

Setting contrast ratio in X-rite's i1Profiler

originally on the X-rite blog

When we calibrate a display, we specify what is called target calibration aim points. We inform the software that we want a certain White Point or Luminance (specified in cd/m²) of backlight intensity. These aim points are selected to produce a visual match between the display and the print viewed next to it. Therefore, the correct values are those that produce a visual match between these two items.

The new i1Profiler software provides another useful and important target calibration aimpoint: Contrast Ratio. To understand what this aim point does, and why it's so useful, consider what the contrast ratio describes. It's the range between the brightest white and darkest black. Contrast ratio is described using a scale such as 300:1. In this example, the brightest white is 300 times brighter than the darkest black. The higher the value, the greater the range between black and white. Here's the math for figuring out the contrast ratio of a display: Divide the white luminance by the black point. If you calibrated the luminance to 150cd/m² luminance and a black point of .25, that would result in a 600:1 contrast ratio between the brightest white and the darkest black of this display.

Modern LCD displays are capable of producing very high contrast ratios. Manufacturers of such displays like to provide these high values as they are attractive for those playing video games or viewing video content. Yet these high values are not useful for those processing images and desiring a good soft proof between a display and a print. On a very glossy paper stock, using a very black 'photo ink', this print may provide a 300:1 contrast ratio. Yet your display may have a contrast ratio of 800:1, 1000:1 or higher. If you soft proof in Photoshop and use the Simulate Paper Color and Ink Black checkboxes found in the Customize Proof Setup (Fig 1), Photoshop uses the ICC printer profile to adjust the print contrast ratio onto the display. The results are often disappointing because you see this very high contrast ratio display become dim as the proper contrast ratio for print viewing is simulated. It is far better to calibrate the display's contrast ratio rather than adjusting the ratio solely by using the paper and ink simulations in Photoshop. When using just Photoshop to do this simulation, only the image, not the rest of the user interface is adjusted which is far from ideal.

This is where i1profiler's new contrast ratio target calibration aim point comes into play. If you know you will be viewing a glossy print and you wish to have a better match of the screen to the print, start with a target calibration of around 300:1 and compare the image being soft proofed on the calibrated display with the print properly illuminated next to that display. You may need to raise or lower that setting until you get a better match. The same is true for adjusting the white point and luminance! For matching to matt papers, a 200:1 contrast ratio may be a good starting point. It's not possible to provide an exact value! It takes trial and error to produce the best settings because everyone's print viewing conditions, inks, papers, and displays are different. The idea is to control not only the target calibration aim points for white point and luminance for a print match but the contrast ratio too. When soft proofing in Photoshop, with the paper profile loaded and the two simulate checkboxes on, you should see a very good screen to print match. The key is the appropriate calibration target values, and setting the contrast ratio has a profound effect.

Originally an article on contrast ratio for Sony Artisan

Black is back!

I'm an advocate for calibrating and profiling a display. I must have started doing this nearly 10 years ago when colorimeters were expensive and rare and most were nicknamed "Breast Pumps" due to their size (can I say that? – Heck, its IR where you don't necessarily have to be politically correct).

Calibration in the last century.

I was a big fan of the older Radius PressView displays mated with the outrageously expensive 12-bit Thunder video cards. They were expensive, but precise to a degree unheard of in the old days (unless you were wealthy enough to afford a \$5000 Barco). Over the years I've discovered a number of nice solutions for calibration and profiling of a display. Anyone that's paid attention to my rants on other sites knows I've become a big Sony Artisan fan. While I realize that LCDs are sexy, and will no doubt become the dominate type of display for the future, they simply don't provide the level of color accuracy I need. But this isn't going to be an article knocking LCDs (although I have plenty of ammo on where they fall short). Instead, I wanted to discuss some of the reasons why the accuracy and repeatability of black calibration is so critical.

Black is beautiful.

Its difficult to discuss and show how important black accuracy is on a system like the Artisan when readers may not have an Artisan to view the examples on. Still, I'll present a file (see 'downloads') that you can attempt

to view and hopefully, you'll get the idea of where I'm coming from. The file "Dynamic_Range.tiff" needs to be examined in Photoshop. The file is untagged and you need to open and assign your display profile. What you see here are four different representations of the same file. These four versions have been produced to simulate the effect of different black settings of a display on a single file (note that this was done for illustration purposes. To do this "for real" we'd need four Artisans with the same image, but with four different calibration aim points – so use this as an illustration).

Calibration of black level.

Each of these images represents the differences that can occur if the calibration of a black varies over $\pm 0.2 \text{cdm}^2$ *. This is what the better CRTs with control over the individual guns say they can produce after calibration. In other words, there is a "fudge factor" of $\pm 0.2 \text{cdm}^2$ that these display systems claim they can hit. If a user were to calibrate to a black point of 0.34cdm^2 , with such a fudge factor, any of the images seen in this file could result each time the display is calibrated. Notice the effect of the color of the models skin in each example. On better-calibrated display systems, you'll really notice how the difference in just black affects not only the shadows but the colors in an image.

*The candela per meter squared (cd/m^2) is the standard unit of luminance. It represents a luminous intensity of one candela radiating from a surface whose area is one square meter.

In addition, if you look at the image in the top left and bottom left (or top right and bottom right), you are seeing how the same image will preview with a variance of $\pm 0.2 \text{cdm}^2$! In other words, it is entirely possible that you could calibrate your display on Monday and open a file, which would preview like the top left image. Open the same image on Friday and that file would preview like the file below it (bottom left). Keep in mind that this variance of $\pm 0.2 \text{cdm}^2$ is from a calibrated display system using internal electronics to adjust the RGB guns and using a true Colorimeter. Why the fudge factor? Well measuring black is difficult to do! It takes a sensor that is designed for reading very low levels and it takes a display that can produce very fine adjustments electronically inside the display itself. I was shocked and surprised to learn that the Artisan is able to calibrate to $\pm 0.2 \text{cdm}^2$ or 10X more accurately than the systems mentioned above. What this means is that when a user calibrates to a fixed black point, they get it and they get it over the life of the display. Day in and day out, the same image

previews identically.

This, by the way, isn't a profile issue, but rather a calibration issue. ICC profiles have no information about the dynamic range of the display they are fingerprinting. It is also important to keep in mind that keeping a black level calibration over the course of about a month isn't easy, but is necessary. Users expect to view a file today and a month from today see the same preview. Unfortunately, there are only two display systems I've run across that can do this, and the Barco cost about \$3500 more than the Artisan.

Dynamic Range

This image illustrates another interesting example of dynamic range or contrast ratio. You can see (well I hope you see) in this file that each image appears differently due to the contrast ratio between black and white. Imagine if you could calibrate the display to hit these ratio's and then view images based on how they will be output. Well Artisan can do this! Because one can set a fixed ratio between black and white, Sony placed controls in the software that allows users to calibrate to a number of colorspace with contrast ratio's that run from 500:1 on down. The ability to control the contrast is a major feature of the Artisan CRS system! Control over contrast allows a user to set the dynamic range of their calibration aim points in an extremely accurate and repeatable fashion that, until now, has never been offered in a display system. Think of dynamic range as the number of tones, or steps, between black and white. In a photo-centric terminology, one could say this is the number of "stops" between black and the whitest highlight. A photo with a 5-stop range has a wider dynamic range than a photo with a 3-stop range.

Artisan allows multiple settings for black and thus the dynamic range from black to white, in precise numbers of contrast ranges. The reason one would pick a certain range over another would be to better preview (soft proof) images for certain kinds of output needs. For example, if a user were doing fine art output on say an Epson 9600 printer with matt black inks, they would find that using the "CRS Fine Art" ColorSpace which has a 500:1 contrast ratio would produce far better and more accurate previews in Photoshop than a ColorSpace with a lower ratio. If a user were going to view a file to be output on a printing press, the "CRS Print" Colorspace which has a 300:1 contrast ratio would be a much better option to pick. Artisan allows users to calibrate to a number of contrast ratios and pick them quickly in the software before viewing files for intended output needs.

Which to pick?

For fine art output to devices like an Ink Jet, one would use the FineArt 500:1 ratio.

For output to photographic devices like a dye-sub, the Photo 400:1 ratio is ideal.

For output to press and an ink-on-paper like reproduction, one would use the Print 300:1 ratio

Figure 1 should show the effect of the contrast ratio on a single image. Notice that the same image appears quite differently with regard to the shadow detail based on the contrast ratio picked. Notice also that the color in the models face looks slightly different due to nothing more than a change in the setting of black! This illustrates how important it is to set and maintain a black setting for calibration and how picking different aim points (Colorspaces) is useful in previewing files. Please note that good output profiles are necessary for accurate soft proofing of images in ICC savvy applications like Photoshop. However, Artisan takes this to a new level by incorporating the ability to calibrate and use different contrast ratio's for different output requirements. Artisan takes soft proofing to another level thanks to its ability to be calibrated to different aim points and keep that calibration accurate at all times!

Test for yourself.

There are some tests you can try on your display system to see how it stacks up. Here's a great test from Imaging Revue expert Bruce Fraser:

1. Launch Photoshop.
2. In Photoshop, set your working space to 'Monitor RGB' so that RGB values get sent directly to the monitor.
3. Make a new document (size isn't important).
4. Fill the document with black (you can use the fill command).
5. Zoom in so document fills screen.
6. Using the rectangle marquee tool (no feather), make a selection in the center (size isn't important but don't make it tiny).
7. Hide the marching ants (command H).
8. Click on tab key then "F" key so that ALL you see is black (full screen mode)! You should see JUST a black screen (no palettes or menus).
9. Call up the Curves dialog (command M). If possible, move it to the side or better, to a 2nd display.
10. Ok, click, as carefully as you can, on the BOTTOM curves point that represents 0/0/0 (black). Using your arrow keys, move the up arrow one click at a time until you can see separation between pure black outside the marquee and the new values in the marquee.

Do you see a difference? Keep pressing the up arrow one press at a time. Do you see a difference between each press of the arrow? Is the difference between each press constant? Also look at the neutrality as you move the arrow key up and make the inside square lighter. Do they remain neutral or do you see a color shift (usually magenta/green). On the Artisan, the lighter square remains dead nuts neutral throughout all steps. On my Artisan, I can see a difference between 0/0/0 and 1/1/1! On most other displays, I have to move the levels up to 6 or more.

Conclusion:

If you need the most accurate soft proofing for, say a scanning or color correction/retouching workstation, you need a display that is consistent at nailing black. The Artisan is a display that was built to achieve this and more. In addition to being extremely accurate, the calibration is conducted internally rather than on a look up table to the video card like most other solutions. That means that a black to white gradient displayed on an Artisan as smooth as a baby's butt and neutral from black to white. Try that on your display.

Nothing is More Important Than Black!

Other display calibration systems exhibit a typical error at black of +/- .2 cd/m². The target black you request can produce a different result each time you calibrate the system. Given a target of .34 cd/m² black and 85 cd/m² at white any of these images might result. The Sony Artisan Color Reference System exhibits a typical black error of +/- .02 cd/m², 10 fold better. Look at each image, notice the large apparent shift in the skin color (a midtone) when black moves. Artisan provides 18 repeatable steps of control between the first image and the last. The black you ask for, the one you need, today tomorrow and next year.



Black @ .17cd/m², Contrast Ratio 500-1



Black @ .24cd/m², Contrast Ratio 350-1



Black @ .34cd/m², Contrast Ratio 250-1



Black @ .54 cd/m², Contrast Ratio 150-1