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?
The first time I laid eyes on Terry Lennox he was drunk in a Rolls-Royce Silver Wraith outside the terrace of The Dancers. The parking lot attendant had brought the car out and he was still holding the door open because Terry Lennox's left foot was still dangling outside, as if he had forgotten he had one. He had a young-looking face but his hair was bone white. You could tell by his eyes that he was plastered to the hairline, but otherwise he looked like any other nice young guy.

No more color worries. The basics of color management.

We will explain about the key points in each production step. Keep these in mind to significantly improve your color management.

**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 print production digital 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.

Poor color management in the digital workflow can lead to significant concerns at the back end of the process.

Monitor

Display with applications that support color management

For correct display, use monitors specifically made for color management.

Color data of the device

Check under the appropriate lighting

Is the monitor’s colors accurate?

Are the color settings of the application correct?

Is it properly calibrated?

Is it printed with the right color?

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.

Monitors and printers have their own color idiosyncrasies and it is impossible to make them a perfect match. However, it is possible to convert the color data of each device via a common color space (a color space independent of any device) so that the various colors can match more closely. This is the basic principle of color management.

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.

**Color management in practice**

Color management can be performed by following a set of rules to correctly handle the data. Color management will not only improve the end quality but also bring other major benefits to each work step.

A designer’s work environment

Full of potential problems in the digital workflow

Color data of the device

Color data of the device

Color data of the device

Common color space

CIEL*a*b, etc.
The Benefits of Color Management in Practice

Preparing 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.

**The key points in production steps.**

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.

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

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

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

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

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

6. ** Extras**
   - Define the color space underpinning the work process

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

Photograph under a 5000 K light source with printing in mind

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.

Modeling lamps with a low color temperature are usually used in studios. If you illuminate the subject with a desk lamp designed for color appraisal, the colors will match those on the monitor.

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.

Embed 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.
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.

Correct use of color is possible by adjusting the monitor to the reference. Correct use of color is possible by adjusting the monitor to the reference. 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 enables 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.

ColorNavigator 6

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 and CX Series come 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.

Hardware calibration that doesn’t sacrifice gradation expression is possible with ColorEdge.

ColorEdge uses ColorNavigator 6, its dedicated calibration software, in combination with the monitor’s built-in sensor or a commercially available external sensor, so the monitor’s internal settings and its color display are adjusted directly. This is known as hardware calibration.

Unlike software calibration, where computer output is adjusted in a general-purpose LCD monitor by a combination of a commercially available calibration sensor and software, hardware calibration performs more accurate monitor adjustment with no gradation loss or color shift.
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 finish on the monitor. Both creativity and productivity are boosted when design work is shown accurately on the monitor.

Adjust the monitor to match printed material.

Color matching between prints and monitor

Color matching between the printed material and the monitor (evaluating side-by-side) can be done by:

- Calibrating the monitor using target values that have been standardized under a 5000 K light source, to create and set the monitor profile

Even with the color temperature of the monitor set to 5000 K, its white may still not match that of the paper. In this case, fine tuning the monitor’s white to match the paper will improve color accuracy.

- 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.

- Selecting the appropriate color temperature (e.g. 5000 K/Ra.99)

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

With ColorNavigator, fine tuning the display is possible even after calibration. By visually matching 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.

Repeats status measurement and profile generation upon completion of fine tuning.
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.

By taking the adjustment value to match the white of the printer paper obtained in **Case 1** and applying it to all monitors in the company or studio, theoretically, the display color of all monitors will match.

Settings may be slightly different between each monitor due to model differences.

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.

**Case 3**

Matching to the printed output

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

ColorNavigator 6, makes it easy to share target values between different ColorEdge monitors using its target adjustment value import/export function.

**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.

The designer’s work environment

The client’s environment

The appropriate fluorescent lighting

Acrobat 8 or later

PDF output in the printer profile color gamut.
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. Open Creative Suite and select “Creative Suite Color Settings” under Edit. A window for selecting settings for all applications will appear. Select Europe “Prepress 3” and click “Apply.”

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

Loading the monitor profile

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NOTE:

Some applications may require manual setup.

Displaying images using applications

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

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.

First, check the application’s color settings

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.

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The color settings you choose in Bridge will stay consistent with every Adobe® application so “Europe Prepress 3” will also carry over.

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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.
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.

Simulating the final print
To simulate how your photograph will look before you print it, go to View > Proof Setup > Custom in Photoshop. Make sure the “Preview” box is checked and click OK.

**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:

- Settings as they would go through a RIP to output.

Simulating the final print
To simulate how your photograph will look before you print it, go to View > Proof Setup > Custom in Photoshop. Make sure the “Preview” box is checked and click OK.
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>Type</th>
<th>Name</th>
<th>Color Temp.</th>
<th>Ra</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCRFL</td>
<td>FL20SN-EDL</td>
<td>5000 K</td>
<td>99</td>
</tr>
<tr>
<td>High Color Rendering Fluorescent Lights</td>
<td>FL40SN-EDL</td>
<td>5000 K</td>
<td>99</td>
</tr>
<tr>
<td>Types</td>
<td>HCRFL</td>
<td>FLR40SN-EDL/M</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FLR40SN-EDL/M.NU</td>
<td>99</td>
</tr>
</tbody>
</table>

*Availability outside of Japan may vary.

In the printing digital workflow, confirm your prints using a light with the following specs:
Color Temp: 5000 K, CRI (RA): 99

Controller environmental light

High quality comes from sharing the same image!
The image profile and evaluation environment of the printed output are the staples that provide a common output image across different steps in the digital workflow:

Photographer
Designer
Plate-making company
Client

Light source: approximately 5000 K
Photograph taken with printing in mind
Printed output is checked under 5000 K light source

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.

Desktop color viewing light box
Hanging fluorescent light module for color proofing designed to reduce unevenness in color and illumination

Correct color under 5000 K light source
Final check under 5000 K light source: Start printing

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.

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.
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.

### 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.

### Characteristics of DDCP

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

### 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.

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.
Summary

| Color Management Setup |

The perfect monitor for every workflow

So far we have followed each workflow to a finished final product by covering correct use of data and putting color management into practice. Here we will introduce the best monitors for using color management in the workflow.

Review

Photographer

Take photographs under a 5000 K light source with printing in mind

Retoucher

Fix a display monitor specifically for color management to perform reliable calibration

Create an appropriate lit environment and embed the profile

Recommended Monitors

Professional Level

ColorEdge CG Series

ColorNavigator 6 calibration software and monitor hood included

Standard Level

ColorEdge CX Series

Built-in correction sensor

ColorNavigator 6 calibration software included, hood optional

Recommended Monitors

Professional Level

ColorEdge CG Series

Exceptional pixel density for the smoothest image display.

Recommended Monitors

Standard Level

ColorEdge CX Series

Maintain Settings with the Built-In Correction Sensor

Highly recommended!

1. The power to reproduce nearly all Adobe® RGB

Produces intend colors and texture detail in a rich, smooth display. Increases the quality of materials with the ability to retouch work further.

2. Stabilized display in only 7 minutes* from startup.

The time it takes for the monitor to stabilize from the moment it is connected to the power is 8 minutes less than other monitors. Increases work efficiency in studios where movement is frequent allowing for quick continuation of image work.

Highly recommended!

1. Complete matching between prints and a correct color display

A circuit corrects unevenness in the screen as well as brightness, chromacity, and gradation to maintain a high quality display, supporting the delicate nature of image work.

2. Automatic color management at regular intervals

The internal correction sensor of the CX series saves your calibration settings and will automatically readjust your display over time with no additional effort.

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4. Stable, uniform display

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5. Automatic color management at regular intervals

The internal correction sensor of the CX series saves your calibration settings and will automatically readjust your display over time with no additional effort.

Printer

ISO12645: 5000 K, 5000 K, CIE, gamma 2.2. Construct a viewing environment that conforms to industry standards. Use a display monitor specifically for color management to perform reliable calibration

Recommended Monitors

Professional Level

ColorEdge CG Series

ColorNavigator 6 calibration software and monitor hood included

Save multiple adjustment values with ColorNavigator

List and create several project goals such as printed materials, web contents, and comp output. With one button you can easily create materials on a suitable monitor and carry out smooth color communications.

Printer

ISO12645: 5000 K, 5000 K, CIE, gamma 2.2. Construct a viewing environment that conforms to industry standards. Use a display monitor specifically for color management to perform reliable calibration

Recommended Monitors

Standard Level

ColorEdge CX Series

Built-in correction sensor

Recommended Monitors

Professional Level

ColorEdge CG Series

More Efficient Calibration

The built-in calibration sensor of each CG series monitor is individually adjusted at the factory to ensure no deviation. Compared to conventional monitors, this reduces the time required for maintenance while meeting the need for strict color control.

Recommended Monitors

Standard Level

ColorEdge CX Series

Maintain Settings with the Built-In Correction Sensor

Highly recommended!

1. Stable, uniform display

A circuit corrects unevenness in the screen as well as brightness, chromacity, and gradation to maintain a high quality display, supporting the delicate nature of image work.

2. Automatic color management at regular intervals

The internal sensor will automatically readjust the monitor’s color to the correct values even when it is not being used, increasing work efficiency.
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.

New devices are constantly being released, and a compatible creative environment needs to be set up.

Viewing the colors in the same way would be ideal...

Workplace issues in the creation of digital content

Reference points are needed for the color of Web content that is viewed in various different display environments.

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.

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.

Compatibility with web browser color management

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6800 K 0 0 color space gamut 2.0

ColorNavigator 6.1 or above comes with a function to create an ICC profile for external devices.

Check the images with the sRGB gamut, which closely resembles those of many devices.

Embroid a profile for users of OS or browsers that are compatible with color management

Adjust the monitor used for creative work to versatile sRGB with its large population of users

6500 K 80 cd/m2 gamma: 2.2

Delivered in the intended color tones

Delivered in the right colors to as many people as possible

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.

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