

## ICC PRINTER PROFILES RESEARCH WITH COLOR THINK PRO SOFTWARE AS A METHOD FOR COLOR MANAGEMENT EDUCATION

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**Abstract:** In accordance to the authors' science project of evaluating the quality of office color printers, sponsored by the Bulgarian Science Research Fund, the following article will investigate a part of the "jungle" of color management and its implementation in color quality evaluation, namely – ICC printer profiles. How do you know if your ICC profile is valid? If the profile is for a printer, you can output a number of representative images and examine the prints under controlled lighting. Various problems, including poor output quality or print-to-screen mismatching, are not uncommon, and it can be difficult to root out the problem within the color management chain. Was the device behaving properly prior to generating the profile (are all ink heads firing)? Is a series of gray patches really gray or do they only appear to be under this lighting? Is the gamut of the device sufficient to reproduce the colors in your images? Such questions are best answered with the analytical and statistical data obtained from a profile. Looking at the problem as numbers can point you toward areas to further examine then fix.

**Keywords:** Color, Color management, color management education

### 1. COLORTHINK PRO SOFTWARE

One utility for gathering a wealth of information about ICC profiles is ColorThink Pro from Chromix Company. It would take many pages to give an overview of all the features and capabilities of ColorThink Pro, so we'll just hit the highlights. ColorThink Pro is a new, improved and more powerful version of the original Color-Think. Its new power comes in a surprisingly easy-to-use mode called ColorSmarts Guide. Simply select the function, such as evaluating the quality of a profile or device, and select the tests in the box at the left. A step-by-step wizard will ask you to select a profile or other necessary information, and the ColorSmarts Guide will do all the work. You really don't need to know anything else about the program's internal workings.

### 2. COLOR MANAGEMENT PRINTER PROFILES TESTS

Here we present a few useful tests that provide feedback about how an ICC profile behaves. We've selected *Evaluate a Profile* and then *Evaluate*

*Neutral Rendering*, and then we are asked to select an ICC profile.

#### 2.1. Evaluate a profile test

ColorThink Pro did all the work in producing the results in Figure 1. You see the red, green and blue curves of the ICC profile (we selected an Epson Stylus Photo 2400 and glossy paper). As we move the cursor from left to right, we can examine the neutrality of the curves within the ICC profile, from black to white, while keeping a close eye on the chroma bull's-eye at the lower right of the Profile Inspector window. A chroma value of 0 would indicate a perfect neutral; 0 chroma indicates no hue. This profile is pretty good; the worst area has a 1.0 chroma at level 12.

Notice in the second Profile Inspector, a profile of an Epson 2200, neutrality is so poor you can't see even a red dot in the chroma area. At this point in the curve the value is a whopping 16. Obviously something's wrong with this profile, and thanks to ColorThink Pro, we know why; due to a clogged print head, there was no dark cyan ink used when the profile target was built.

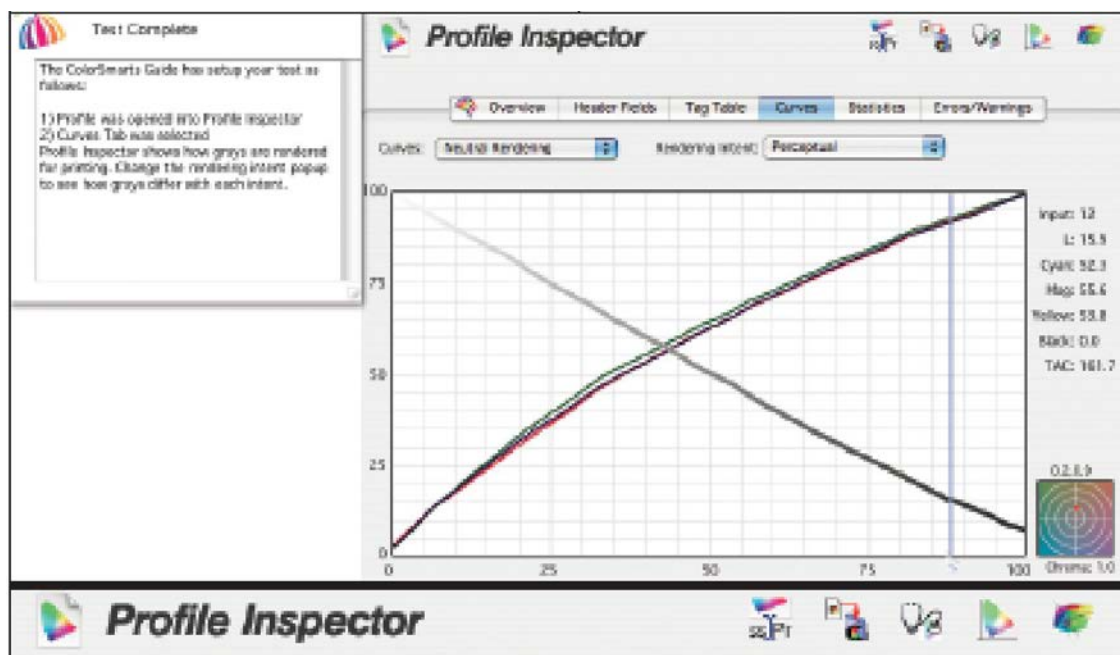


Figure 1 : The ICC profile

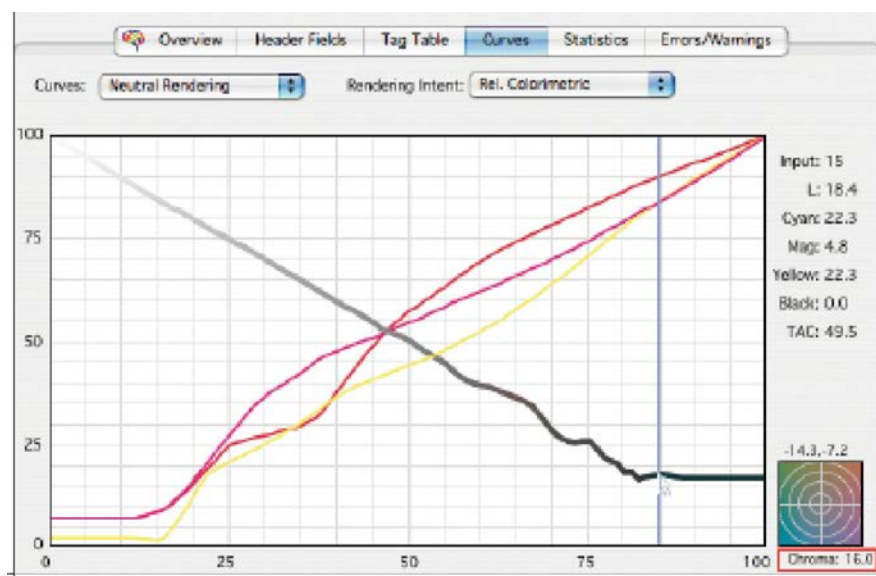


Figure 2 : The first Profile Inspector window

Figure 2 - The first Profile Inspector window shows a very low chroma value of 1.0 at level 12. However, the second Profile Inspector window shows a very high chroma value (outlined in red) of

16, due to this profile's having been built on a printer with a clogged print head.

## 2.2. Evaluate device RGB calibration test

Since an output profile provides data about the device it is based on, this profile provides useful information about each device. When we click on **Evaluate a Device** in the ColorSmarts Guide, we are presented with six options. We select **Evaluate Device RGB Calibration**. ColorThink Pro's online help (in the far right window) tells us this test will evaluate the neutrality of a device at the time the profile was built. We simply select a profile and click the Next button. ColorThink plots the neutrals in a three-dimensional graph that can be rotated. In Figure 2 you can see the results from the same Epson 2400. Spinning this plot around an axis makes it much easier to see where the grays fall outside a perfect neutral; a perfectly straight line of dots running vertically from black to white.

This is illustrated when we plot an RGB working space —Adobe RGB (1998)—using the same test. The balls line up perfectly in the vertical axis. Each of the 256 values in Adobe RGB (1998) is neutral, a benefit of all RGB working spaces.

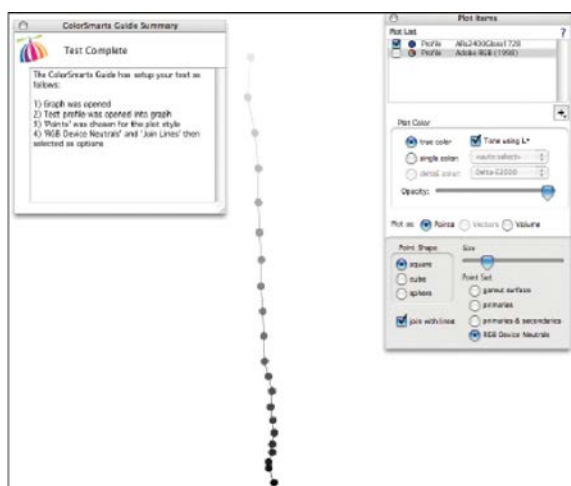


Figure 3: The results of the test

Figure 3 show the results of this test how well the printer behaves with respect to neutrals from black to white.

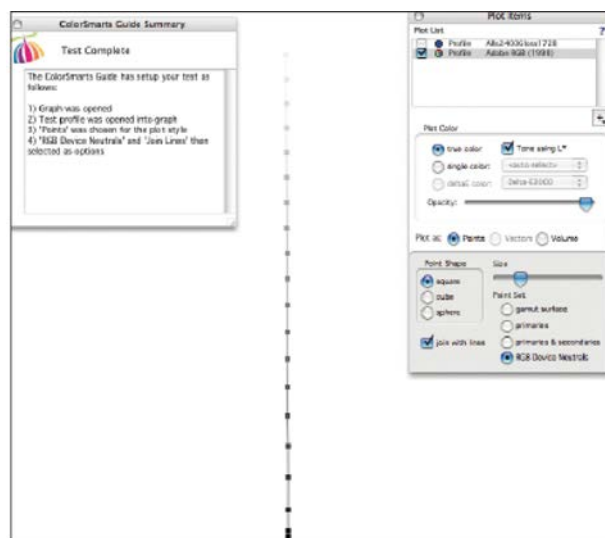


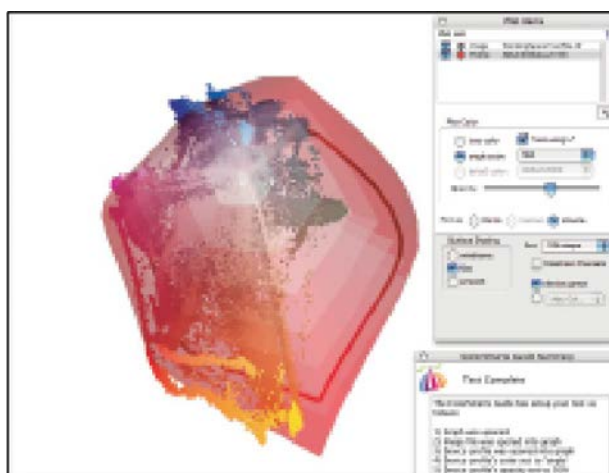
Figure 4: The graph of Adobe RGB

Figure 4 shows spinning of three-dimensional graph makes it easier to see where neutrals shift. Notice that even in print, the graph of Adobe RGB is perfectly straight along the vertical axis.

### 2.3. Gamut comparison tests

One more useful test: we can compare the color gamut of any image to the gamut of any device using ColorSmarts Guide. We simply select an image and an ICC profile. We again selected the Epson 2400 and a drum-scanned image with highly saturated colors. In Figure 3 the gamut of the printer is in red and the actual colors from the image are represented as colored dots, one dot per color. You can see that some yellow, blue and magenta dots fall outside the gamut of this printer. We can spin this three-dimensional graph to see the entire color space. Notice, too, that the red gamut representing the Epson printer has a controllable translucency so we can see where the colors of our image fall.

Figure 3 shows the gamut of a printer and an actual image. Each colored dot represents the gamut of the color in the image.



**Figure 5:** Gamut of a printer

### 3. Conclusion

ColorThink Pro and ColorThink are great teaching tools because they show us how the color spaces of devices and images interact. One can even record a QuickTime movie of a spin of these gamut plots to share with other researchers or students. The software presented is a valuable tool for the authors' science research project – "Development of a stand and a methodology for color print quality evaluation of office print equipment", sponsored by the Bulgarian

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