Color Management Handbook

Strategies to master color management in the digital workflow.
Start applying them today.
Is that really the correct color?

“Is this color good to go?”
— A hesitation we often have before making prints in the digital workflow.

Photographer
Is the image displayed on the monitor really accurate?

Designer
Are the application settings on the monitor correctly adjusted and does the color match the printed image?

Retoucher
Is the photograph edited the way it was intended?

Printer
Do the colors in the design comp and color proof match?
A designer’s work environment ➞ Full of potential problems in the digital workflow

Concerns over color in the digital workflow

A monitor to display the data, a printer to check it on paper... Issues concerning color are a constant concern in the production workflow. Anyone involved in creating printed materials is bound to have experienced color variations depending on the monitor used for the check, or a difference in color tones between the comp output and printed material.

What is color management?

Color management provides a unified environment for handling colors where a common color reference is used at each step of production from photography to design, plate making, and printing. It aims to unify the image throughout the entire production by using the profiles of the various devices to adjust their colors.

Monitor

Common color space

Monitor, inkjet printer

Digital camera

Display with applications that support color management

Check under the appropriate lighting

For correct display, use monitors specifically made for color management

Print in the correct color!

Display the data, a monitor to check it on paper...

If we compare the color space widely used in digital cameras, Adobe® RGB, with the printing color standard of ISO coated v2, we can tell that there is a difference in the color gamuts that can be reproduced. These two gamuts cannot be made to coincide, but color management can make them approximate one another. Maintaining an awareness of the final printed color in the finished product in the photographic, design, and plate making stages, and making it the shared standard, makes it possible to handle data smoothly.
The Benefits of Color Management in Practice

Preparating an environment for color management involves installing the appropriate machinery, adjusting settings, and deciding and sharing rules for color management with work staff to remain consistent. While it may be a challenge, we will show the benefits of using a color management system in the creative workflow.

Communication between front-end and back-end of the process is smooth

1. Photographer / Retoucher
   - Illustrator
   - 1st proof → 2nd proof → 3rd proof
   - Good 1st color proof or monitor-based proof!

2. Design company
   - Illustrate
   - Design with the colors as they are on the monitor
   - Output a comp and PDF based on the printer profile

3. Plate making company
   - Plate making
   - Output a color proof via DDCP or an inkjet printer

4. Printing company
   - Accurate display
   - Peace of mind
   - Proof
   - Deliverable

Reduce cost and time associated with reprints and multiple proofs

Reduce cost and time associated with reprints and multiple proofs

You can increase the quality of the final product with these benefits.

What should we be careful about to ensure that data is handled correctly in each process leading up to the finished product? We will deal with each production step separately. By referring to these steps, you can greatly increase your color management accuracy.

- **Photographer**
  - Photograph under a 5000 K light source with printing in mind

- **Retoucher**
  - Embed the profile while working in a correctly lit environment

- **Designer**
  - Design with the colors as they are on the monitor
  - Output a comp and PDF based on the printer profile

- **Printer**
  - Convert images to CMYK while looking at the monitor
  - Output a color proof via DDCP or an inkjet printer

- **Summary**
  - The perfect monitor for every workflow

- **Extras**
  - Define the color space underpinning the work process
Photographer

Photography

Photograph under a 5000 K light source with printing in mind

In ISO international standards “D50” is adopted as the light source for evaluating the color tones in printed materials. This value, determined by sampling based on the human sense of color, is a color temperature of 5000 K. For proper color management it is vital to keep this 5000 K in mind right from the photography stage.

It is possible to maintain color consistency from the photography stage to printing by making the color temperature of the light source during the shoot as close to 5000 K as possible, and by using 5000 K as a yardstick in the white balance settings of the camera and in the RAW development.

Key points when comparing the subject at the shoot and how it looks on the monitor

Use a light source at the shoot that is close to 5000 K.

Use a light source at the shoot that is close to 5000 K.

Retoucher

Retouching

Embed the profile while working in a correctly lit environment

The document profile (source profile) used in the digital printing workflow is Adobe® RGB or sRGB. The white point in these profiles is set as D65 and, based on this, some people hold that the color temperature of the monitor should be 6500 K. However, as was stated earlier, ISO printing standards stipulate viewing under D50 light source and in Photoshop, the white point is also processed at 5000 K. When retouching photographs, it is essential to prepare a 5000 K work environment that accords with these standards. In addition, always embed the profile when saving a file so that the colors of the image can be accurately conveyed to the back-end of the process.

Settings for color sample comp output

When outputting a color sample comp to send to the back-end printing process, choose “Photoshop Manages Colors” for Color Handling and specify the printer profile compatible with the paper. Click on Print Settings and select “Off (No Color Adjustment)” under Mode.

Photographer

Retoucher
Use a monitor specifically for color management.

Why is a color management monitor necessary?

There are many different types of LCD monitors, from inexpensive ones to high-performance models. However, the display properties of the monitor are very important for accurate display and proper color handling. The ColorEdge series shown in 1 has clear gradations for each RGB color, but the monitors shown in 2 and 3 have uneven and fluctuating gradations. This not only means that they cannot display images correctly, but there is also the danger of corrupting high-quality data. It is essential to employ a monitor specifically for color management in the digital workflow.

What is monitor color?

Of the many adjustable color settings, “brightness” and “color temperature” are especially important.

- Brightness of the monitor is expressed in cd/m² (candela).
- Color temperature is the color tone when white is displayed on the monitor expressed in K (kelvin).

Just like the color of paper can look different depending on the lighting conditions, different monitors will display different colors. Correct use of color is possible by adjusting the monitor to the reference.

The ideal monitor

Individual adjustment at the factory

Every ColorEdge monitor is individually adjusted at the factory for displaying the entire RGB color space, giving each one a smooth, consistent display.

Dedicated circuit for display correction

Sometimes LCD monitors may display uneven levels of brightness and color across the screen. Monitors with a dedicated circuit to rectify this ensures work efficiency with a uniform display.

Easy setup using dedicated software

When print output is being evaluated in a 5000 K environment, adjusting the monitor to 5000 K enables good color matching and correct use of color. ColorNavigator 6, dedicated calibration software for ColorEdge, facilitates accurate and quick monitor adjustments to the target color temperature and brightness.

High-precision calibration can be performed in just a few minutes by simply choosing the default 5000 K and 80 cd/m² target values for printing.

Automatically generate accurate profiles

Setting an accurate monitor profile is essential for accurate color matching. With its dedicated calibration software, ColorEdge is able to automatically generate and store an accurate profile.

Color management with an automatic internal sensor

A monitor’s display of color changes over time with use so regular readjustments are important. The ColorEdge CG Series comes with a built-in sensor that automatically adjusts the monitor at user-determined intervals. This gives the user a consistent display that is easy to setup and maintain.
Design

Design with the colors as they are shown on the monitor

Color management has seen revolutionary changes in both the input (photography, scanning etc.) and output (printing) processes. However, in the design process, which lies directly between them, the traditional method of determining colors by CMYK values is still going strong, while there are many cases where people who use monitors with a low level of accuracy are swayed by their visible perception of the colors. However, by using a monitor with excellent tone and color reproducibility, and introducing color management, it becomes possible to simulate the print finishes on the monitor. Both creativity and productivity are boosted when design work is shown accurately on the monitor.

Use the same profile embedded in the image in the design process.

Sometimes the profile embedded in the photographic data is deliberately removed by the designer. This is probably due to an incomplete understanding of systemic color management. Removing an image’s profile puts the colors in an undetermined state and can cause problems in the back-end process. It is important for the designer to use monitors with a high level of accuracy and use the same profile embedded in the image in the design process.

Visible perception of the colors.

Adjust the monitor to match printed material.

Adjusting the monitor so the white of both the paper and monitor match (Paper White Measurement*)

White Paper Measurement with ColorNavigator 6

You can measure the white of the paper by using an external sensor and adjusting the values of the monitor to approximate them.

With ColorNavigator 6’s manual adjustment function makes fine tuning white color very easy!

With ColorEdge, fine tuning the display is possible even after calibration. By visually rescaling the white color, it is possible to derive a calibration target value that is better suited for the matching application.

It is possible to regenerate profiles to match the objective.

With ColorEdge, it is possible to regenerate a profile to better match the objective by performing a remeasurement based on the target values obtained from manual fine tuning.

Influencers

Illustrator or InDesign

Adobe® RGB or sRGB

Arrange PSD or TFF files embedded with the profile just as they are.

By selecting “Europe Prepress 3”, you will be able to select “Preserve Embedded Profiles” for RGB under Color Management Policies.
Matching the monitor color for all workers.

Color quality in the digital workflow can be improved by matching the color of each monitor and having the workers share a common image. There are also two methods by which the color of monitors may be matched.

**Case 1**
Matching them to the printed output

By using each of these methods, color accuracy can be improved.

**Case 2**
Matching them to an industry reference value

Very convenient for in-house color consistency but not compatible outside the company or studio.

**Case 3**
Matching them to the printed output

Provides a high level of compatibility but may not match print output.

By adjusting all in-house monitors to an industry standard, you can establish a basic color management environment. This may not meet necessary requirements in terms of matching with actual print output.

**Comp and PDF**

Output a comp and PDF based on the printer profile

Once the design is finished, the comp is output using a laser printer or inkjet printer. This is a very important stage where the designer and the client both look at the printed output and do a comprehensive check of the composition, color coordination and so on. This cannot be done efficiently if the color tones on the monitor and in the comp output are different. Recently it’s becoming more common to export a PDF file and send it to the client. This is a very convenient way of doing things if the printing colors can be simulated at the PDF stage. Outputting a comp and PDF based on the printer profile makes it possible to share the finished image with the client.

Illustrator or InDesign

PDF output in the printer profile color gamut

**ISO 12646:2008** characteristics of proofing monitor and observation conditions

The appropriate fluorescent lighting

The designer’s work environment

The client’s environment

Acrobat 8 or later
Display using applications that support color management.

For accurate color management, it is necessary to check the data and simulate printing on the display using applications that support color management. To correctly view an image in accordance with color management rules, the application must load each of the profiles for the monitor and the image, and perform accurate color conversion.

For precise color utilization, color settings are first adjusted to the requirements of each job. You can adjust the color settings in any software individually, but with Adobe® Bridge you can save settings across all Adobe® programs at once. Bridge is usable with CS2 and above.

Open Creative Suite and select “Creative Suite Color Settings” under Edit. A window for selecting settings for all applications will appear.

Select the appropriate color setting and click “Apply”.

- For the USA: North America Prepress 2
- For Japan: Japan Prepress 2
- For other countries: Europe Prepress 3

The color settings you choose in Bridge will stay consistent with every Adobe® application so your selection will also carry over.

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Applications supporting color management

Loading the monitor profile

Applications that support color management will automatically load the monitor profile set in the OS.

NOTE:

- Some applications may require manual setup.

Displaying images using applications

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STEP 1
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<tr>
<td>CMYK: Select according to the color standard used in the workflow. When re-embedding the image profile, make selections based on the back-end workflow and the type of end deliverable.</td>
</tr>
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<td><strong>Color Management Policies</strong></td>
</tr>
<tr>
<td>For both RGB and CMYK, select “Preserve Embedded Profiles.”</td>
</tr>
<tr>
<td>Select all color settings so it is possible to make positive identification either when files that have embedded profiles do not match the “Working Spaces”, or when files without an embedded profile are being opened. (Recommended)</td>
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</tr>
<tr>
<td>For CMYK: select “Preserve Colors (Ignore Linked Profiles).”</td>
</tr>
<tr>
<td>CMYK affects how RGB is that it does not define color spaces, but prioritizes percentage values.</td>
</tr>
</tbody>
</table>

STEP 2
Open the image file

Loading the image profile

To open an image file correctly while referencing a profile, select one of the following two methods.

1. Use the profile embedded in the image.
2. Use the profile specified in “Color settings”.

In normal digital work, the embedded profile should be used by selecting method 1.

Use the profile embedded in the image

When opening the file in the application, select “Use the embedded profile instead of the working space.” By maintaining the embedded profile, an image can be handled with the same color setting throughout the digital workflow. When an image is embedded, the color values are locked, which reduces the file size. The color can be viewed in the working space specified in the application’s “Color Settings.” This is a useful function that allows data to come from various external organizations or devices, or when it is necessary to switch profiles depending on the back-end process.
Output a comp to a printer with the correct settings.

For precise color management it is necessary to prepare the printer you will be outputting the comp to with the correct settings.

**Using an inkjet printer**

In order to manage colors using your image software, you must specify a printer profile. While referring to the printer profile and the image profile within the software, we can change the colors for output.

**Using a laser printer**

Laser printers are equipped with a RIP (raster image processor). We will apply the output profile directly to the laser printer (DTP full color all in one printer-copier) so there will be no need to manage color settings in your image software.

Check the color under the correct light source.

**Why the light source must be controlled**

The printed material reflects the light from the light source so colors look different depending on the environmental light (ambient light).

To correctly control color in the digital workflow, it is necessary to evaluate printed material according to set standards with appropriate lighting conditions.

Even with a clear image of the desired color, a change in environment can result in the following:

- Work created under improper lighting
- Correcting colors to match the comp
- The creator’s intended colors
- When printed under proper lighting conditions, it’s different from what was envisioned
Controlling environmental light

Solution

1. Lighting with a high color rendering index and appropriate color temperature.
2. Block outside light and view solely under the appropriate lighting as much as possible.

High Color Rendering Fluorescent Lights*

<table>
<thead>
<tr>
<th>Light source</th>
<th>Color Temp</th>
<th>CRI (RA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Color Rendering Fluorescent Lights</td>
<td>5000 K</td>
<td>99</td>
</tr>
</tbody>
</table>

*Availability outside of Japan may vary.

Use of color evaluation systems can be very effective!

Installing a dedicated color evaluation system will make it possible to perform color checks of printed material in a more optimal environment.

Printed color simulation using Photoshop’s “Proof Colors” command

Converting RGB data to CMYK means revising the image from the wide RGB color gamut to the narrower CMYK one. The image quality deteriorates if this is done repeatedly. Rather than first converting the image to CMYK to perform retouching during the plate making process, you can get better results if you finish the retouching while it is still in RGB form and then convert it to CMYK and make any minute adjustments required. If you select “Working CMYK” in the Photoshop “Proof Setup”, and use “Proof Colors” to switch between them as you work, you can run simulations of the print colors while still in RGB, which makes for more efficient retouching.

Plate making

Convert images to CMYK while looking at the monitor

In today’s digital printing workflow, it is the norm to submit RGB data. Dedicated conversion software is sometimes used to convert RGB to CMYK, but it’s more common to do the conversion in Photoshop. Generally speaking, the profile embedded in the image data in commercial printing is Adobe® RGB, however sRGB data is sometimes submitted. Whichever kind of data it is, as long as you have color conversion software that supports color management, such as Photoshop, and a monitor calibrated to D50 (5000 K), you can do your work with a fairly good idea of how the final print will look.
Color proof

Output a color proof via DDCP or an inkjet printer

Before sending material to be printed, you should check the color proof. Even in an environment appropriately prepared for color management and color properly checked on the monitor, the texture and whiteness of the printer paper, and the reproducibility of the ink used can cause different results. Thus, it is necessary to output a color proof on paper. Here we introduce various kinds of color proofs and their characteristics.

Color proof trends

A flat-bed proof, press proof, DDCP (Direct Digital Color Proofing), or inkjet can be used for printing color proofs to match purpose, cost, and speed. Recently, high-end DDCP is capable of reproducing each dot and is the most popular while inkjet is lower cost by comparison. The main types of proofs are detailed in the chart below.

<table>
<thead>
<tr>
<th>Characteristics of DDCP</th>
<th>DDCP</th>
<th>Inkjet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dot reproducibility</td>
<td>Same as the printer</td>
<td>Differs from the printer</td>
</tr>
<tr>
<td>Paper</td>
<td>Dedicated paper type (fewer types)</td>
<td>Dedicated paper type (including newspaper coating)</td>
</tr>
<tr>
<td>Color space</td>
<td>Slightly narrower than general offset printing</td>
<td>Wider than general offset printing</td>
</tr>
<tr>
<td>Spot color</td>
<td>None</td>
<td>PANTONE, DIC Color Guide, etc. (Difficulty with metallic and fluorescent colors)</td>
</tr>
<tr>
<td>Color stability over time</td>
<td>Good reproducibility</td>
<td>Good reproducibility (Difficulty with metallic and fluorescent colors)</td>
</tr>
<tr>
<td>Cost</td>
<td>Cost increases with mass production</td>
<td>Lower cost (Takes more time for mass production)</td>
</tr>
</tbody>
</table>

What is DDCP?

DDCP printing includes hardware such as laser, thermal, and inkjet. Traditionally in terms of color proofs, DDCP refers to a system required to satisfy the need for high precision output. However, recently it has come to also refer to digital output. Depending on the type, DDCP can be affected by ambient lighting. In order to accurately evaluate a color proof, it is important to maintain a properly lit environment.

Install a suitable light source

Check that the color proof is at 5000K

A large Epson printer equipped with many colored inks

Lighting in the designer’s and client’s environment is important

The environmental light of the designer and the client is very important when checking printed color proofs. As was explained in pages 19-20, the colors will look the same when the environmental lighting in their respective locations is controlled. The efficient creation of high-quality printed materials is possible when communication about color goes smoothly.

Color proofs: from flat-bed proof presses to DDCP, and now ink-jet is mainstream

The need for inkjet output of color proofs is gradually increasing, but paper type is limited and they cannot reproduce moire patterns. When compared to printed color proofs, there are still limitations to its reproducibility. Soft proofing, where proofs are done on a display monitor, may be a way to resolve these technical challenges.
Summary

| Color Management Setup

The perfect monitor for every workflow

So far we have followed each workflow from start to finish, covering correct use of data and putting color management into practice. Here we will introduce some of the features of EIZO’s ColorEdge lineup that are ideal for each workflow.

**Ideal Features!**

- **Vivid Colors Reproduced to Industry Standards**
  The wide color gamut of ColorEdge monitors reproduces almost the entire Adobe® RGB color so images shot in Adobe® RGB will be displayed correctly. This ensures photos of vibrant blue skies and lush green forests are reproduced faithfully.

- **Stable Color in Just 3 Minutes**
  Many CG Series monitors take a mere 3 minutes for the brightness, chromaticity, and tone characteristics to stabilize. Whether you are working in a studio or taking the monitor with you on location, you get reliable color display soon after turning the monitor on.

- **Consistent Color Throughout the Workflow**
  Using ColorEdge throughout the photography workflow ensures the same color information is shared at each step of the process. You can adjust the monitors to display the same colors using ColorNavigator 6 software bundled with every ColorEdge monitor.

- **Complete Matching Between Screen and Prints**
  The wide color gamut of ColorEdge monitors ensures reproduction of almost the entire ISO-coated and US web-coated CMYK color spaces so you can ensure the prints match the image on screen.

- **Easy Recalibration to Maintain Color Consistency**
  The calibration sensor that comes built-in to the ColorEdge CG Series saves your calibration settings and will readjust your monitor automatically at user-defined intervals for peace of mind.

- **Save Multiple Adjustment Values with ColorNavigator 6**
  List and create several project goals such as printed materials, web contents, and comp output using ColorNavigator 6. With one button, you can easily create materials for smooth color communication throughout the workflow.

- **Design Freely with Ample Screen Space**
  ColorEdge 24.1” models display two A4 pages plus tool palettes for flexible use of space. The 27” models give you even more room with their spacious screens.

---

**Recommended Monitors**

- **For Professionals**
  - **ColorEdge CG Series**
    Get the best in both color and convenience for the optimal creative workflow.

- **For Hobbyists and Prosumers**
  - **ColorEdge CS Series**
    Create, edit, and enjoy photography, illustration, and more.

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**For Professionals**

- **Take photographs under a 5000 K light source with printing in mind**
- **Use a display monitor specifically for color management to perform reliable calibration**
- **Create an appropriately lit environment and embed the profile**

**For Retouchers**

- **ISO12646: 5000 K, 80 cd/m², gamma 2.2**
- **Construct a viewing environment that conforms to industry standards**
- **Convert to the printer profile on a monitor capable of accurate display**
- **Check the color under the correct light source**

---

**For Designers**

- **Printed output is checked under a 5000 K light source**
- **Print accurately on proofing paper**
- **A high-quality finished product**

**For Clients**

- **A high-quality finished product**
- **Client**

**Printer**

- **Connect to the printer profile on a monitor capable of accurate display**
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Creating digital content

Define the color space underpinning the work process

As IT has become more widespread and sophisticated in recent years, printers and designers who used to create content mainly aimed at printed materials are now having more and more opportunities to become involved in the creation of digital content. Product advertising that uses digital media and e-commerce is expanding in scale and becoming more important with every passing year, and color reproduction in digital content is now a problem that cannot be ignored.

Color matching for digital devices

Most of the end-use display devices, such as tablets and digital signage, do not have a color space or profile that can act as a reference when creating content. Nor are they installed with a color management function that would use such benchmarks.

It is therefore necessary to do the creative work on a monitor which can reproduce the tones of the display device in order to produce a design with the intended final color tones.

Device emulation

Using ColorNavigator 6, the dedicated calibration software, the ColorEdge CG Series provides an emulation function for the color tones of devices such as tablet computers. Emulation is performed by reading color patches displayed in the web browser of the emulated device, and creating an ICC profile which is adopted for the ColorEdge’s internal parameters. This function can be used with a variety of devices such as smartphones, portable game terminals, and CRT monitors as well as tablets.

Device emulation requires a supported external sensor (i1Monitor, i1Pro, i1Pro 2, ColorMunki).

ColorNavigator 6 automatic measurement technology used to display on Web browsers is EIZO patented technology.

Color management of web content

There is an increasing need to create web content with accurate color display, particularly for e-commerce sites. However, the color tones on the devices displaying the web content depend on the web display environment of each user. It is thus effectively impossible to have all users view the content in the correct color tones.

Viewing conditions on various monitors using sales websites

There is great diversity in the color tones of the devices that display web content so recently more and more browsers are equipped with a color management function. Browsers such as Safari, the Mac standard, and Firefox in the Windows environment are compatible with color management functions, so it is desirable that images for use in web content be embedded with a profile. On the other hand, there are still many environments, such as the long-established Internet Explorer, that are incompatible with color management functions so it is probably safer to create images using the sRGB color gamut.

When creating web content it is necessary to conform to the highly versatile sRGB, designated as the web standard by the World Wide Web Consortium (W3C) and to think about how to enable as many people as possible to see the intended colors.

Compatibility with web browser color management

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