



Technical Newsletter: HP Advanced Profiling Solution

June 10th, 2007



Summary

The HP Advanced Profiling Solution (APS) powered by X-Rite is an integrated solution for calibrating and profiling monitors, profiling HP Designjet Z Photo Printer series and for validating and optimizing ICC profiles.

A number of profiling solutions are available ranging from the in-the-box HP Easy Profiling Solution (EPS), over optional software and hardware bundles like APS, to high end stand-alone software packages like X-Rite ProfileMaker, Monaco, or Heidelberg PrintOpen. The features and price points of these solutions vary widely, from very easy to use and included in the printer purchase price, to quite sophisticated and expensive.



The HP Advanced Profiling Solution powered by X-Rite represents a reasonable middle ground with respect to features and price. All solutions provide good colorimetric accuracy, but especially the details of perceptual rendering intents can and do vary. As usual, the best advice is to compare carefully and use the most fitting tool for the job.

In the following pages we describe in detail the HP Advanced Profiling Solution (page 2-5) and we provide a comparison to other profiling solutions (page 6).

What is the HP Advanced Profiling Solution (APS)?

The HP Advanced Profiling Solution (APS) powered by X-Rite is a software and hardware package for generating ICC profiles, with a wizard style user interface.

It uses the HP Designjet Z Photo printer series' Embedded Spectro-Photometer (ESP) for printer profiling, and an in-the-box X-Rite Eye-One Display 2 colorimeter for monitor profiling. Both Mac and Windows versions are available. APS is sold as a software accessory by HP and/or bundled with certain versions of the HP Designjet Z Photo printer series (region dependent). The figure below shows the main user interface.



What does APS do?

HP APS calibrates and builds International Color Consortium (ICC¹) compliant color profiles for HP Designjet Z Photo Printer series and for any computer monitor.

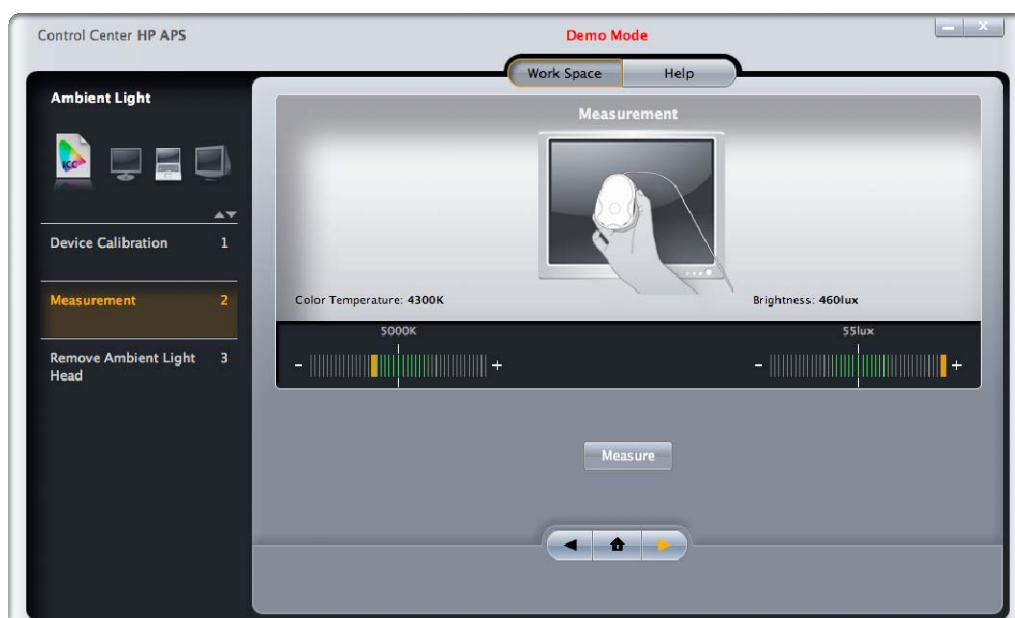
ICC profiles describe the range of colors that a given device can capture or produce, and how to obtain those colors. They are a fundamental element in

¹ www.icc.org

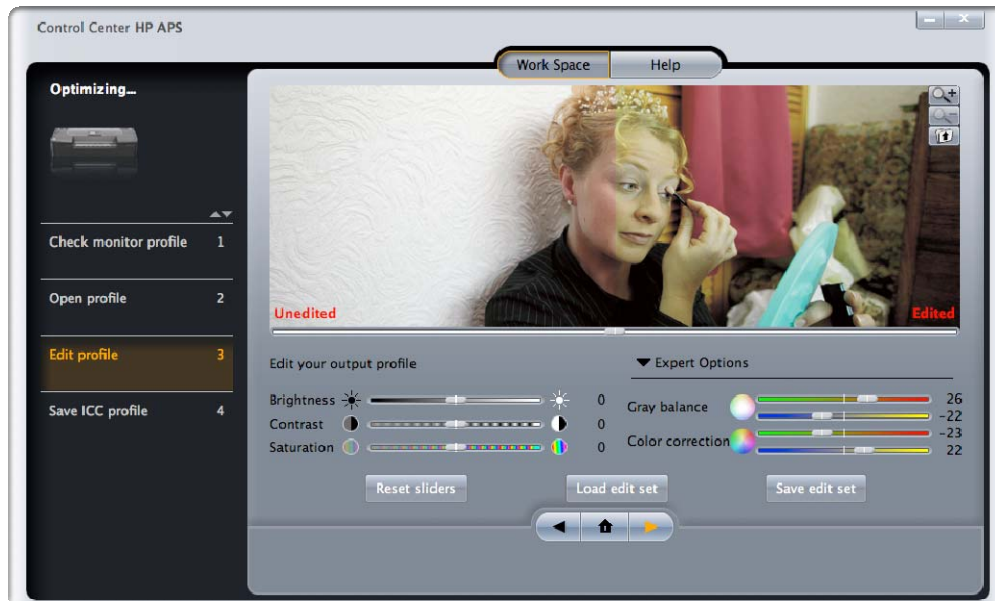
digital color management. A number of options are provided for monitor calibration (white point, gamma, and luminance) and for Z series printer profiling (chart size, profile size, gray axis style, and viewing light source). The printer profiling parameters user interface is shown below.



The standard RGB driver print path can be profiled via an on-line workflow (with integrated chart printing), and third party print paths (e.g. using a Raster Image Processor) can be profiled via an off-line workflow (with separate printing and measuring/profiling steps). APS also lets you validate your viewing environment ambient lighting conditions, and lets you edit the HP Designjet Z Photo printer ICC profiles it has created. The ambient light check user interface is shown below.



The printer profile editing user interface is shown below.



What does APS *not* do?

APS does not create ICC profiles for scanners, digital cameras, or other kinds of input devices. It does not work with X-Rite Eye-One or other standalone colorimeters or spectrophotometers for printer profiling.

While it has a number of parameters for monitor and printer profile creation, it does not have the sophisticated separation or black generation, gamut mapping style, and other controls that some profiling packages offer.

The list of supported viewing light sources is more limited (D50, D65) than some other packages. It does not support software correction for optical brighteners.² It generates RGB and CMYK printer profiles, but not multi-color or device link profiles.³ The included printer profile editor is a visual one (using a sample image) for the perceptual rendering intent, and it uses a simple slider based user interface.

² The HP Designjet Z Photo Printer series embedded spectrophotometer has a built-in UV-cut filter, which makes software correction for optical brighteners unnecessary and irrelevant.

³ The fact that RGB or CMYK profiles are being used does not imply that only RGB or CMYK inks are being used to print the targets. All inks present in the Z series (8 or 12 depending on the model) will be used via the standard printer drivers. Third party RIPs typically do the same, but details are RIP-dependent.

It does not allow low level editing of render tables or other ICC profile tags (components).

Does APS guarantee a perfect match to monitor (WYSIWYG⁴)?

No, it does not, and no profiling package does. A *color match* implies no perceivable difference (or zero delta-E) between one medium (the monitor) and another (the print), even when seen side by side. This is only achievable for some colors (in the intersection of the two device gamuts) in lab conditions with the strictest control of viewing environments, viewer adaptation, and other variables, which makes it impractical for real world applications. General color gamut size and shape differences between monitors and prints imply that there will always be colors that can be reproduced on one device but not on the other, and vice versa – obviously making a *match* impossible for those colors.

What APS can do, however, is to calibrate monitors and printers to a good degree of accuracy and repeatability for each device, generating the corresponding ICC profiles. These profiles can be used in application software and color management systems in general, which can provide a good degree of similarity between monitors and prints if configured correctly and used correctly (in the appropriate viewing conditions, for instance). APS does provide an ambient viewing light check using the included colorimeter, which can help determine if the viewing conditions are appropriate.

What's in the box?

The solution includes:

- **HP Colorimeter**, powered by Eye-One technology
 - Calibrate and profile all of your monitors – LCD, CRT, and laptops
- **Profiling Software**, powered by X-Rite that includes:
 - Printer profiling tool: RGB and CMYK print paths, online and offline workflows
 - Display calibration and profiling tool: set white point and gamma, create profile
 - Validation and Optimization tools: check viewing conditions, edit printer profiles

⁴ WYSIWYG: What You See Is What You Get

Printer profiling options

- Supported printer profiling charts:
 - HP Easy RGB 1.2 (45 patches), HP RGB 1.5 (288 patches), HP TC9.18 RGB (1100 patches)
 - HP Easy CMYK 1.2 (45 patches), HP CMYK 1.1 (323 patches), HP ECI2002 CMYK Ref (1496 patches)
- Supported viewing illuminants: D50, D65
- Neutral axis style: Paper Colored Gray, Neutral Gray
- Black generation parameters (CMYK profiles only): Total Ink Coverage, Black start, Max Black

Technical specifications

| Ordering information | |
|---|---|
| Q6695A | HP Advanced Profiling Solution International |
| Q6701A | HP Advanced Profiling Solution Japan and Asia Pacific |
| Recommended system requirements | |
| Macintosh | Apple Mac OS X 10.3.9 or above: Mac G5, 1 GB RAM, 2 GB available hard disk |
| Windows | Windows XP or 2000: Pentium IV, 3 GHz, 1 GB RAM, 2 GB available hard disk |
| Other | High-speed internet connection, 17" or larger color monitor with 1024 x 768 pixel resolution is recommended |
| Supported devices for monitor profiling | HP Colorimeter (provided) |
| Supported devices for printer profiling | HP Embedded Spectrophotometer (Designjet Z series) |
| Connectivity | USB 2.0 (Win & Mac), TCP/IP |

How does APS compare to other solutions?

In general, we distinguish a number of different profiling solutions for the HP Designjet Z Photo printer series, which we will group into levels:

- A. In the box: Every HP Designjet Z Photo printer series comes with a complete printer calibration and profiling solution in the box, known as the HP Easy Profiling Solution (EPS). It is accessed via the Color Center or Printer Utility, and it uses the Z printers' built-in spectrophotometer. As the name indicates, this solution is aimed at maximum ease of use, and hence provides no profiling parameters beyond the profile name. EPS generates RGB printer profiles only for the Z2100 and Z3100 series, and CMYK printer profiles only for the Z6100 series.
- B. HP software accessory and/or bundle with some printer versions (region dependent): The HP Advanced Profiling Solution powered by X-Rite is a software and hardware bundle with a broader scope (monitor and printer profiling, RGB and CMYK printer profiles, viewing condition measurement, profile editing) and with more flexibility (different profiling charts, online and offline flow, neutral axis style, etc.).
- C. Profiling software bundled with or integrated in third party Raster Image Processor (RIP) solutions, using the Z series' embedded spectrophotometer (ESP). The functionality and features are solution dependent.
- D. Stand-alone profiling software packages such as GretagMacbeth (now X-Rite) ProfileMaker, Monaco (now X-Rite) Profiler, Heidelberg PrintOpen, and others. These packages may or may not work with the Z series' embedded spectrophotometer (ESP), but typically do support a variety of stand-alone color measurement instruments. The functionality and features are solution dependent, and range from very simple to very sophisticated.

Characterizing the performance of levels A and B is obviously easier than C and D, mostly because the number of solutions in levels C and D are potentially quite large. In what follows we will use just a few representative examples. The matrix below summarizes the differences between EPS (level A) and APS (level B).

| | | hp Color Center | HP Advanced Profiling solution |
|-----------------------------------|--|-----------------------------|--------------------------------|
| Printer profiling | Select from predefined illuminants: D50 or D65 | NO | YES |
| | RGB ICC profile generation. Select from various test charts HP Easy RGB 1.2 (45 Patches), HP RGB 1.5 (288 Patches), HP TC9.18 RBG (1100 Patches) | Embedded Color Center chart | YES |
| | CMYK ICC profile generation. Select from various test charts HP ECI2002 CMYK Ref (1496 patches), HP CMYK 1.1 (323 patches), HP Easy CMYK 1.2 (45 patches) | NO | YES |
| | Predefined separations (ink limit) Optimized for HP media, Standard Inkjet 260, Standard Inkjet 400 | NO | YES |
| | RGB and CMYK profile edition | NO | YES |
| Monitor Calibration and Profiling | Calibrate and profile all your monitors LCD, CRT and laptops | NO | YES |
| | Adjustments for advanced users White point, Gamma and Luminance Contrast, Brightness and RGB calibration | NO | YES |
| Validation | Ambient light measurement | NO | YES |
| | Automatic Monitor Profile Validation after calibration | NO | YES |
| Optimization | Wizard based profile edition for RGB and CMYK profiles | NO | YES |

Table: Comparing Easy Profiling Solution (Color Center) and Advanced Profiling Solution features.

Colorimetric accuracy

Color profiles can be evaluated numerically with regards to color accuracy, which is relevant e.g. for proofing applications. The figure below illustrates typical print-and-measure color differences in delta-E (1 dE being the smallest perceivable difference in theory) for the 46 colors represented in the FOGRA⁵ color control strip processed through the same ISO coated input profile and different HP Designjet Z3100 Photo Printer output profiles generated with different profiling packages, on HP Premium Instant Dry Satin paper, in ICC Absolute Colorimetric mode.

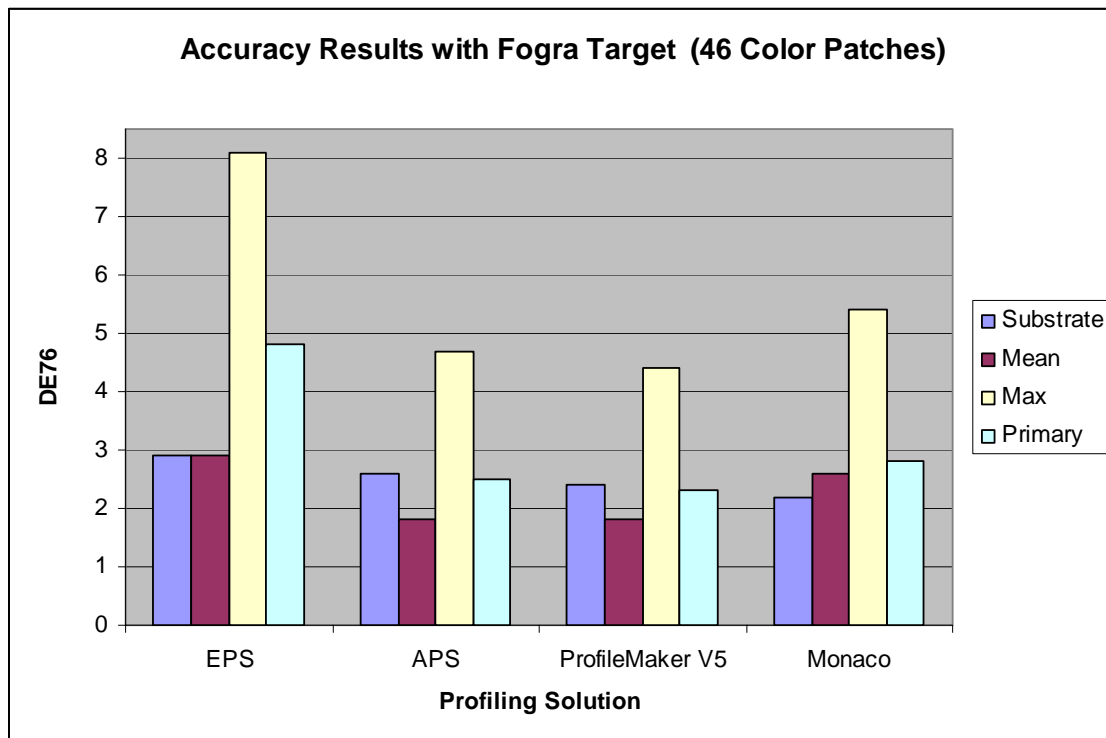


Table: comparing typical print-and-measure color accuracy results for different profiling packages, using the FOGRA color control strip and the HP Designjet Z3100 printer on HP Premium Instant Dry Satin paper.

Perceptual rendering

For photographic applications, numerical color accuracy is less important than what the final print looks like to an observer. Unfortunately this is a rather difficult thing to measure quantitatively, because we have no access to directly measurable quantities inside observers' heads. The results can and do also depend on the type

⁵ <http://www.fogra.org/> FOGRA is an international organization with the objective to promote print engineering and its future-oriented technologies in the fields of research, development and application, and to enable the printing industry to utilize the results of this activity

of images printed, the type of substrate (paper) being used, the viewing environment that prints are seen in, the kind of application or use that prints are meant for, and even who is doing the viewing, their psychological state, and eventually personal preferences.⁶

Having said all that, we can provide a rough indication of observer preference for a particular test image printed with the Z3100 on HP Hahnemühle Smooth Fine Art paper. Obviously this can only be taken as indicating a trend for a particular image, paper, and group of observers. As always, *your mileage can vary*. The figure below illustrates the test image, made available on the internet by well-known photographer and color management guru Bill Atkinson (<http://www.billatkinson.com/>). As specifically established by Bill Atkinson in his web site: *"These files are offered in the spirit of one artist sharing brushes with other artists. I hope you find them useful, but please understand that they come with no support whatsoever. If you need help, ask a friend"*



Figure: Bill Atkinson's test image used for a perceptual print quality test (this is a reduced size version, and converted from the original CIELAB color space to sRGB)

⁶ Or as the ancient Romans would have it: *De gustibus et coloribus non disputandum est!* [One cannot argue about colors and tastes].

The rank order of prints made with different profiling packages under the conditions described above, using Perceptual rendering intent, is as follows (from better to worse):

1. Monaco Platinum
2. HP Advanced Profiling Solution powered by X-Rite, X-Rite ProfileMaker 5
3. HP Easy Profiling Solution

As indicated above, these results must be taken as indicating a trend for a particular image, paper, and group of observers only.