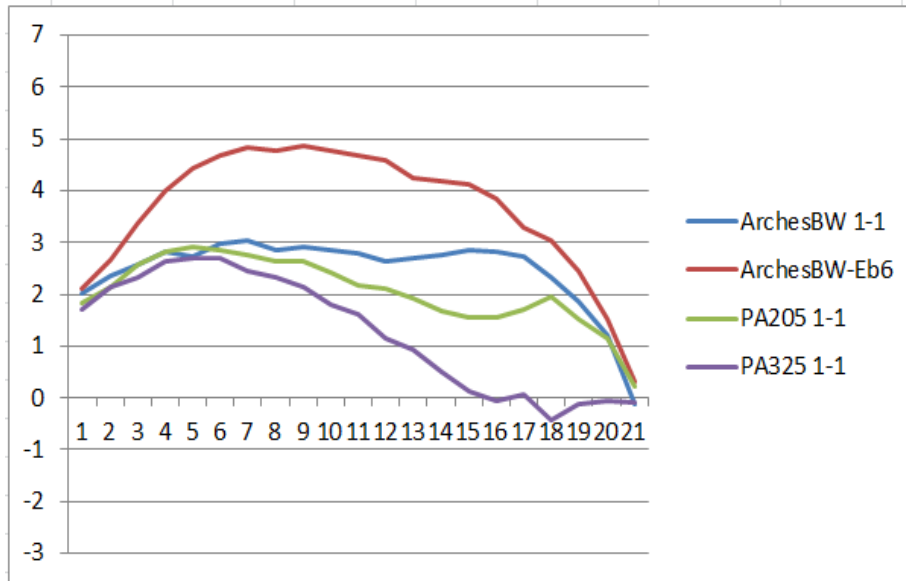
Hahnemuhle Bamboo, on the other hand, was a very pleasant surprise, with a creamy white paper base and very low Lab B rise with a 1-1 blend. See the graphs of Lab B values for these Hahnemuhle papers, below.

Hahnemuhle Photo Rag and Bamboo  
Lab B values, Eboni-6 only as well as 1:1 with HP



Arches Hot Press watercolor paper (uncoated) and its Bright White (but no OBAs) version are always primary targets of mine. Because it has not coating, Arches watercolor paper may be the most archival<sup>24</sup> paper that can make good inkjet prints. On the other hand, Premier Art’s Smooth Fine Art papers are also noted for being very archival, print more smoothly, and may be more lightfast. They all respond very well to the 50/50 or (“1-1”) or other blend of Eb6 and HP pigments. See the graphs of their Lab B values, below.

Arches BW, Premier Art 205 and 325 Lab B values

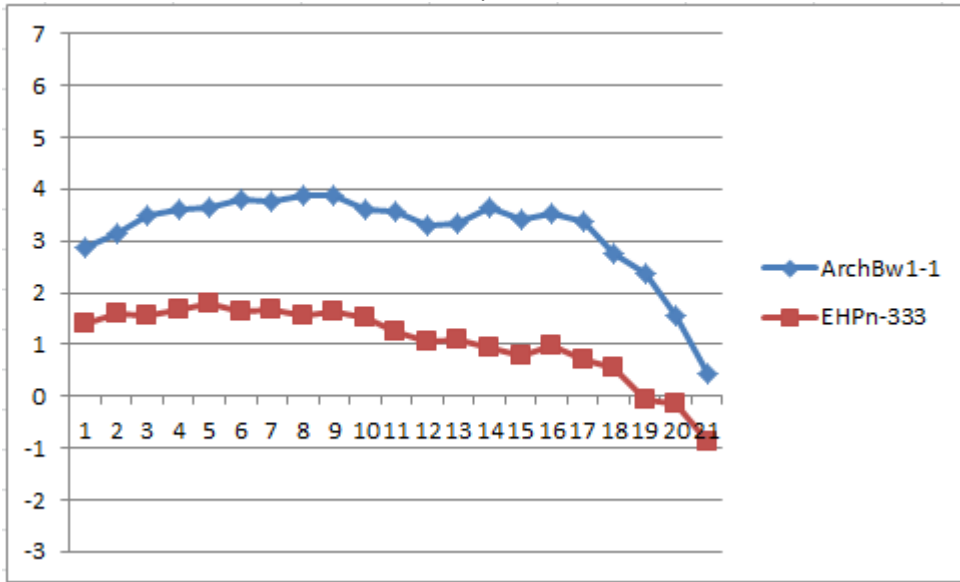


As noted earlier, another route to more neutral prints that may be worth exploring is the use of a “Black Only” (“BO”) channel or profile used in combination with the Eb6 and HP pigments. The Eb6 BO profile essentially prints totally neutrally. It is, by itself, rougher than I like, as it uses no dilute inks in the profile. However, when used with Eb6, it can make prints that are smooth enough for display in many if not most situations. I have used this approach successfully on the 1400, but, of course, that printer uses much smaller dots than the 7800. Whether the additional graininess the BO profile adds is consistent with the printing goals is subjective.

A blend of 33% Eb6, 33% BO, and 33% HP results in a print that is rather neutral. With these prints, the smoothness is such that, at arm’s length, most viewers would probably not be able to tell the difference from a print that used only the dilute inks. “Pixel peepers” will be able to see the BO dots in the highlights. For the most neutral, 100% carbon Arches watercolor print, one might experiment with a 50-50 profile blend of Eb6 and BO. The Lab B values for these mixes is graphed below.

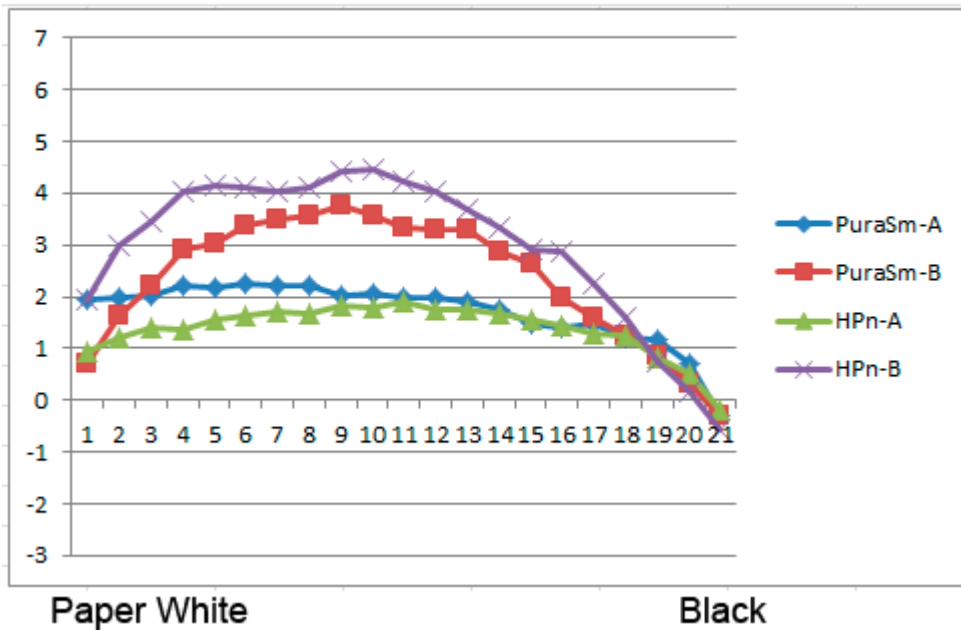
<sup>24</sup> “Archival” is a poorly defined term, but one that most understand in a general way. What I believe distinguishes Arches watercolor papers from the inkjet papers is the lack of an inkjet coating. Coatings and laminates tend to deteriorate with time due to differential expansion and contraction of the paper base and coating due to temperature and humidity changes. This ultimately cracks the coatings. With Arches (internally sized with gelatin) the carbon particles simply bury themselves in the paper itself. Arches is very highly thought of in the larger art market.

Lab B, Arches at 50:50 BO:Eb6; Epson HPn at 33% Eb6, BO, and HP



A relatively new paper that appears to deserve exploring is the Breathing Color Pura Smooth.<sup>25</sup> It is said to be the only OBA free bright white paper. The Lab A and B curves below show how it compares to Epson Hot Press Natural, which has one of the most neutral looking 100% carbon images. Note the low Pura Smooth Lab B and relatively elevated Lab A.

Lab A & B, Eboni-6 inkset, 7800 printer  
Breathing Color Pura Smooth v. Epson Hot Press Natural



<sup>25</sup> See [http://www.breathingcolor.com/action/bc\\_shop/224/](http://www.breathingcolor.com/action/bc_shop/224/)

## Summary

I have now used this 7800 EbHP-2013 setup for over a year, and it has proved very good at making near neutral prints on matte paper. I do not believe there is any other readily available method to make relatively neutral B&W prints that are as lightfast and neutral as this inkset is able to do.

Paul

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

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## Appendix A

MIS Eboni 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.<sup>26</sup> “Delta-e” measures the degree to which density and color have changed from the beginning of the fade test.<sup>27</sup> Lower is better.

### Delta-e at 60 Mlux-hrs Light Exposure

	Average	50% test patch
Eboni 3-MK, PA 205, Print Shield spray	0.2	0.2
Eboni 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 patch, are more representative of the relative degree of visual fade and tone change that will occur.

### HP Z3100/3200 Neutral Test Patch Fade Characteristics

The color pigments used to cool the warm carbon in the HP PK and its dilutions will fade faster than the carbon, causing Lab L and Lab B to increase. The key to a good carbon-color blend is not only using high quality pigments but also matching the fade rates of the cyan and magenta (or other similar pigments used to make a blue offset color). Typically, cyan is stronger than magenta, so the third party blends typically fade to a greenish tone. HP, however, appears to have selected pigments that avoid any significant green shift. See the graph below that shows the fade characteristics of the neutral 50% patch from Aardenburg-Imaging tests of HP pigments on Hahnemuhle Photo Rag and Photo Rag Pearl papers.<sup>28</sup>

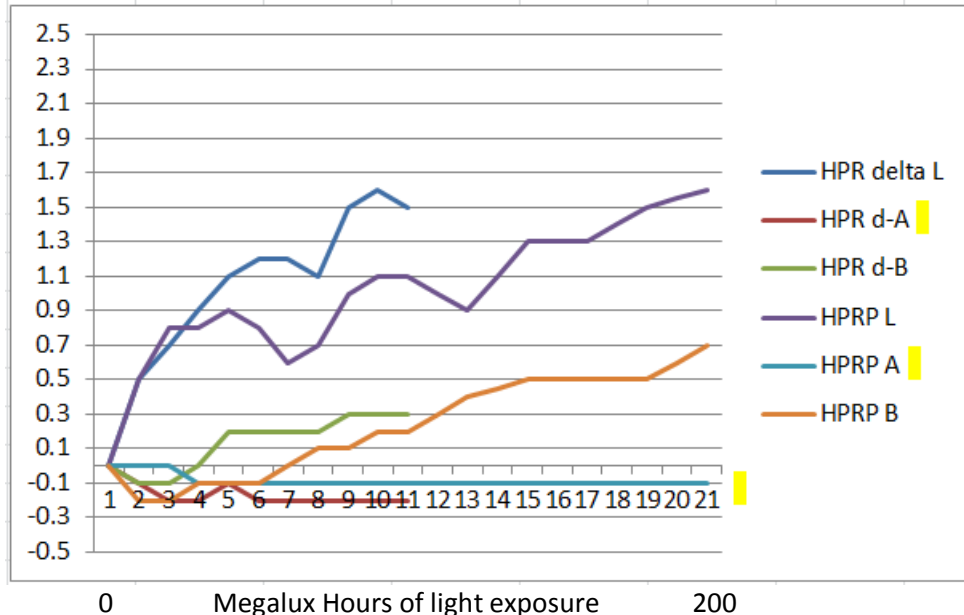
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<sup>26</sup> See <http://www.aardenburg-imaging.com/> for full reports. See also <http://www.paulroark.com/BW-Info/R1800-Lightfastness.pdf> for general information relating to carbon pigment lightfastness.

<sup>27</sup> See [http://www.colorwiki.com/wiki/Delta\\_E:\\_The\\_Color\\_Difference](http://www.colorwiki.com/wiki/Delta_E:_The_Color_Difference)

<sup>28</sup> It appears that HP uses its gray inks exclusively in generating neutral test patches. Epson typically adds some color inks to these.

Change in Lab L, A, and B (delta L, A, & B)  
HP Z3100/3200 Neutral 50% Test Patch



Of particular note are the flat lines for the change in the Lab A (delta-a) values (yellow highlight). A green shift due to differential fade of the color pigments used to cool the carbon has been a weakness with inkjet B&W that uses any color at all. With these HP pigments, however, there is no significant Lab A change over time. Note that with the HPR test, where the 50% patch had a -0.2 Lab A change, the paper base had a -0.6 change. The worst HP pigment Lab A performance for the 50% neutral test patch on a matte paper in the Aardenburg-Imaging database that I found was with Hahnemuhle Photo Rag Bright White. There, at 60 Mlux-hrs the delta-a for the 50% test patch was -0.3. However, that paper had a delta-a of -1.2. So, we could be seeing the impact of the paper's color/hue shift. On the other hand, The HPR test print with Cone Piezography Neutral K6 inks, the delta-a at 100 Mlux-hrs for the 50% patch was -2.6.

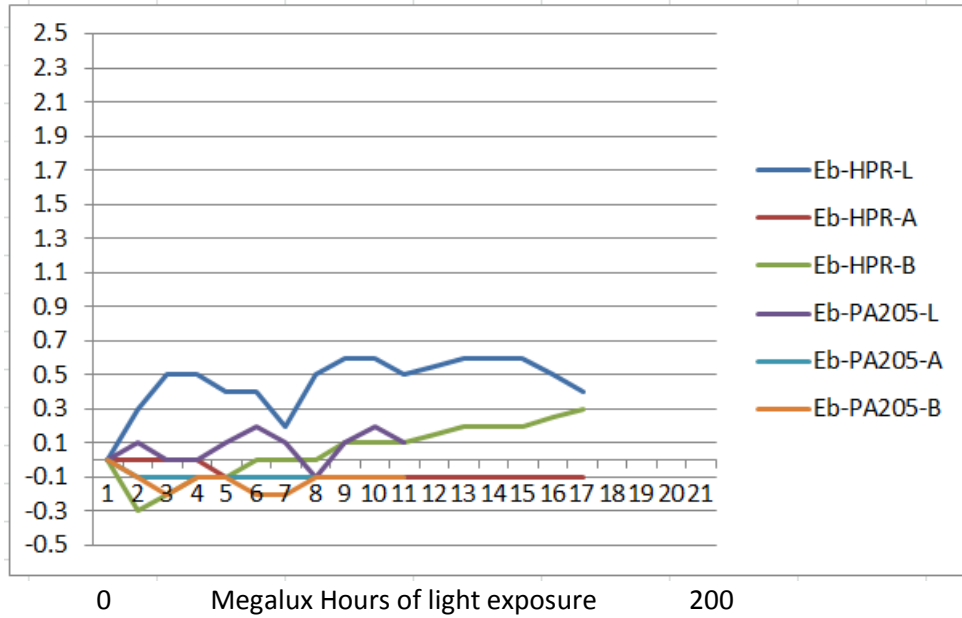
To summarize, in my review of the tests, HP neutral test patches are second only to 100% carbon pigment prints in their lightfastness, and in particular the Lab A stability.

It appears in all the tests that there is an initial non-linear fade rate that exceeds what occurs later. This may be due to an initial "curing" period, oxidation of particles that are on the small end of the bell curve of particle sizes (dust), and perhaps other factors. At any rate, from the starting, no-light-exposure (0 Mlux-hrs) point to the 10 - 20 Mlux-hr point the Lab L, in particular, takes a jump. It is likely that future changes should be judged based on the slopes of the lines after the initial non-linear fade periods.

Note also that these graphs are showing very small changes. A one Lab unit change is considered just perceptible. If one uses Wilhelm Research "years of display" ratings, where 100 Mlux-hrs equals 51 years of display, none of the color changes in the HP graph would be noticed at the ends of the test periods above. The fade would be perceptible in side by side comparisons.

For comparison, the graphs of Eboni carbon pigments on Hahnemuhle Photo Rag as well as on Premier Art 205 (Epson Scrapbook) paper are shown below.

Change in Lab L, A, and B ("delta" L, A, & B)  
Ebony 3-MK Neutral 50% Test Patch



Here, all changes are well below what could be seen.

Epson at one point stated that Epson Premier Art Scrapbook paper was its most archival paper. That is consistent with my tests and the tests I've seen of others. Above, at 100 Mlux-hrs the Ebony on Premier Art 205/Scrapbook paper has increased only 0.1 units. It's at the same place it was at 10 Mlux-hrs. This test sample had also been sprayed with a Premier Art Print Shield. This provides some protection from both UV and oxidation. A UV glass over the print might provide similar protection. The degree to which the Premier Art (Scrapbook) paper sample's superior performance was due to the coating is unknown.