



Color Calibration and Profiling



[Workbook](#)



Version 2

Welcome to the OUTWARD course “Color Calibration and Profiling”!
The estimated runtime of this course is 55 minutes.

Here you see how to navigate within the course.

KONICA MINOLTA, the KONICA MINOLTA logo, OUTWARD, the OUTWARD logo, PageScope Mobile, the PageScope Mobile logo are registered trademarks of KONICA MINOLTA, INC.

© 2015 KONICA MINOLTA, INC.

© 2015 KONICA MINOLTA BUSINESS SOLUTIONS U.S.A., INC.

© 2015 KONICA MINOLTA BUSINESS SOLUTIONS EUROPE GMBH

© 2015 KONICA MINOLTA BUSINESS SOLUTIONS AUSTRALIA PTY LTD

Adobe Creative Suite, Adobe Photoshop and Adobe InDesign are either registered trademarks or trademarks of Adobe® Systems Incorporated. Creo is a trademark of Creo. Command WorkStation, EFI logo and Fiery are registered trademarks of Electronics For Imaging, Inc. G7 and GRACoL are registered trademarks of IDEAlliance. HKS a registered trademark of Hostmann-Steinberg Druckfarben, Kast + Ehinger Druckfarben und H. Schmincke & Co. MacBooks and Macintosh 10.X are either registered trademarks or trademarks of Apple Inc. Linux® is the registered trademark of Linus Torvalds. Microsoft and Windows are either registered trademarks or trademarks of Microsoft Corporation. PANTONE® and other Pantone trademarks are the property of Pantone LLC. SWOP® is a trademark of SWOP, Inc. X-Rite is a registered trademark of X-Rite, Inc.

OUTWARD materials may not be reproduced in part or in full without permission. Under no circumstances shall KONICA MINOLTA BUSINESS TECHNOLOGIES, INC., KONICA MINOLTA BUSINESS SOLUTIONS U.S.A., INC., KONICA MINOLTA BUSINESS SOLUTIONS EUROPE GMBH, KONICA MINOLTA BUSINESS SOLUTIONS AUSTRALIA PTY LTD be liable for any damage or consequences, incurred by the user of this OUTWARD material ("Material"), or any third party that results from the information or Material, or the use of the information or Material.



Learning Objectives

- To understand what color calibration is
- To understand what color profiling is
- To understand the connection between color calibration and profiling
- To understand how color calibration and profiling facilitate color print workflows
- To know about the different color profiles
- To know how to calibrate and profile monitors and printing devices
- To know an ideal schematic color-managed workflow

The learning objectives for this module are:

- To understand what color calibration is
- To understand what color profiling is
- To understand the connection between color calibration and profiling
- To understand how color calibration and profiling facilitate color print workflows
- To know about the different color profiles
- To know how to calibrate and profile monitors and printing devices
- To know an ideal schematic color-managed workflow



Course Overview

- Color Management, Calibration and Profiling
- Monitors - Calibration and Profiling
- Printing Devices - Calibration and Profiling
- In Practice

The first lesson of this course will illustrate why calibration and profiling of devices are important in any color-managed workflow.

The next lesson will explain what monitor calibration and profiling means and how it is done.

The third lesson focuses on calibration and profiling of printing devices.

The final lesson will illustrate what to consider in practice.

1

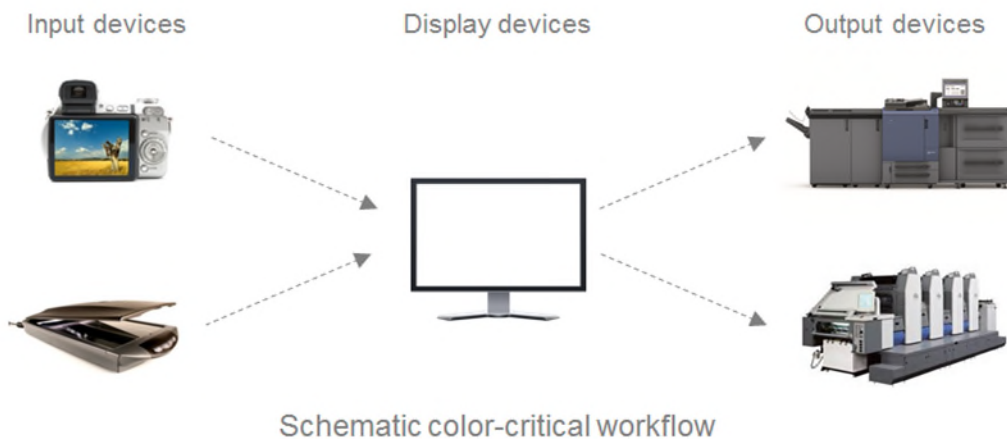
Color Management, Calibration and Profiling

- A Typical Color Workflow in Practice
- Calibration and Profiling

This lesson will first introduce an example case that illustrates the challenges of a typical color workflow in practice.

The next topic will explain why calibration and profiling are necessary components of color management.

- Design and publishing industry is constantly changing
- Especially DTP and digital printing devices have influenced the whole production process
 - They speed the whole process up
 - They provide specific challenges for color-critical workflows
 - They brought about the increase of open production systems



The design and publishing business is constantly changing, even more so since the development of desktop publishing (DTP) and digital printing devices.

Soft proofing – the proofing of layout as well as colors onscreen – and digital hardcopy proofs for offset printing are becoming commonplace. While these changes speed up the whole production process, they provide some specific challenges for color-critical workflows.

For example, DTP and digital printing devices have brought about the increase of open production systems. These systems are made up of numerous devices and may involve professionals who are unfamiliar with color-critical workflows.

A schematic color-critical workflow that targets at printing includes:

- Input devices like a camera or a scanner.
- Display devices, in other words monitors.
- Output devices like a digital printer or a printing press.

To get an introduction to a real-life example of a color printing workflow, proceed to the next slides.



Imagine the following situation:









A new founded company for healthy lemonades wants to start their market entry with a professional marketing campaign. Flowers and humming birds inspired their choice of the brand colors: dark purple and a specific green. Since they want this color combination to become globally known, they are keen on the exact hues. They create a quick draft of their idea and engage a designer to develop their visual brand. Since the founders are that keen on the colors, the designer focuses first of all on the visual brand design.

To see how successfully color may be associated with a specific brand, proceed to the next slide.


Quiz

outward
EXPERT

Do you recognize these brands, even though the images only show the color or colors? Match the images with the respective brands.

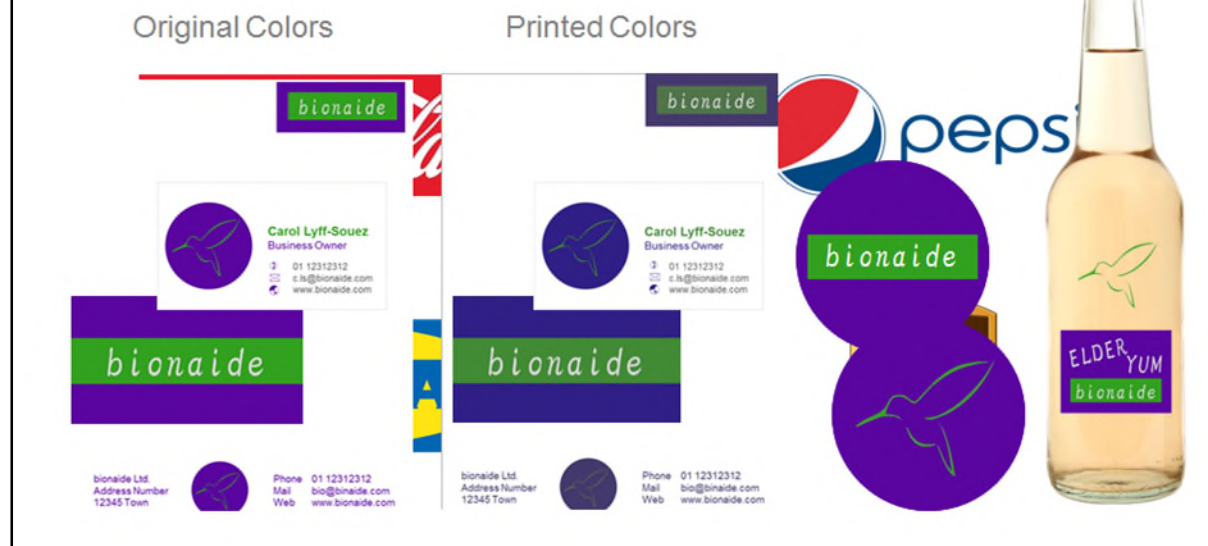
	
	
	
	

Submit

Click the  Quiz button to edit this quiz

Do you recognize these brands, even though the images only show the color or colors? Of course, some of the examples may be more common in some countries than others. But surely you will recognize one or the other, do you? Give it a try and match the images with the respective brands.

- Color and typefaces define a visual brand
- Color is considered to be one of the most important components of brand identity
 - Is the first element that a mind sees and the last it forgets
- Color workflows concerning brand colors are most critical

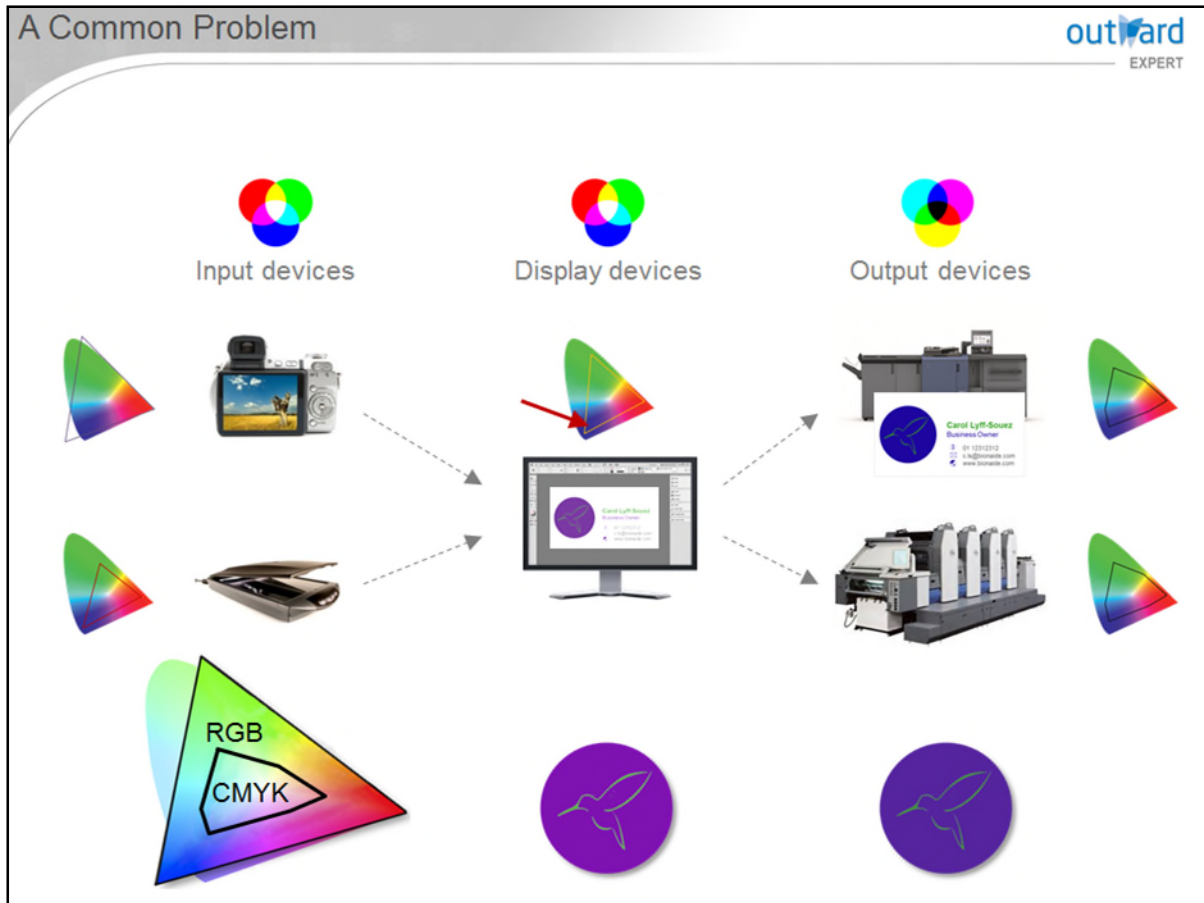


As you have seen, the use of distinctive colors may be a successful way to identify products. Typically, color and typefaces define a visual brand. Nowadays, color is even considered to be one of the most important components of brand identity. Mainly because color is the first element that the mind sees and the last it forgets. Color workflows concerning brand colors are therefore most critical.

Especially if the customer wants to associate a brand with a particular color scheme like in the example.

The company founders choose the color combination and the basic design as displayed on the screen. The bottle labels and coasters came out ok. Unfortunately, the business cards and letterhead have been printed with distorted colors.

This lack of color accuracy is a common problem in color DTP workflows.



The simple workflow scheme clearly illustrates why color accuracy is an issue in color-critical workflows:

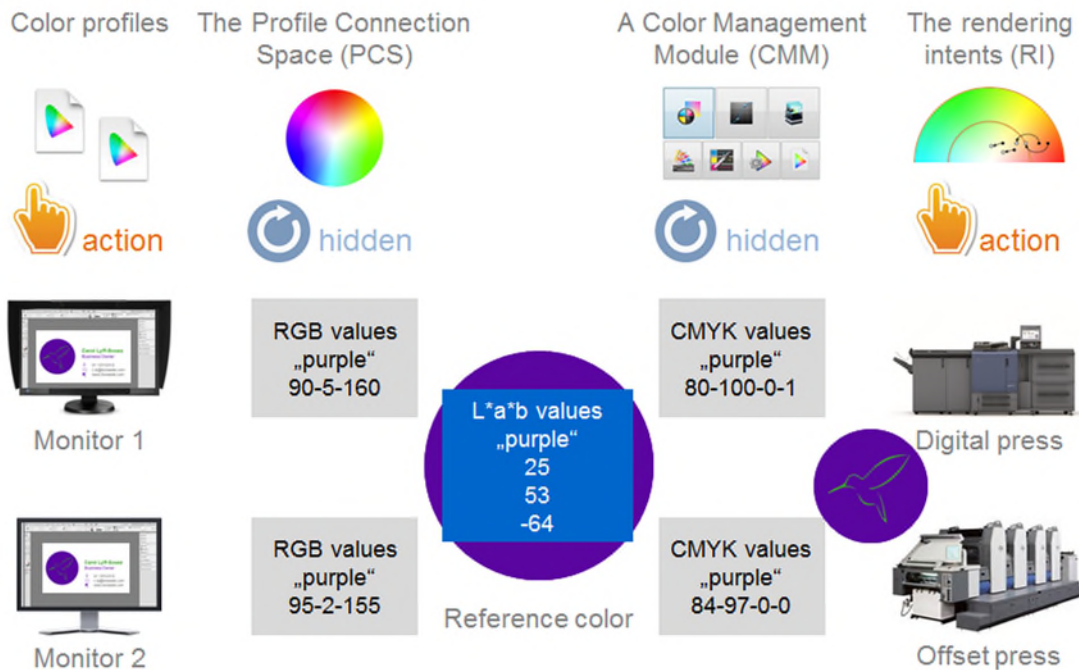
First of all, because devices that use light to create color – like cameras, scanners and monitors – use an RGB color gamut. Whereas printing devices require a CMYK color gamut. As you can see from the gamut comparison, RGB devices have a bigger gamut than CMYK devices. Additionally, CMYK devices apply ink or toner to a printing substrate like paper or foil. The material and the color of the substrate contribute to how the color is perceived.

Furthermore, different devices use different RGB and CMYK color gamuts.

And last but not least, each single device reproduces color differently because color reproduction is 100 percent device-dependent.

Therefore in a non-color managed workflow, the color you see at one stage of design and print production rarely matches what you see at another. To improve color matching accuracy throughout the entire workflow, a reliable color management strategy becomes a critical issue.

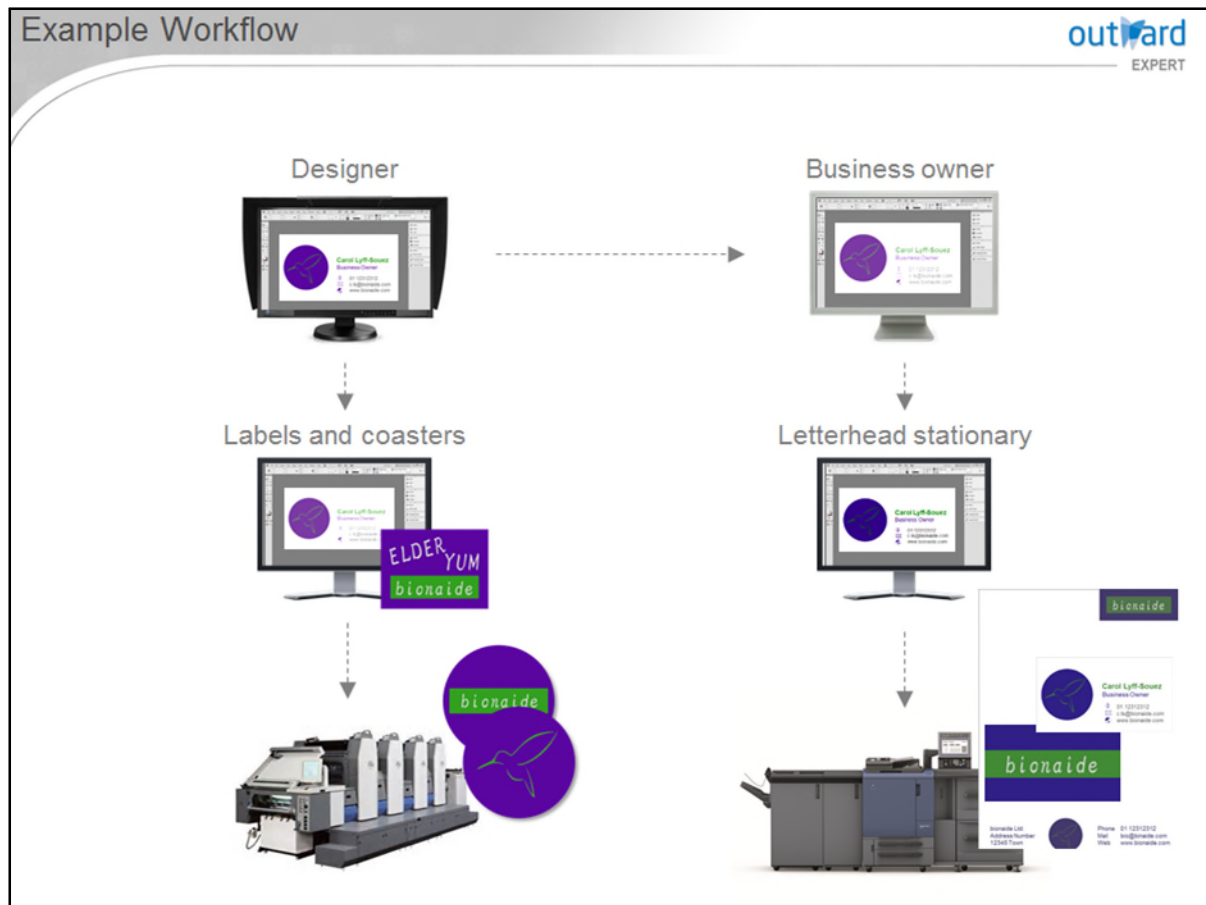
Color management systems consist of



Color management enables accurate color reproduction from input through to output. So, how does it work? To manage colors, you need a color management system that consists of four components:

- Color profiles that describe the color characteristics of a particular device or color space.
- The Profile Connection Space (PCS); the color space in which the color conversion or remapping takes place.
- A Color Management Module (CMM); the engine that converts color data from one color profile to another.
- The rendering intents (RI). An RI is a method for mapping or remapping color values. Roughly speaking, the entire color conversion process is about matching the device-dependent numerical values of one device to the device-dependent values of another. You provide the profiles and choose the rendering intents. PCS and CMM work with the profile data and mathematical functions. This process ensures that both sets of values reproduce a specific color which is at least similar when perceived by the human eye.

Of course, this is just a simplified scheme. But basically, that is what color management is all about: Use numerical values and transformation to get the devices reproduce colors as intended.



The complete color workflow in the real-life example includes numerous monitors and printing devices, for example: The monitors of the designer, the business owner and the different print providers. Different printing devices like:

- A sheet-fed press for the labels and coasters.
- And a bizhub PRESS C1070 for the letterhead stationary.

However, this module will focus on the sub workflow for the letterhead stationary because this process resulted in distorted colors. It comprises:

The monitor of the business owner.

The monitor of the print provider.

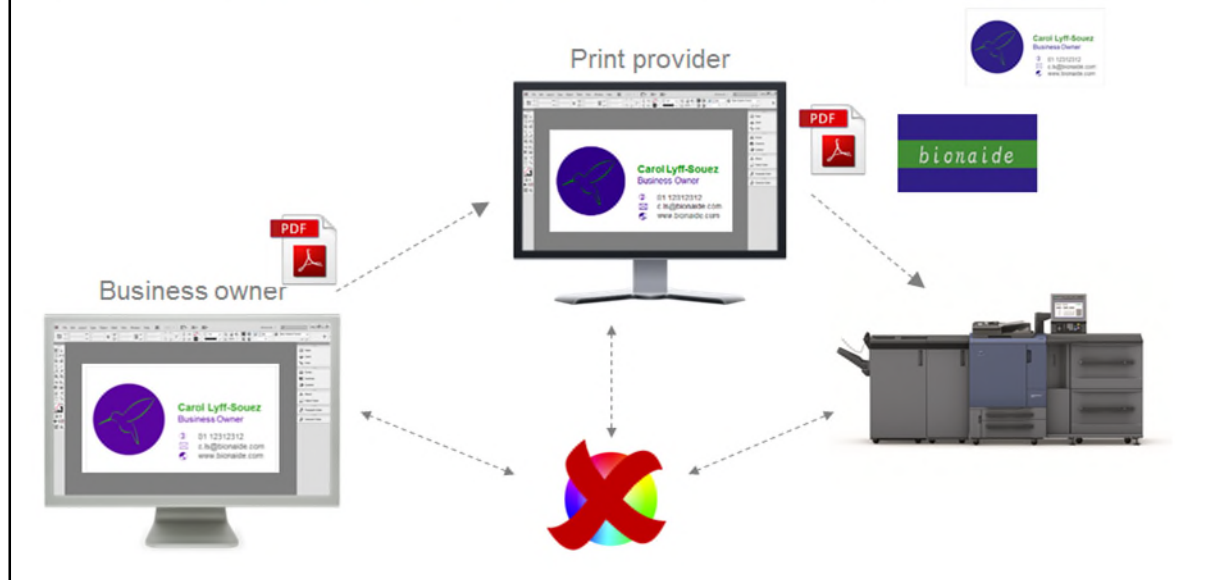
The bizhub PRESS C1070.

Since the colors have been printed correctly with the presses – the designer was in charge –, the workflow as such is evidently color-managed. The sub workflow “labels and coasters” resulted in correct colors. So, what went wrong with the sub workflow “letterhead stationary” which the business owner has overseen?

As you see on the screen, the colors of the business card already differ slightly on the monitor of the business owner. Even more so on the monitor of the print provider. The printout shows even another color – blue instead of purple. The colors of the letterhead look the same onscreen, but printed they differ considerably from the business card. Even though they have been printed on the same device. In such cases, checking color calibration and profiling should be the first step. The next topic will feature a few of these components, which are indispensable for any strategy of

color management.

- Calibration and profiling are important components of color management
- A CMS translates individual color characteristics in a common and shared way
- Colorimetric characteristics are imperative for color management
- RIP and application color management can produce different color outputs



In our example case, the business owner receives print data from the designer and opens it. However, she ignores the attached profiles.

Her monitor is not calibrated either, so she cannot confirm the color quality on her end and is satisfied with what she sees.

The print provider makes the same mistake, believes that everything is in order and starts printing.

The output of the print process is technically correct. The operator is surprised and the business owner complains because their monitors display different (and wrong) colors.

What has happened? Both have ignored the color profiles and thus color management as such. Additionally, none of the devices were properly calibrated. However, calibration and profiling are two important components of any color management strategy: Because every device reproduces color individually, a color management system must translate all of their rendering abilities in a common and shared way. Only if the colorimetric characteristics of the involved devices are known, it is possible to transmit color consistently from one device representation to another. Please also note that there is a difference between color management in an application and on the controller (RIP). Both methods can produce different color outputs.

- Calibration tunes a device so it produces a known, reproducible standard
 - It actually changes the behavior of the device



Reason

Calibration in general means to tune a device so that it produces a known, reproducible standard. Note that calibration actually *changes* the behavior of the device. Thus, the device can produce a more accurate and predictable output. In this context, “known” and “reproducible” are both keywords. Can you imagine or do you know why?

To get the explanation, click the “reason” button.

- Calibration tunes a device so it produces a known, reproducible standard
 - It actually changes the behavior of the device



- Necessary because
 - Devices degrade over time
 - Calibration ensures color accuracy
 - Is a prerequisite for profiling

The accuracy of all technical devices degrades over time. Typically, normal wear and tear or the replacement of consumables cause such a degradation. The main target of color calibration is to ensure that the device always produces the same color in response to a given set of numbers.

Calibration is a prerequisite for profiling. Otherwise, you would profile a device in its non-calibrated state and the resulting profile would be useless regarding color accuracy and predictability.

How you calibrate and what kind of tools you use is dependent on the specific device. You will learn more about monitor and printer calibration in the following topics.

RGB	L*a*b
90	25
5	53
160	-64



A color profile is only valid for a device if the device is in the same state of calibration as it was when it was profiled.

To put it simply, profiling records *how* a device produces color: It usually does not change the behavior of the device, but just records what colors a device can reproduce and how it produces these colors. However, you can also change the color output (gray balancing) during the profiling process, depending on the profiling software.

The profiling results are stored in a so-called color profile. Essentially, a color profile is a lookup table or matrix: One set of entries contains the device RGB or CMYK values. Another set contains the actual colors, expressed in device-independent numbers like CIE L*a*b values.

Without a color profile, the combination of RGB or CMYK values that make up a color have no particular meaning: They describe a color like „purple“, but no other device can guess what kind of purple is meant. Color profiles assign a specific color meaning to RGB or CMYK numbers.

A color-managed workflow depends on color profiles for all involved devices. There may even be more than one color profile for a single device. For instance, if different types of paper are used like in the example workflow.

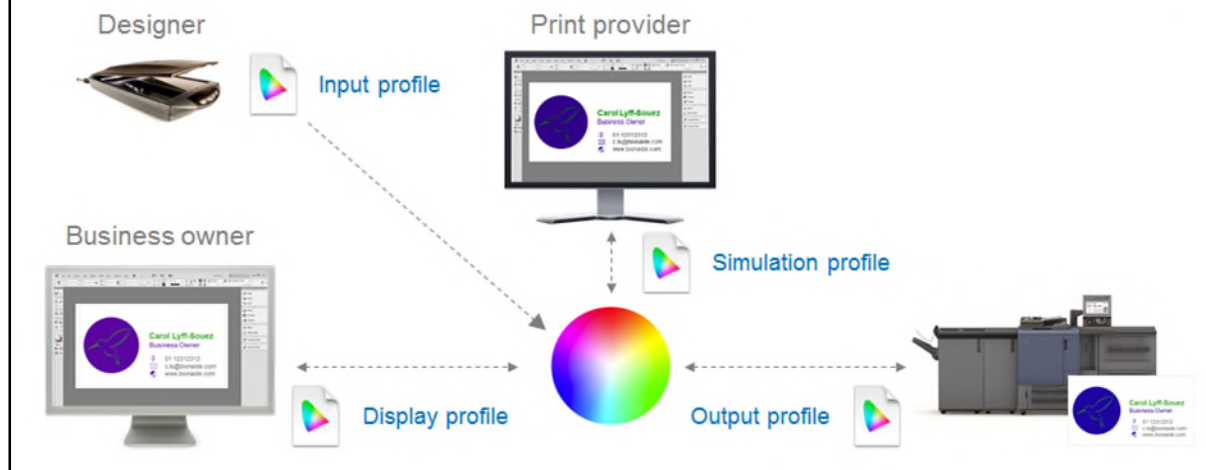
The accuracy of the profiles determines the quality of the color management strategy: Profiles are essentially snapshots of the behavior of a device at a given time. If the behavior of the device changes, the profiles are no longer consistent with the actual behavior and you will no longer get predictable colors.

To view a glossary entry message, click the underlined term.

- Most important color profiles: ICC profiles
- Different types, for example
 - Input profiles
 - Output profiles
 - Device link profiles
 - Simulation profiles

International Color Consortium (ICC)

In 1993, various vendors established the ICC. The main purpose of founding this consortium was to create and promote the standardization and evolution of an open, cross-platform color management system. The outcome of this co-operation was the development of the ICC profile specification.



Different kinds of color profiles exist. Among them, ICC profiles could be considered the most important.

Basically, ICC profiles are standardized files that describe the color characteristics of all sorts of devices and images using numerical values. Thus, ICC profiles supply color management systems with the information they require to transform color data between the various input and output color spaces.

Various types of ICC profiles exist. Regarding color printing workflows, the most important are:

- Input profiles.
- Output profiles.
- Device link profiles.
- Simulation profiles.

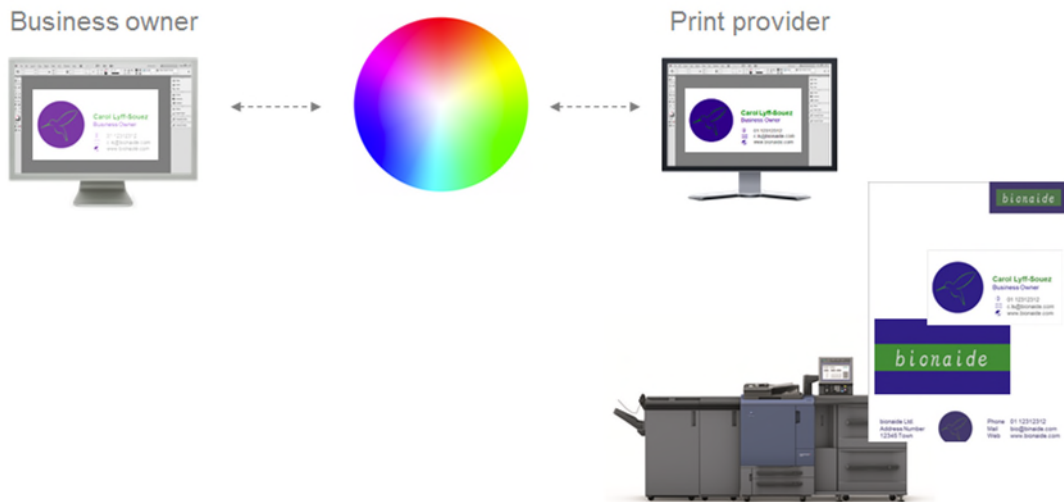
To view a glossary entry message, click the underlined term.

- Input profiles describe the color characteristics of input devices



An input profile generally describes the color characteristics of an input device, that is a camera or a scanner. If a camera is the origin of the color, the input profile describes the color gamut of this camera.

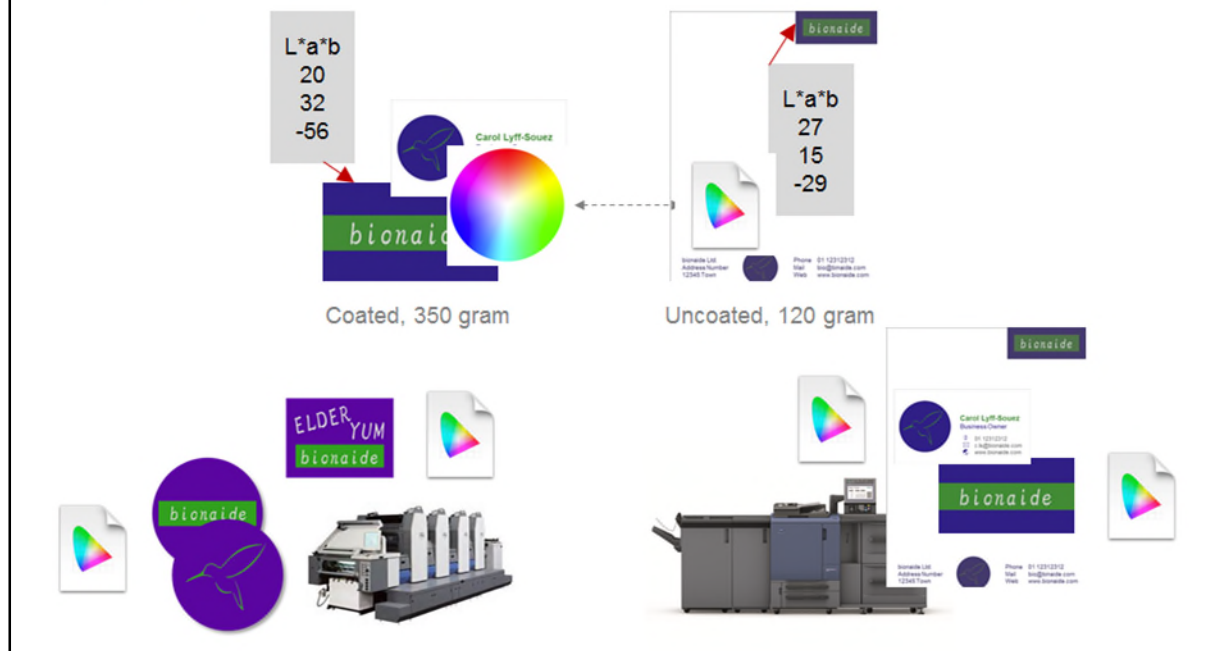
- Display profiles describe the color characteristics of displays
- They are two-way profiles



A display profile describes the color characteristics of displays such as monitors or data projectors.

Since displays can act as input and output device, display profiles are two-way profiles: They contain transforms from device to PCS and from PCS to device.

- Output profiles describe the color characteristics of an output device in combination with the media in use

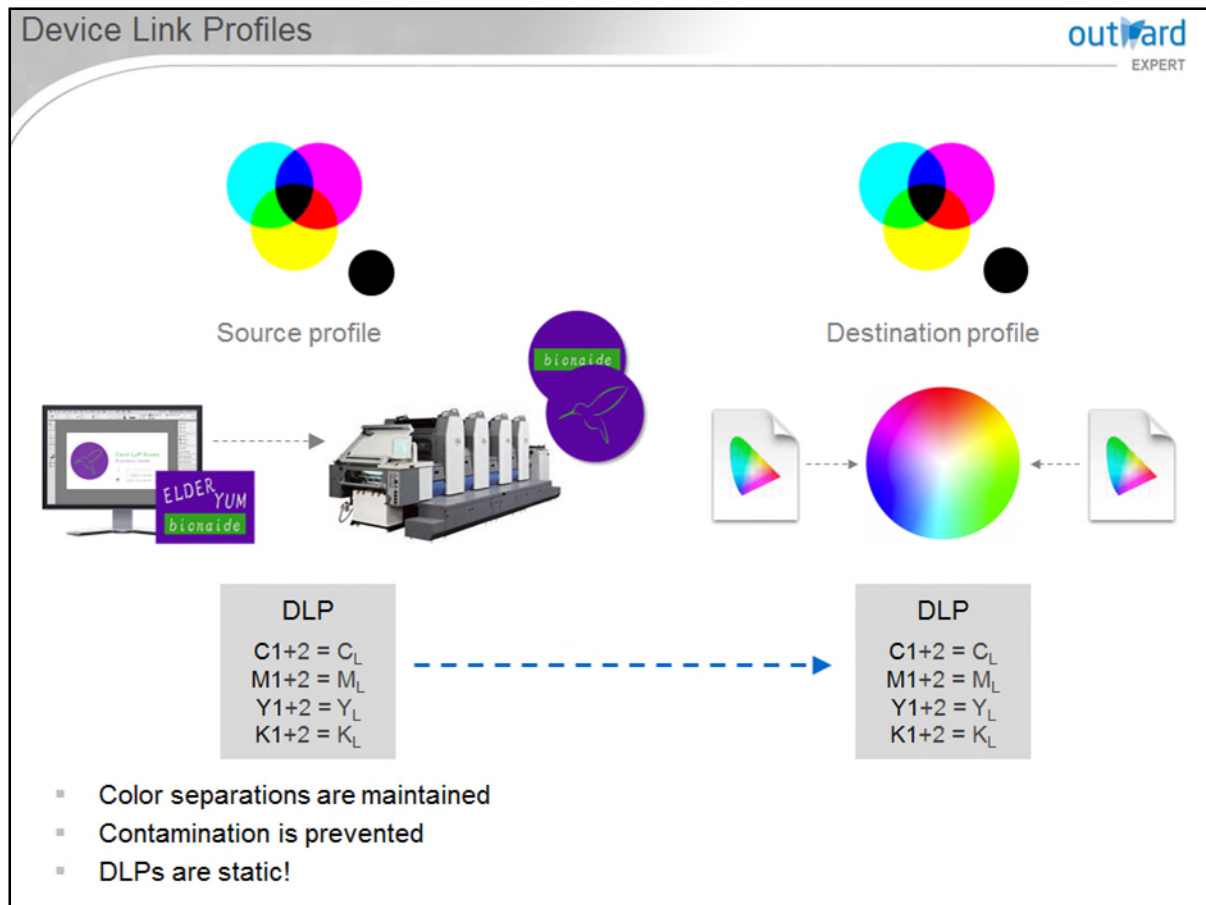


Generally, output profiles not only describe the color characteristics of output devices like printers and film recorders. Since different media reproduce color differently, they also include the relevant data for the media in use – be it transparencies, paper or other printing substrates.

Therefore output profiles describe the specific gamut of the device plus media combination in use. Have a look at the example: The print provider neglected that coated 350 gram cardboard and uncoated 120 gram letterhead paper need different profiles to reflect colors similarly. Thus, the printed colors differ considerably.

You may often find the term “printer profile” instead of “output profile”. A printer profile is just an output profile that describes the color characteristics of a specific printing device in combination with the printing substrate. In the entire workflow of the example, four different printers – or output – profiles are necessary:

Two printer profiles for the sheet-fed press because two different substrates are used. And two printer profiles for the bizhub PRESS C1070: one for the business cards and another one for the letterhead paper.



Commonly, the gamut of one device is transformed to the gamut of another device via the device-independent PCS. However, a device link profile is a special kind of ICC profile that does not use the PCS as an intermediate. It converts the color space of the input device directly into the color space of the output device. This process is a one-way conversion directly from source to destination color values and cannot be reversed.

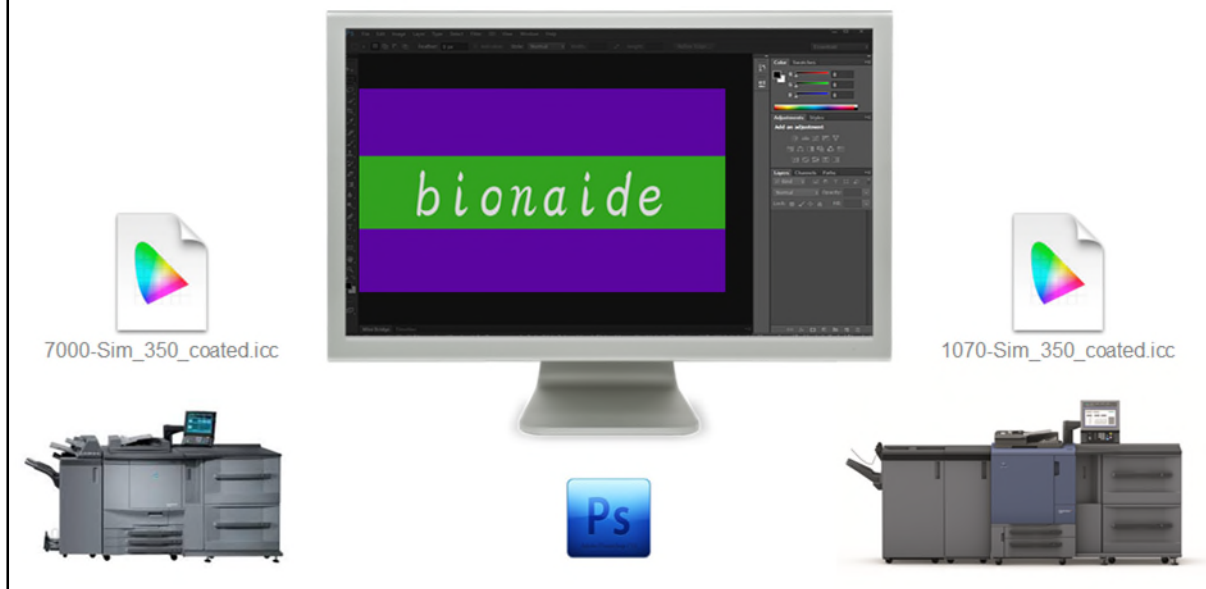
Ordinary ICC profiles provide a basis for creating a device link profile.

Device link profiles are commonly applied to CMYK-to-CMYK transformations because converting between profiles using a device-independent PCS can lead to undesirable effects, such as unsmooth gradients. In a device link profile the color separations are maintained, thus preserving among others the black channel of the source profile. Furthermore, contamination by other colors is prevented and the purity of the primary (CMYK) and secondary (CM, CY and MY) colors are protected.

The main disadvantage: Contrary to usual ICC profiles – which are flexible –, device link profiles are static. They can only be used with exactly the devices and media they have been created for.

Nevertheless the print provider for the labels and coasters used device link profiles. In combination with properly calibrated monitors and printing devices, this approach contributed to highly accurate colors.

- Describe the color space of different output devices
- Used to simulate how colors will look when you reproduce them on a particular device



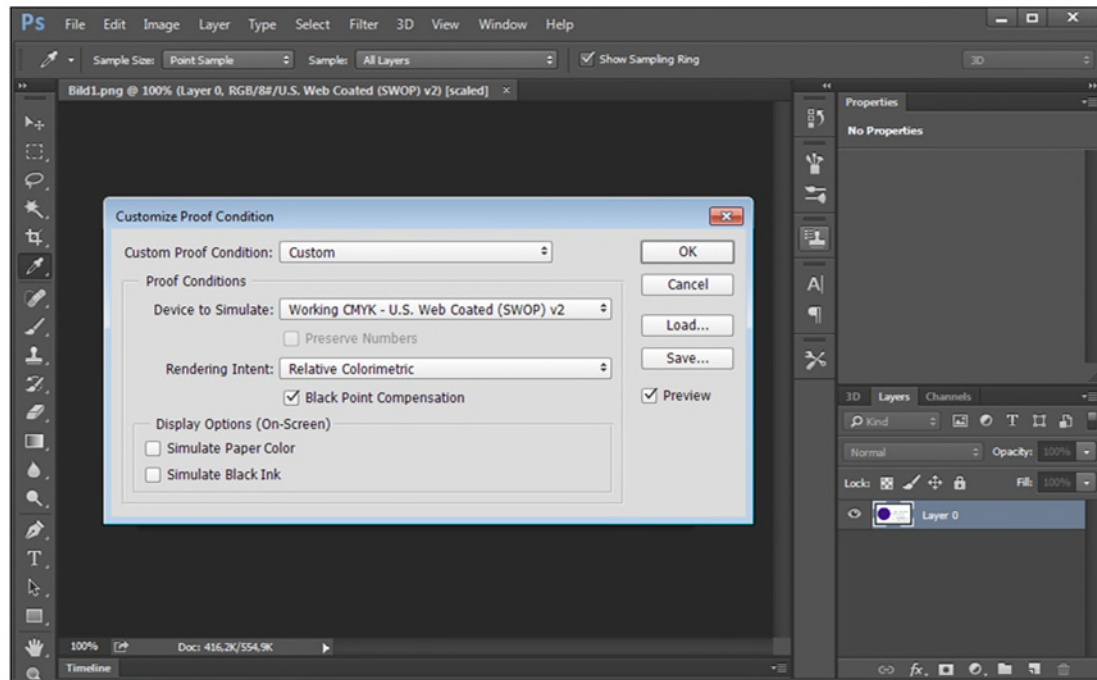
Simulation profiles generally describe the color space of different output devices. They are used to simulate how the colors of a file will look when you reproduce it on a particular output device. The reliability of such a simulation depends on the color reproduction capabilities of the monitor.

Simulation profiles are one of the main advantages of color-managed workflows: You can use them to soft proof an image or file directly on the monitor.

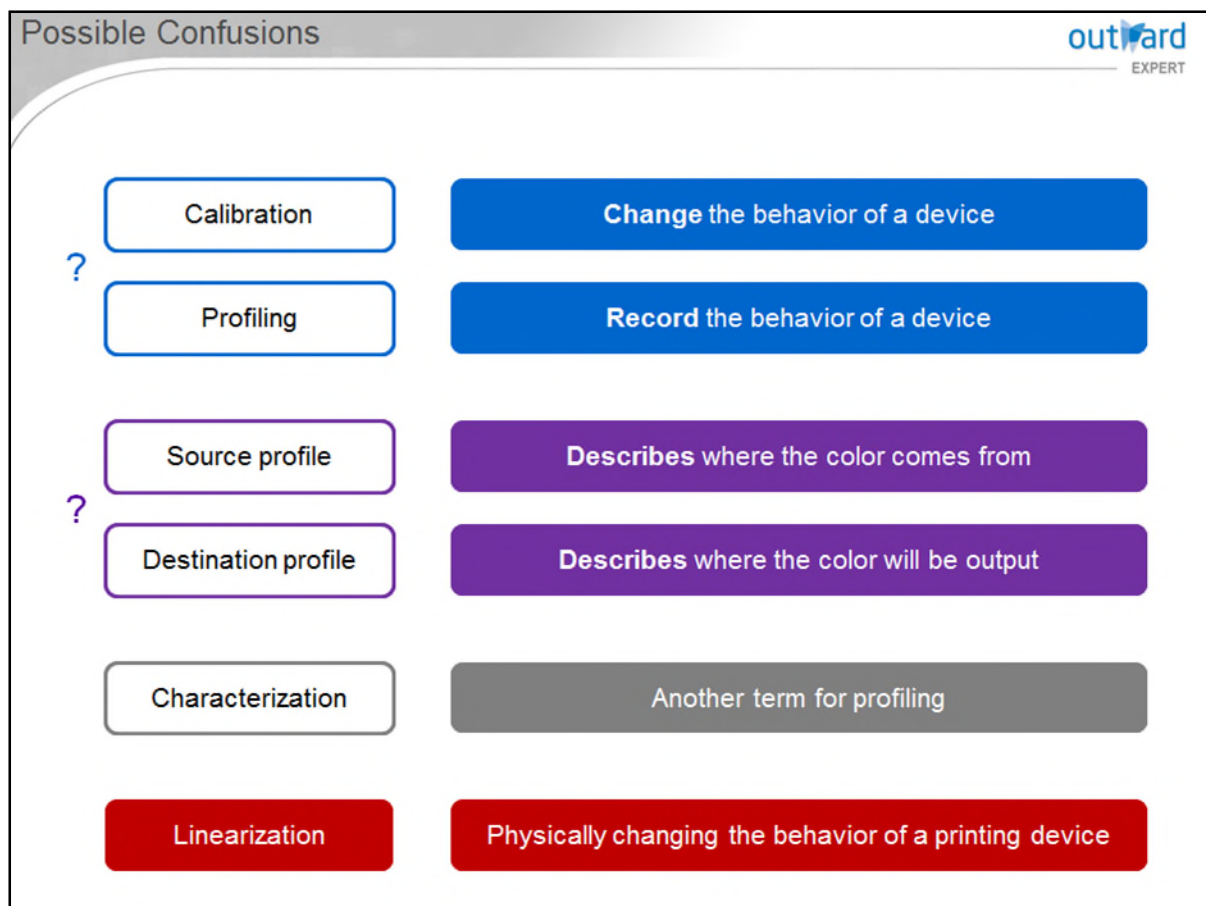
With a simulation profile, the print provider could have used a DTP application like Photoshop to preview the colors of the letterhead stationary.

To view the different simulations, click the simulation profiles.

To view how to enable simulation profiles with Photoshop, click the PS button.

[Back](#)

To softproof with Photoshop, select Proof Setup and then Custom in the View menu. When you select the device you want to simulate, you automatically use a simulation profile.



Be aware that your customer may confuse calibration and profiling: The involved steps seem very similar on the surface. Both processes involve sending a target of known color signals to a device, measuring the color that results and then feeding the results into some software. With devices like monitors, calibration and profiling can even be performed at the same time by the same pieces of hardware and software. Therefore it is important to remember the differences between these processes: When you calibrate, you actually *change* the behavior of the device.

When you profile, you usually simply *record* the behavior and store it in a file that is called “color profile”.

Besides the ICC profile types like input and output profile, you may come across the terms “source profile” and “destination profile”. These terms describe the *role* of a color profile in the context of a specific color conversion, they are no profiles as such. The source profile describes the current color space of an image or file – where it comes from. This source can be an input device, but also a working space or an output device.

The destination profile describes the color space of the device or process where an image will be output. This destination can be an output device, but also a display or a working space.

Another source of confusion is different terms that are in use:

Profiling is often also called “characterization” of a device.

The calibration of a printing device is often referred to as “linearization”. To distinguish

the two, calibration refers more to changing color lookup tables in the RIP to compensate for inaccuracies due to environmental conditions. Linearization refers to actually changing the physical characteristics of how an engine produces color. First you analyze the way that the printer applies the ink or toner to the media. In order to achieve the desired printing behavior, you then influence the behavior of the device. The outcome of this process is similar to that of a “calibration”, while the means are different. If an engine is properly linearized, there is little need to calibrate the controller.

Quiz


outward
EXPERT

Which of the following statements about color calibration and profiling are true?

Select the correct answers.

- ☐ You cannot calibrate a non-profiled device.
- ☐ You should avoid profiling a non-calibrated device.
- ☐ A color profile is a record of a device at a given moment.
- ☐ You need one specific color profile for a color-managed workflow.

Submit

Click the  Quiz button to edit this quiz

Test your knowledge in a quiz!

1

Lesson Summary

In this lesson, you have learned:

- What color calibration is
- What color profiling is
- How color calibration and profiling are connected
- Why color calibration and profiling are important components of each color-critical workflow
- Which types of ICC color profiles exist

In this lesson, you have learned:

- What color calibration is.
- What color profiling is.
- How color calibration and profiling are connected.
- Why color calibration and profiling are important components of each color-critical workflow.
- Which types of ICC color profiles exist.

2

Monitors - Calibration and Profiling

- Monitor Calibration
- Calibrate a Monitor
- Monitor Profiling
- Create Monitor Profiles
- Insert and Use Monitor Profiles
- Dos and Don'ts

The first topic will introduce you to monitor calibration in general and will explain types of monitors and calibration methods.

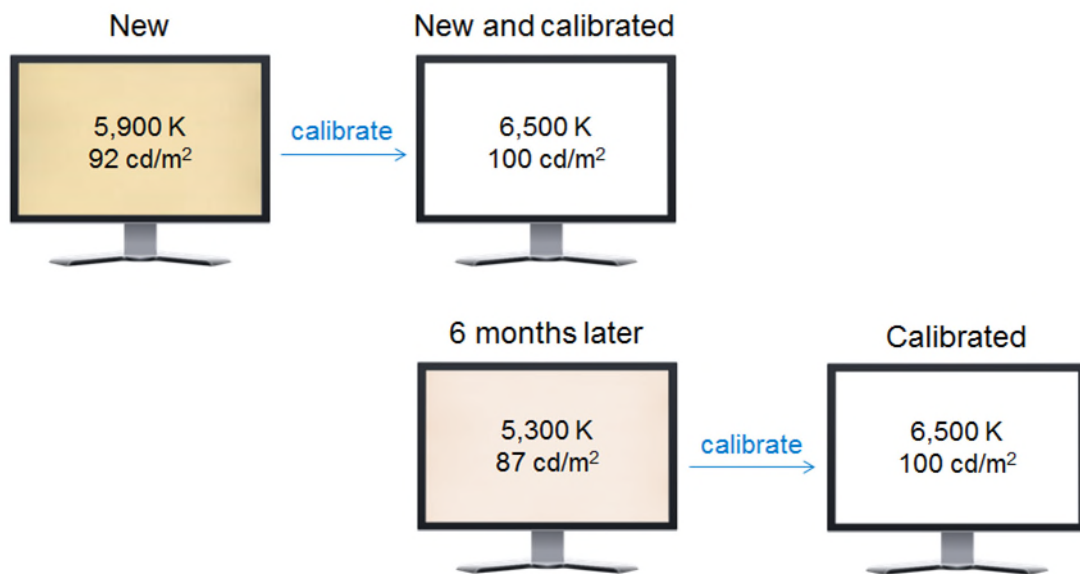
The second topic will illustrate how to calibrate a monitor.

Next, you will learn about monitor profiling and about profile creation for monitors.

The fifth topic will outline what to consider when you insert and use monitor profiles.

The final topic will highlight important dos and don'ts.

- Put a monitor into a known, reproducible target state
- Regular calibration ensures stable colors over time



Everyone who is involved in professional color workflows needs reliable colors on the display. Display profiles are key to the success of color management. You cannot stress enough the importance of good monitor calibration and profiling to any effective color management.

When you calibrate a monitor, you put it into a known, reproducible target state by altering how it displays colors.

Monitors all vary in their settings, even the same monitor model may display colors differently. Calibration makes the monitor display as accurate a color as possible.

Regular calibration ensures that your monitor displays stable color at all times of its life cycle. To calibrate monitors regularly is important because over time the color performance of monitors change due to the aging technical components.

Calibrating and profiling optimize the monitor settings for contrast, brightness and color temperature.

Note: Calibration and profiling work hand in hand. You first calibrate the monitor and then you create an ICC profile.

At the moment, very different types of computer monitors are available on the market. From laptop screens to standard displays to high-quality monitors for color critical work. While most of them are Liquid Crystal Display (LCD) flat panel monitors, they vary heavily in terms of panel technologies and performance.

Except for Macbooks, laptop displays usually have only a small gamut and they allow only limited calibration because they provide no hardware setting controls. Therefore, they are unsuited for color critical workflows.

Standard consumer and business displays range from low-budget TN panel displays to middle-class VA panel display up to quality IPS panel displays. Quality IPS panels are suited for color critical workflows. Not only because of their color reproduction capabilities, but also because they allow software calibration as well as classical hardware calibration.

High-quality, color critical displays are especially developed for color critical workflows. Usually, they use IPS or a variation of this panel technology. They are always matte – also called anti-glare – and provide a huge color gamut.

Such professional color displays allow software calibration, classical hardware calibration as well as direct hardware calibration. Some even offer a built-in self-calibration function.

To view explanations, click the info buttons.

- Uses onscreen test patterns and the human eye instead of a measuring device
 - Critical because color perception is highly individual
- Is not suitable for professional color-managed workflows
- Different software and utilities available
- Built-in calibration utilities for software calibration:



Display Color Calibration



Display Calibrator Assistant



Depends on distribution



A software calibration is a long way from the quality of hardware calibration. First of all, because instead of a measuring device, software calibration makes use of various onscreen test patterns and of the human eye. As you may remember, color perception is highly individual and complex and no two people perceive the same color identically. Therefore software calibration is a no go in any professional color-managed workflow, but at least it is a start.

You can use different calibration software: Free tools, third-party software or just a common operating system.

Windows, Macintosh 10.X and many Linux distributions provide built-in calibration utilities. The OUTWARD expert module “Color Printing Workflow” walks you through the Windows and the Macintosh calibration processes.

To view the summaries of these walkthroughs, click the PDF button.

- Classic hardware calibration
 - Also called "software calibration with a hardware device"
 - Translation table is installed in the look-up-table (LUT)
 - If no internal LUT is available, the graphic card LUT is used
 - Different monitor calibration solutions exist
 - Most common are instrument and software bundles
- Direct hardware calibration
 - Guarantees the most accurate calibration
 - Requires dedicated hardware and monitor LUTs



X

Look-up-table (LUT)

"LUT" refers to a component that calculates input signals from the computer and maps them to output signals suited to the monitor. Typical quality LCD monitors will employ an LUT table with eight bits per RGB color. Whereas high-quality LCD monitors will incorporate an LUT with ten or even twelve bits per RGB color.

Without an LUT, an input color value (here: 159) is send directly as an output value of 159, no matter what the color is. A LUT uses the tonal curves to look up each red, green and blue value. Thus, an input of RGB 159 – 159 – 159 may be changed to 145–155 – 162 for example.

Classic hardware calibration - also known as "software calibration with a hardware device" - is an appropriate type of calibration for quality LCD monitors.

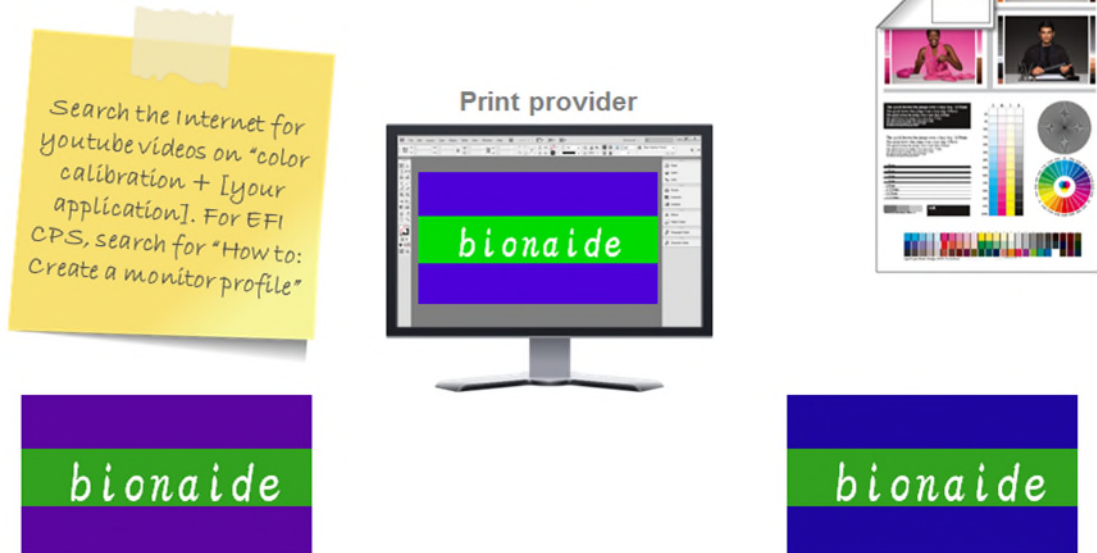
This method uses a colorimeter or spectrophotometer to accurately read the color coming from a monitor. Then a translation table between the target color and the actual color is created and installed in the so-called look-up-table (LUT) of the monitor. Since budget monitors have no internal LUT, the LUT must be applied to the graphic card. Thus, the graphic card modifies its signals to produce the most accurate possible color.

You can use different monitor calibration solutions. Most common are instrument and software bundles. Software-only solutions that support different measurement instruments are possible, too.

If your customer uses a Fiery controller, the EFI Color Profiler Suite with the ES-2000 spectrometer or the i1Pro2 is a good choice.

Another method is "direct hardware calibration". With this method, a monitor specific software allows a direct calibration that finally results in a smooth calibration across the available gamut. This method guarantees the most accurate monitor calibration. It requires dedicated hardware and LUTs inside the monitor. Usually the instrument and the equipment come bundled with the monitor.

- Never change settings if a monitor is calibrated and profiled
- To be precise, monitor calibration affect the whole display system



Different monitor settings can change color reproduction on a display a lot. The print provider from our example case has adjusted the brightness and contrast of the monitor after calibration, purely based on what felt good. Unfortunately, these settings result in purple looking more similar to a dark blue. Because the screen would not show the correct color, the wrong colors on the printout did not attract any attention. The adage “never change a winning team” applies here: If a monitor is calibrated and profiled, it displays colors as best as possible on the one specific device it has been paired with.

To achieve this goal, the calibration software makes the screen display a wide variation of colors. These colors are then measured and the numerical values are adjusted to optimum color performance.

It is also possible to use the monitor settings to calibrate the whole display system which includes the monitor, the graphic card and the drivers. Before you start the actual calibration and profiling process, some preparation is essential as you will see on the following slide.

- Check the surrounding:
 - Are there reflections?
 - Is the ambient light appropriate?
- Prepare the monitor:
 - Allow a warm-up time of about 60–120 minutes
 - Is the screen clean?
 - Are the monitor and the computer connected with a digital interface?
 - Are all screen savers deactivated?



To prepare a calibration professionally, consider the following preparatory steps:

- Check the surrounding according to the specifications of a standard viewing condition.
- Prepare the monitor.

This step includes a warm-up time of about 60–120 minutes before you start measuring. Check if the screen is clean, for example free of dust or fingerprints. Make sure the connection between monitor and computer is a digital interface and that all screen savers are deactivated. Otherwise the measurements may be incorrect. Check if the monitor is set to its default settings. This adjustment helps to improve the accuracy of the calibration as well. And last but not least, define the target settings. Make sure that you know the best settings for your purpose. The main target settings of a monitor calibration procedure are:

- The color temperature or “white point”.
- The gamma.
- The luminance.

- All professional calibration solutions guide you through the calibration process step by step



Professional calibration software – like Color Care Display or EFI Color Profiler Suite – guides you through the actual calibration process step by step.

As an example, monitor calibration with Color Care Display works as follows:

Select Softproof and start the calibration and profiling process via the Start button.

Color Care Display will show the Measurement window.

Position this window in the middle of the display and the measurement instrument in the middle of the measurement window. Mind to position the measurement device flat on the screen surface.

Click Measure to start the procedure.

The calibration process is automatized and it takes a few minutes for Color Care Display to create and measure the different color patches.

After the actual calibration, Color Care Display immediately measures the color characteristic of the monitor again to create the ICC profile.

Finally, Color Care Display shows a report and an evaluation. This evaluation compares the current status with the previously selected target settings – for example a white point of 5,000 K – and its stability.

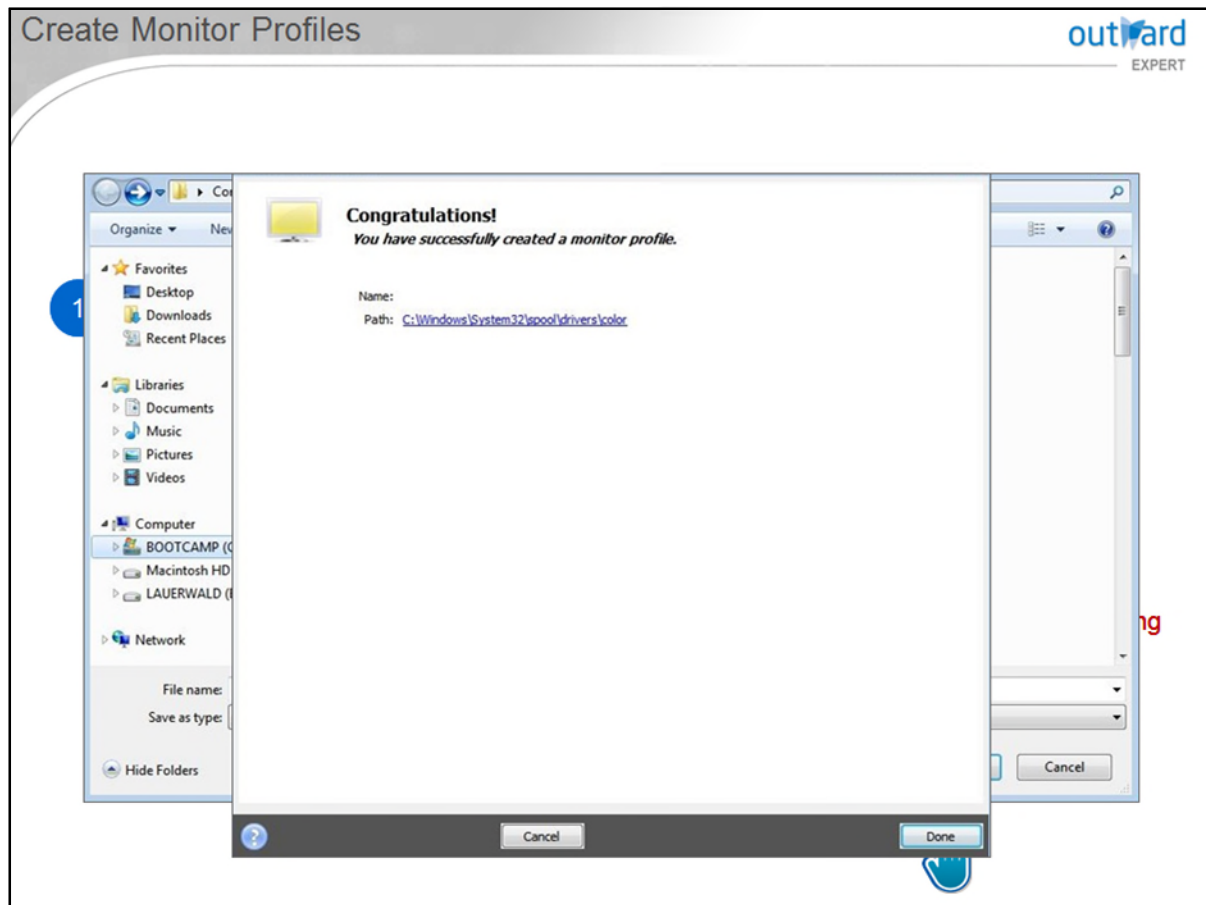
You can save the evaluation report as PNG file.

Click OK to close the report window.

The green light indicates that the latest calibration is within the tolerances.

In most software solutions, you can define specific target settings through an Advanced Settings option or the like. For detailed instruction, refer to the manual of

your calibration software.



As you have seen, Color Care Display immediately created the monitor profile as part of the overall calibration procedure. Most professional calibration solutions work like that. Once the software has the device data and the corresponding measurements, it proceeds to create the data structures which form the monitor profile.

As with monitor calibration, you can use different solutions for monitor profiling as well. One example is the EFI Color Profiler Suite:

First, select Monitor and the Monitor Profiler window opens.

Choose between the Easy and the Advanced mode. This example workflow will continue with the Easy mode.

Now you first calibrate the spectrophotometer and then you position it on the monitor.

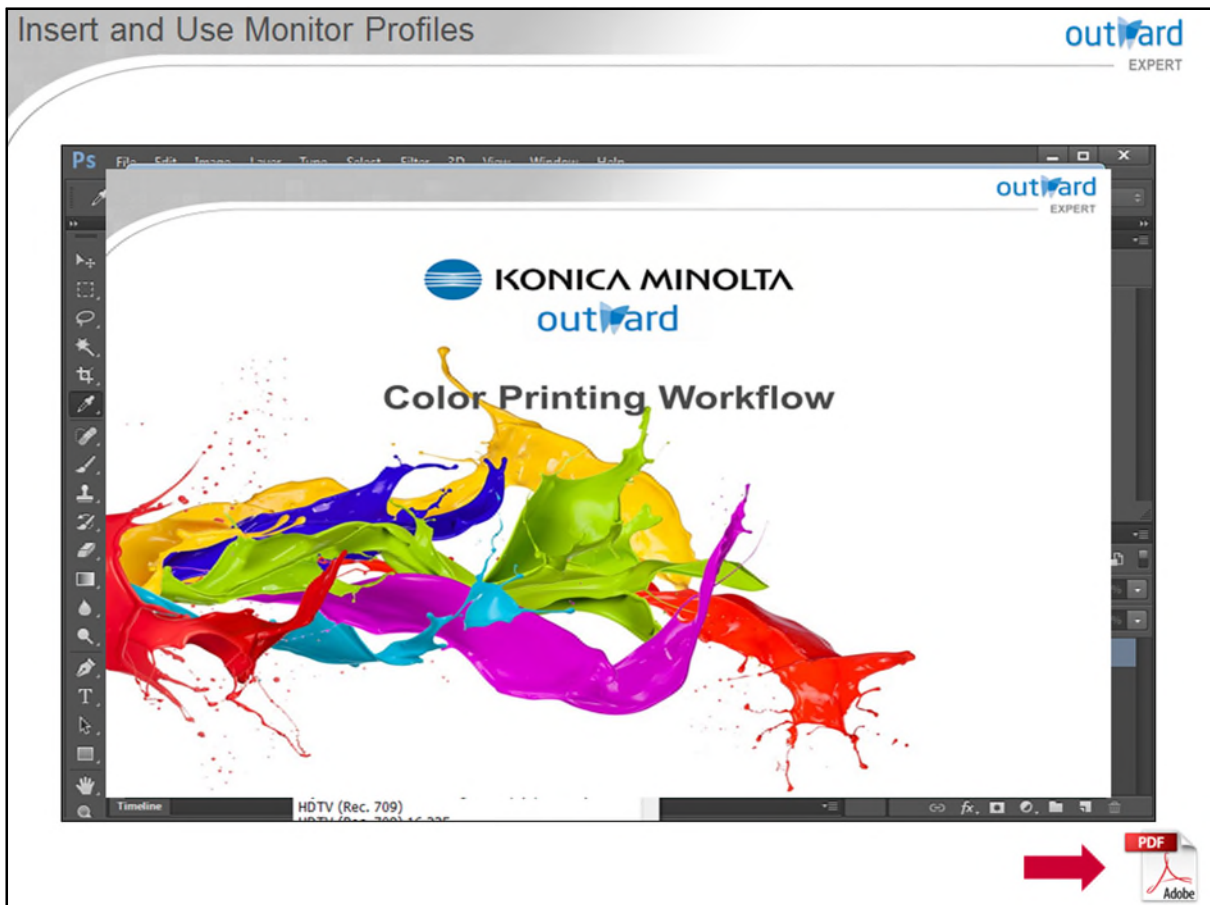
To begin the measurement, click Next.

When the measurements are completed, select Next to create your monitor profile and install it on your computer.

You can now name the new profile. Best practice recommends using date and profile target as name.

In the next step, you can select "Compare before and after to review" to compare color display with the old and the new profile.

Finally, you save the new profile. Thus, it is set as the default display profile.



Usually, you simply apply a monitor profile in the operating system.

The OUTWARD expert module “Color Printing Workflow” walks you through the procedures to apply monitor profiles in Windows and on a Macintosh.

After both the business owner and the print provider have successfully calibrated their monitors, the monitors display the intended colors far more accurately.

Note: DTP applications like Adobe Photoshop or InDesign typically use the monitor profile that the operating system uses.

If you want to verify that Photoshop uses your monitor profile properly, proceed as follows:

- Open the Color Settings window.
- Select the Working Space pull-down menu and scroll up to see which monitor profile is enabled.
- Be careful not to change your working space in the process.

To view the summaries of the walkthroughs, click the PDF button.

WHAT TO DO

- Control ambient lighting and reflections
- Use high-quality monitors or at least IPS quality monitors
- Always use hardware calibration (every 200-300 hours)
- Make sure to prepare the procedure and all equipment carefully
- Be careful to use the correct target settings
- Set up: White point 5000K (D50), luminance 80cd, gamma 2.2
or: White point 6500K (D65), luminance 100/120 cd, gamma 2.2
- Apply the correct profile for your use

WHAT NOT TO DO

- Never use different calibration solutions on the same system
- Do not turn on or off the light or use a computer during calibration
- Do not touch or move the measuring device
- Do not calibrate when there are heavy light reflections
- Do not adjust the settings by visual control only
- Do not adjust any monitor settings after calibration

As you have seen, calibration of display devices can have a large impact and takes little time to set up. The following advice on what and what not to do should help you in your calibration setup.

What to do:

- Control ambient lighting and reflections.
- Use high-quality monitors or at least IPS quality monitors.
- Always use hardware calibration every 200–300 hours.
- Make sure to prepare the procedure and all equipment carefully.
- Be careful to use the correct target settings.
- Set up the following values: Either white point 5000K (D50), luminance 80cd, gamma 2.2 or white point 6500K (D65), luminance 100/120 cd, gamma 2.2
- Apply the correct profile for your use.

What *not* to do:

- Be careful not to use different calibration solutions on the same system
- Do not turn on or off the light or use a computer during calibration.
- Do not touch or move the measuring device.
- Do not calibrate when there are heavy light reflections.
- Do not adjust the settings by visual control only.
- Do not adjust any monitor settings after calibration.


Quiz

outward
EXPERT

Which calibration methods are most suited for color-critical workflows?
Mark the correct answers.

- ☐ Direct hardware calibration.
- ☐ Classical hardware calibration.
- ☐ Software calibration.
- ☐ Built-in self-calibration.

Submit

Click the  Quiz button to edit this quiz

Test your knowledge in a quiz!

2

Lesson Summary

In this lesson, you have learned:

- What monitor calibration is in general
- Which monitor types and calibration methods exist
- Which of them are suitable for color-critical workflows
- How to calibrate and profile a monitor
- Which software and tools to use
- What to consider when you use monitor profiles
- Important dos and don'ts

In this lesson, you have learned:

- What monitor calibration is in general.
- Which monitor types and calibration methods exist and which of them are suitable for color-critical workflows.
- How to calibrate and profile a monitor and which software and tools to use.
- What to consider when you use monitor profiles.
- Important dos and don'ts.

3

Printing Devices - Calibration and Profiling

- Printing Device Calibration
- Printing Device Profiling
- Create Output Profiles
- Insert Output Profiles
- Create Device Link Profiles
- Insert Device Link Profiles
- Dos and Don'ts

This lesson will start with a general description of printing device calibration and profiling.

You will then learn about the creation and implementation of output profiles.

The following two topics will illustrate how to create and insert device link profiles.

The final topic provides an overview of relevant dos and don'ts.

- A properly calibrated print engine is key to accurate colors
- Before calibration, check both D-Max and density balance on your prints
- A number of issues influence color print quality, for example:
 - Condition of the engine
 - The environment
 - Steady toner density
- Many factors affect toner density, like
 - Service settings
 - Heat and humidity
 - Varies over time
- To compensate for the effects
 - Linearize the engine prior to controller calibration

Toner density level



A properly calibrated print engine is key to accurate colors. A number of issues influence the color print quality. Before starting calibration, check both D-Max and density balance on your prints.

For example:

First of all, the quality depends on the condition of the engine, of the environment and steady toner density. Many internal and external factors such as service settings, heat and humidity affect toner density. Furthermore, it tends to vary over time. You cannot eliminate such variations, but you can minimize their effect. Linearization before controller calibration helps to compensate for them. Linearization is a calibration process as well: It consists of creating calibration tables that are mapped to a specific substrate type and a screening method. The print controller then uses the data in this table to compensate for the differences between the actual, measured density level and the target density level.

The bizhub PRESS C1070 in the example was properly linearized and toner density was no issue.

To view model results of incorrect toner density, click the buttons.

- In color-critical workflows, calibration is at least a daily task
- Generic calibration procedure

- 1 Prepare calibration (engine, standard, stock)
- 2 Launch the software
- 3 Print the color chart
- 4 Measure each color patch in the printout
- 5 The software compares the known and the printed values and stores the differences



Your customer performs the calibration!

Fiery IC-308



Creo IC-309



Internal IC-602



In color-critical workflows, color calibration of print controllers should be performed daily. If different print jobs demand various print substrates, calibration should be performed before the new print job as well.

The individual calibration procedure is different depending on the print controller and the calibration software.

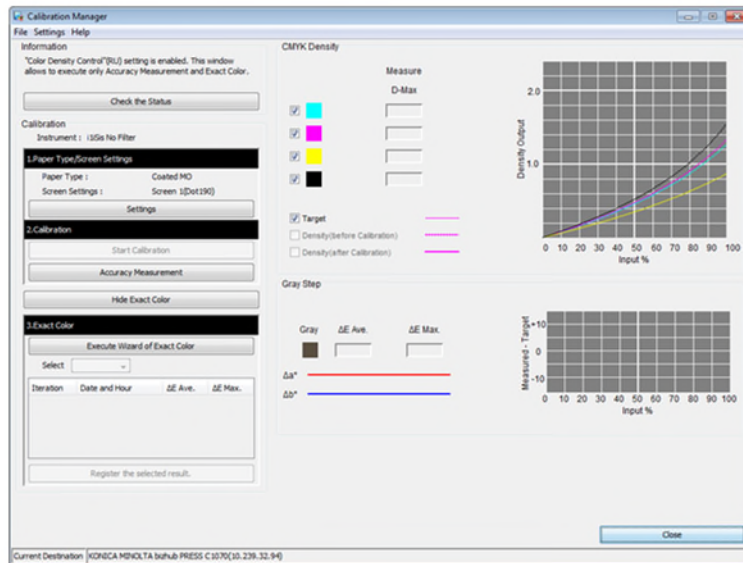
But the generic procedure is always similar:

- First and foremost, prepare the calibration. Run several hundred sheets prior to calibration or profiling because the engine must be in a "warmed up" state. Decide to which standard you want to calibrate. Then load the intended papers in a tray and register them before you perform a calibration.
- Launch the calibration software tool.
- Print the color chart with known color values.
- Measure each color patch in the printout.
- Now the software compares the known and the printed values for each patch and stores the differences.

Note: Your customer performs the calibration of the controller! You may show the customer how to perform it, but calibration is always an end-user function.

To view different calibration solutions, click the print controllers.

- Color Centro provides
 - Regular Calibration
 - Advanced Calibration
- Advanced offers
 - Exact Color as default
 - G7 Calibration



Back

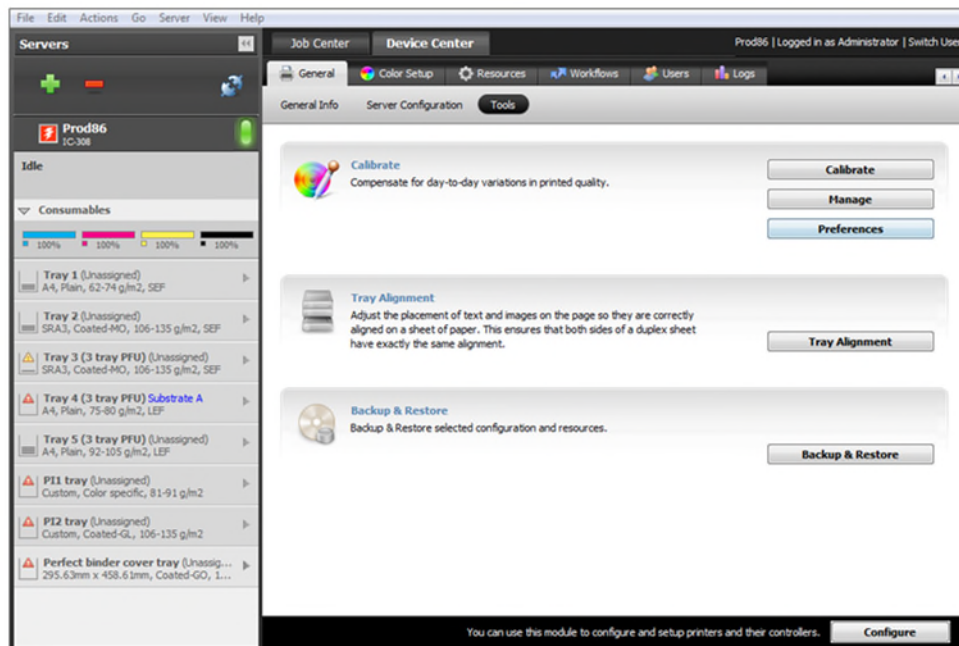
When Color Centro is started, the Launcher Screen becomes available. Select the Calibration tab. The calibration manager window is displayed.

To get a detailed instruction, refer to the bizhub PRESS C1070 manual.

Note: With Color Centro, you can choose between Regular Calibration and Advanced Calibration. Advanced Calibration provides two different calibration methods:

- First, Exact Color. This method is configured as default.
- Second, G7 Calibration. IDEAlliance has developed G7 to control gray balance more specifically. The G7 calibration method therefore aims at gray reproduction in various printing methods by adjusting the curve of each color of CMYK. It controls the CMY gamma curve and the “mixed gray gradation” to get the same result as “K gray gradation”.

Calibrate a Printing Device



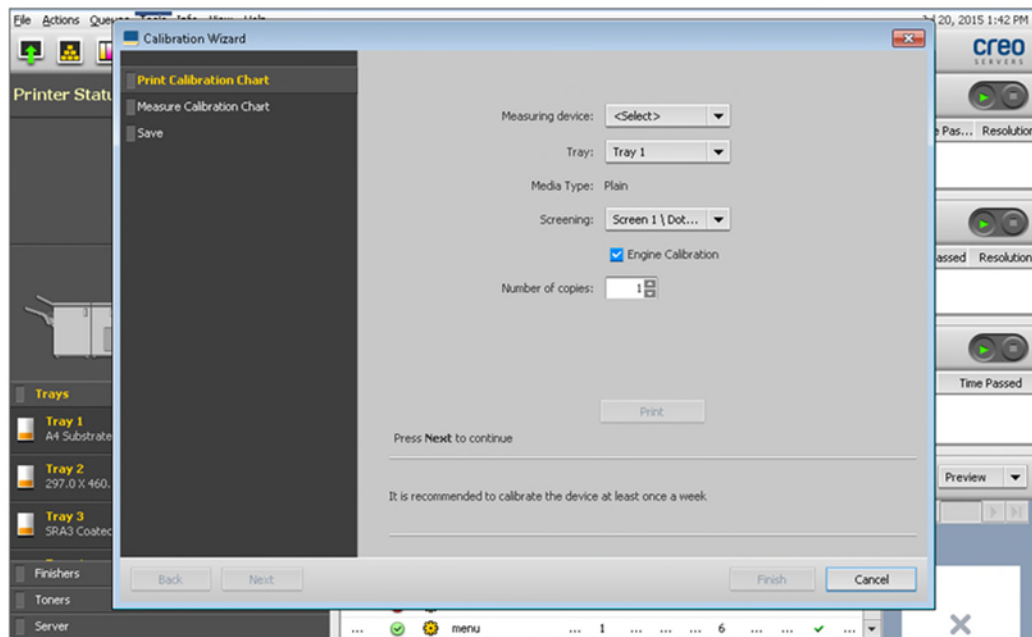
[Back](#)

To calibrate a printing device with the Fieri Command WorkStation, select Device Center or choose Tools from the Go menu.

To get a detailed instruction, refer to the Fieri “How-To” site.

“How-To: Create and Manage Calibration on a Fieri Driven Printer using an EFI ES-2000 spectrophotometer”.

Calibrate a Printing Device

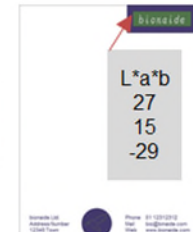
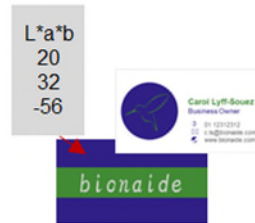
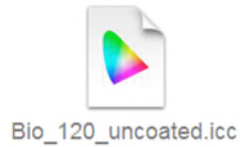
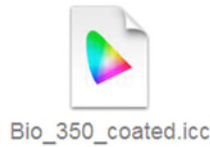


Back

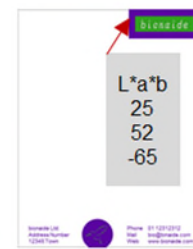
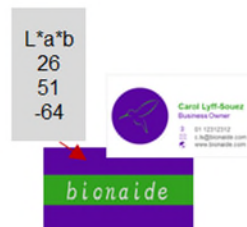
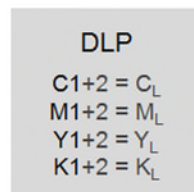
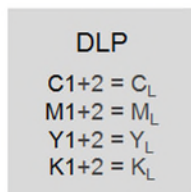
With an IC-309, select Calibration from the Tools menu to open the Calibration Wizard window.

To get a detailed instruction, refer to the IC-307 controller user guide.

- Calibration and profiling are separate processes
 - Involve different substrates



- Different types of profiles possible



Other than with monitor calibration and profiling, calibration and profiling of printing devices are two clearly separated processes.

This difference is on one hand because printer calibration and profiling involve different substrates. To ensure the reproduction of the same color „purple“, the print provider needs two different profiles even though the same printing device is used. On the other hand, different types of ICC profiles may be needed.

In case of the print provider, device link profiles for the second run could ensure reliable color reproduction.

- To create a printer profile add the intended paper type
- Use of different applications – and respective measurement devices – possible
- Basic procedure is similar

- 1 Prepare creation of printer profile (engine, standard, stock)
- 2 Launch the software
- 3 Enter a name for the printer profile
- 4 Follow the instructions and print the color chart
- 5 Measure each color patch in the printout
- 6 The software stores the printed values as ICC printer profile



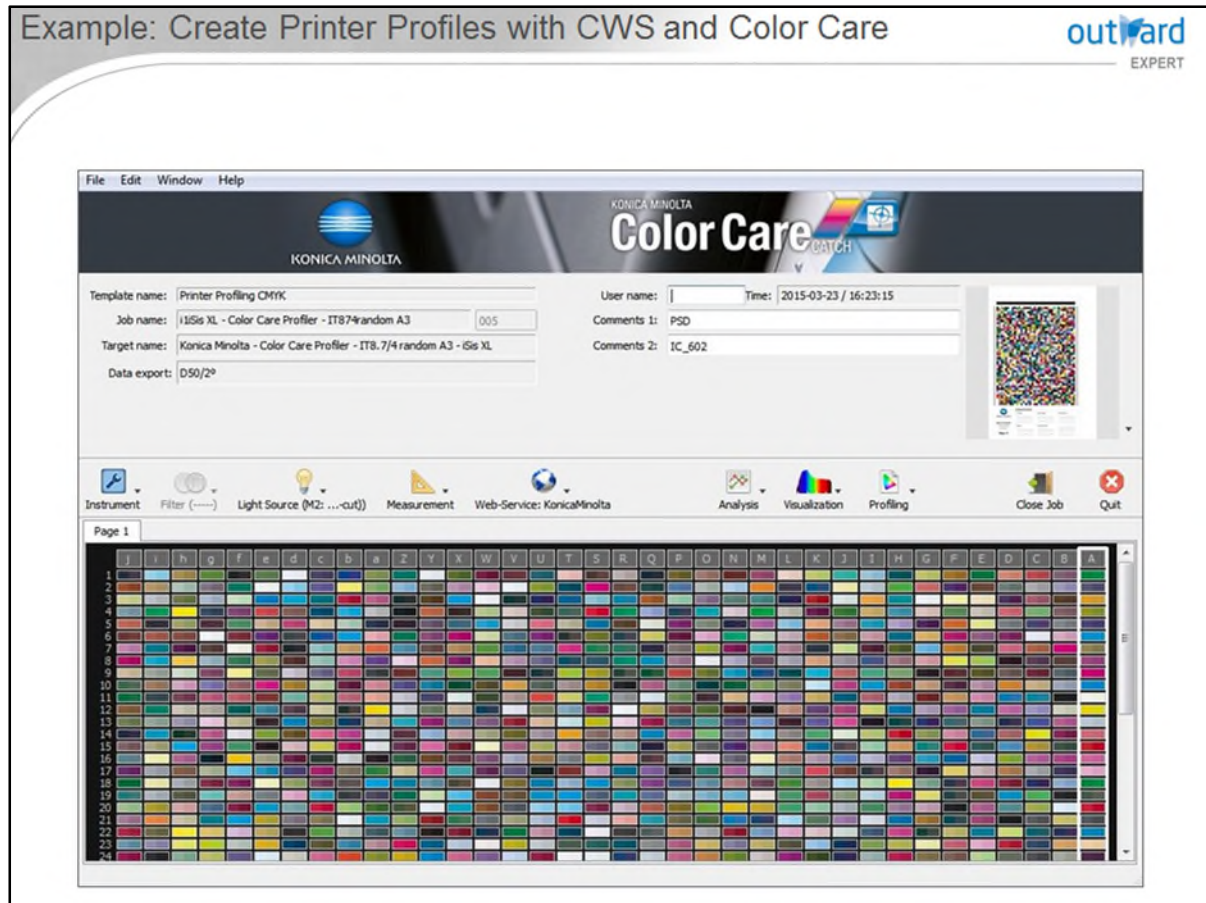
Bio_350_coated.icc



Bio_120_uncoated.icc

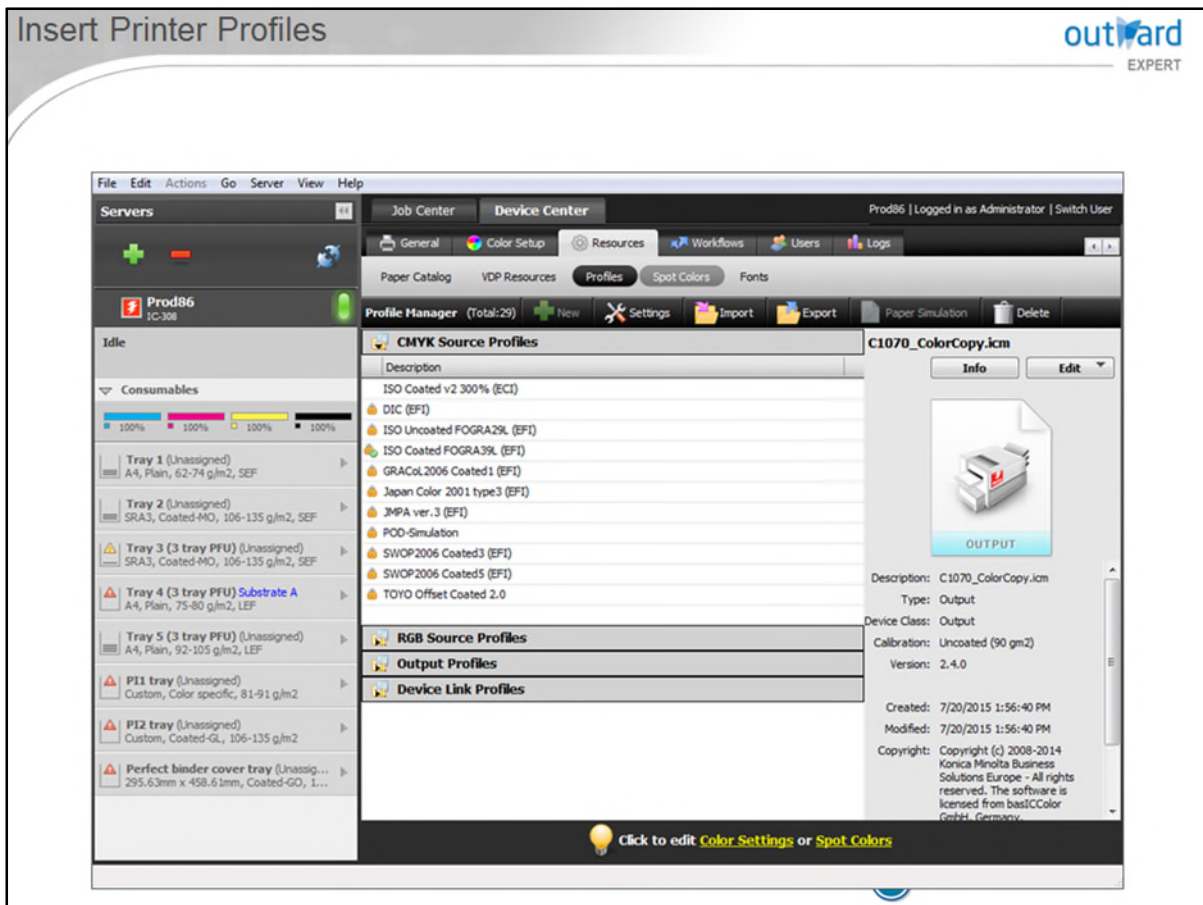
Remember: Printer profiles are a specific type of output profiles. To create a printer profile, you use not only the calibrated printing device but also the intended paper type inclusive of weight and other characteristics. Different software applications enable profile creation, but the simple basic procedure is quite similar with all of them:

- Prepare the profiling.
- Launch the software.
- Enter a name for the printer profile.
- Follow the instructions and print the color chart.
- Measure each color patch in the printout.
- The software stores the printed values as ICC printer profile.



As an example for the creation of printer profiles, we will have a look at how it is done via Command WorkStation and Color Care. After the calibration procedure, perform the following steps:

1. When the charts are measured click Profiling from the Color Care catch tool bar and select ICC profile. Thus, Color Care catch forwards the measurement data automatically into Color Care Profiler and launches the profiler application.
2. Enter a name for the profile.
3. Select Optimize colorimetric precision from the pull down menu.
4. Click OK. With Color Care profiler, you will now see a mosaic instead of the usual progress bar. After a while a prompt appears "Successfully created profile".
5. Answer the prompt "Successfully created profile" with OK. Now the profile is stored in the Windows or Mac default directory for ICC profiles.



A stored profile can be inserted through various applications that work in a very similar manner. To give you an example, this is how profiles are inserted in Command WorkStation:

1. Launch Command WorkStation 5 and login as Administrator.
2. From Device Center select Resources and Profiles and click Import.
3. Select System from Location drop-down.
4. Scroll down and select your previously created ICC-profile.
5. Choose Output from Import profile as: drop-down.
6. Click Import.

Note: If the import was successful, you find a new set in the list of Output profiles that shows the new ICC profile that is combined with your media-specific calibration.

- Device link profiles are static and convert from one gamut to another gamut

Source profile



DLP

$$\begin{aligned} C1+2 &= C_L \\ M1+2 &= M_L \\ Y1+2 &= Y_L \\ K1+2 &= K_L \end{aligned}$$

Destination profile



- You need software that supports device link profiles

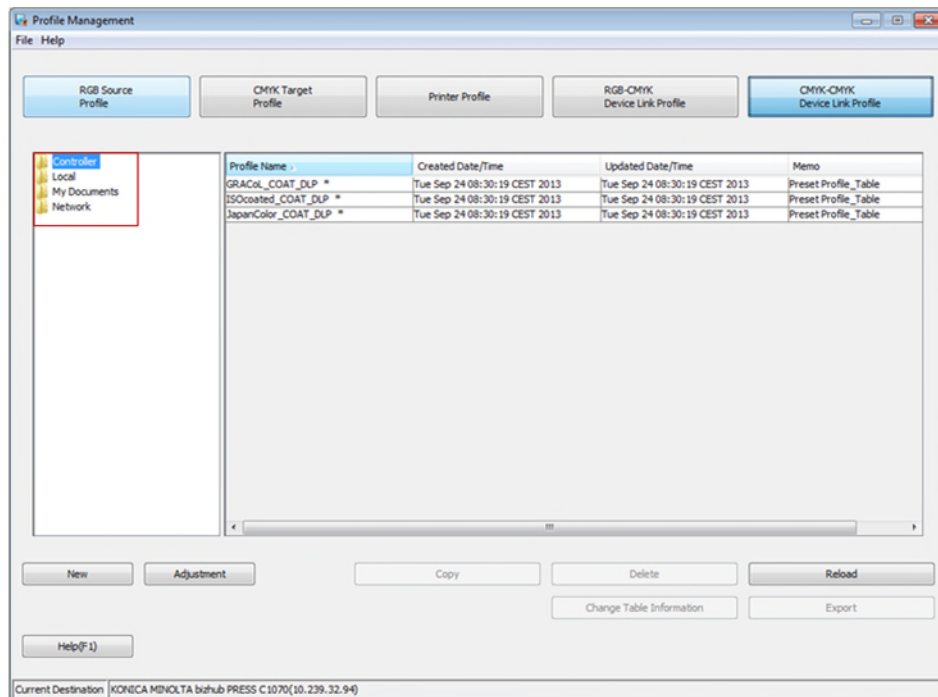


As you now know, a device link profile converts the color space of the input device directly into the color space of the output device. Device link profiles are static and convert from one gamut to another gamut, eliminating the need to recalculate colors every time.

Note: You need software that supports device link profiles. Examples are:

- The Fiery Color Profiler Suite.
- Color Care Linker.
- Color Centro.

To view an example of how to create a device link profile, proceed to the next slide.



Once again, different software applications will provide slightly different options and may require some more or some less user input. However, you find detailed information in the manuals or user guides. The basic procedure is quite simple, as the following example will illustrate.

To insert device link profiles with Color Centro, proceed as follows:

1. Launch Konica Minolta Color Centro and connect with the IC-602 controller.
2. Click the Profile Management tile.
3. Click CMYK-CMYK Device Link Profile.
4. Use the navigation menu on the left to browse to *C:\Users\userXX\Desktop*
5. Select the recently created Device Link and click Import.

Note that this procedure is only necessary when the device link profile was created with another application, since you can also create them in Color Centro.

WHAT TO DO

- Familiarize with at least one calibration solution
- Use an appropriate, calibrated and functional measurement device
- Create different calibration sets for different stocks
- Ensure that the engine is in good condition and linearized
- Print at least 3 copies of the charts and measure the last one
- Check chart outputs
- Use the highest available patches on the calibration chart
- Measure carefully and straight with a handheld device
- Put 10-20 blank sheets of the same substrate below the charts when measuring
- Check density curves on screen after measuring.
- Always check your measured values after calibrating
- Use correct settings after calibration

WHAT NOT TO DO

- Do not use a substrate for calibration that the customer does not use.

Even though color calibration and profiling of printing devices is quite challenging, you will be successful if you heed the following dos and don'ts.

What to do:

- Make sure that you are familiar with at least one calibration solution.
- Use an appropriate and calibrated measurement device. Check the device for damages and dust on the sensor glass.
- Make sure that you create different calibration sets for different stocks.
- Ensure that the engine is in good condition. Linearize the engine and make sure that engine adjustments like color registration or beam pitch have been carried out.
- Print at least 3 copies of the charts and measure the last one.
- Check chart outputs (calibration and profiling) . Print again, if there are any artifacts (caused by glitches in belt and others).
- Use the highest available patches on the calibration chart.
- With a handheld measuring device, measure carefully and straight (use guide rail) to avoid inaccurate values that are caused by an incorrectly positioned device.
- Put at least 10, better 20 blank sheets of the same substrate below the charts when measuring to avoid inaccurate values.
- Calibration: Check density curves on screen after measuring. When there are any abnormal peaks or dents, measure again.
- Always check your measured values after calibrating.
- Make sure that you use correct settings after calibration. Setup the profile as output

profile.

What not to do:

- Do not use a substrate for calibration that the customer does not use.


Quiz

outward
EXPERT

Which of the following standards are common industry standards for print production?
Mark the correct ones.

- ☐ GRACoL
- ☐ RAL
- ☐ G7
- ☐ ECI
- ☐ Fogra

Submit

Click the  Quiz button to edit this quiz

Test your knowledge in a quiz!

3**Lesson Summary**

In this lesson, you have learned:

- What printing device calibration and profiling is in general
- What to consider when calibrating and profiling printing devices
- Which software and tools to use for calibration
- Which software and tools to use for profiling
- How to create and insert output profiles
- How to create and insert device link profiles
- Which important dos and don'ts to mind

In this lesson, you have learned:

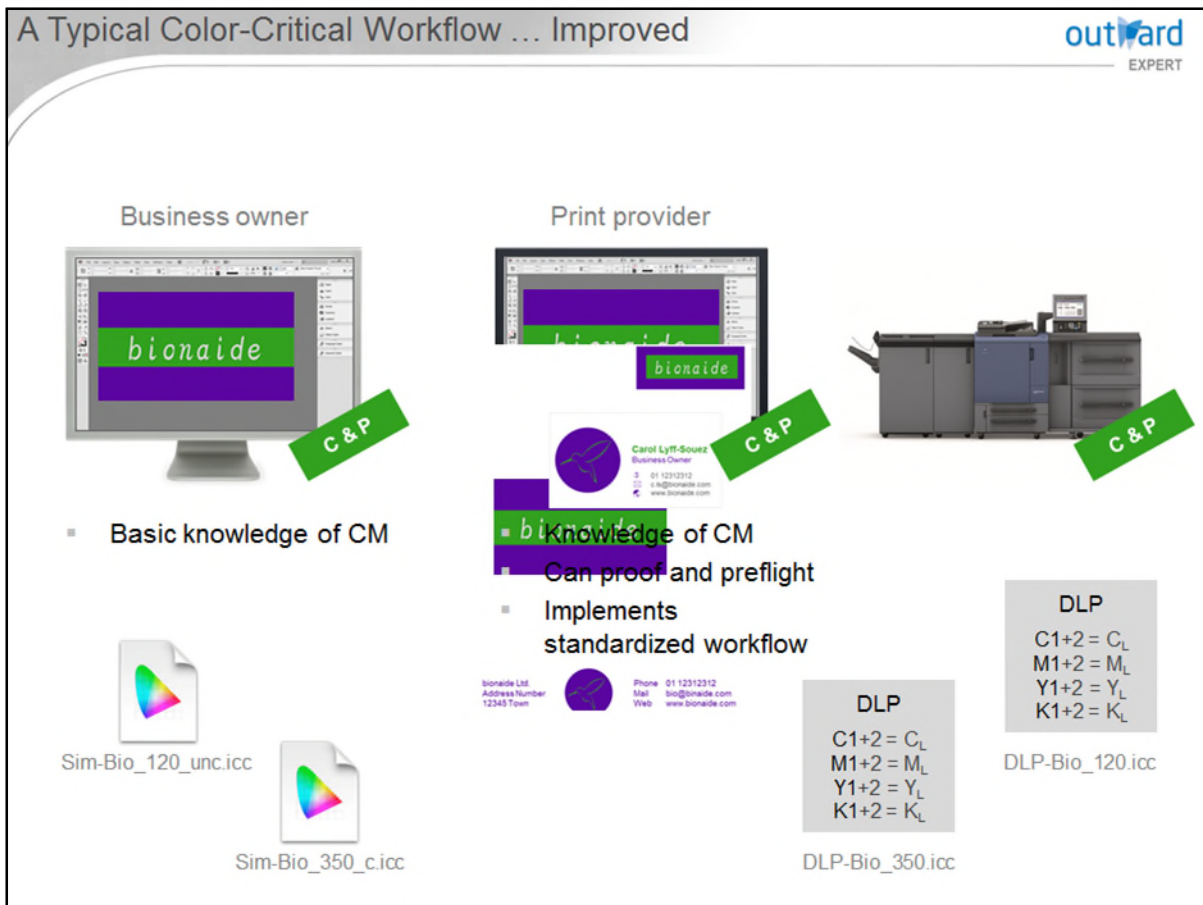
- What printing device calibration and profiling is in general.
- What to consider when calibrating and profiling printing devices.
- Which software and tools to use for calibration and profiling.
- How to create and insert output profiles.
- How to create and insert device link profiles.
- Which important dos and don'ts to mind.

4

In Practice

- A Typical Color-Critical Workflow ... improved

This lesson will introduce a solution for the unsuccessful color-critical workflow and thus will illustrate how it could become a color-managed successful workflow.



So, what would be the ideal color-managed workflow for the business cards and letterhead?

First, the business owner has at least basic knowledge of color management strategies to oversee a color-critical workflow more effectively.

Second, the print provider has adequate knowledge of color management as such and of tasks like color proofing and preflighting files.

Third, all involved devices are accurately calibrated and profiled.

Fourth, simulation profiles for both the business cards and the letterhead enable a realistic onscreen simulation. The print provider can use them to softproof the files.

Fifth, appropriate profiles for both substrates are used. These profiles may be printer profiles or – even better – device link profiles.

Additionally, the business owner asks for hard copy proofs to be sure that the colors are printed as intended.

Last but not least, the print provider implements a standardized color workflow and provides information on the type of files they require. For example, to use printing standards like PDF/X helps to minimize color and workflow-related issues.

If you want to know more about the PDF/X standards, refer to the OUTWARD expert modules on “Adobe PDF Print Engine” and “DTP Applications”.

- Besides color management, the prepress tasks preflight and profiling are important to ensure colors print as intended
- Prepress comprises all processes before printing
- Preflight checks whether the all the data meet the necessary requirements
- Proofing uses soft or hardcopy proofs to check what the final product will look like when it gets printed
- Contract proofs are a contract between the printer and the customer
 - Only if it is signed, the printing process will start



The next step of the advertising campaign is an ad poster print in quantity. This undertaking is quite expensive, therefore the customer wants to know if the designer can ensure color accuracy.

In answer to that, the designer briefly outlines the prepress tasks preflight and proofing:

Basically, prepress comprises all the processes that occur before printing and finishing. The prepress processes may take place at one single location – such as a printing company – or at various places. Preflight and color proofing are two prepress tasks that are most important in color-critical workflows.

- Very simply put, preflight checks whether the characteristics of those files or images are in sync with the desired output. In other words, preflight is a validation to check if all the data meet the necessary production requirements.

- Proofing: The main objective of proofing is to produce either a digital or a hard copy of what the final product will look like when it gets printed. More and more such proofs are soft proofs that are evaluated on a monitor. Nevertheless, hardcopy proofing remains popular when there is sufficient time for it and for color critical or expensive jobs.

Besides preflight and proofing, the designer additionally advises to opt for a contract proof. Such a contract proof is usually a color proof that is looked on as a contract between the printer and the customer. Only if the customer signs the proof as ok, the final printing process will start.

4

Lesson Summary

In this lesson, you have learned:

- How color calibration and profiling facilitate a successful color-critical workflow
- That classical prepress tasks like preflighting and color proofing are further important steps

In this lesson, you have learned how color calibration and profiling facilitate a successful color-critical workflow.

You now know that classical prepress tasks like preflighting and color proofing are further important steps in such a workflow.



Course Summary

In this course, you have learned:

- What color calibration and profiling are
- Why they are important in any color-managed workflow
- What monitor calibration and profiling means
- How to calibrate and profile monitors
- What calibration and profiling of printing devices means
- How to calibrate and profile printing devices
- Important components of an ideal schematic color-managed workflow

In this course, you have learned:

- What color calibration and profiling are.
- Why they are important in any color-managed workflow.
- What monitor calibration and profiling means.
- How to calibrate and profile monitors.
- What calibration and profiling of printing devices means.
- How to calibrate and profile printing devices.
- Important components of an ideal schematic color-managed workflow.

Congratulations!

You have completed the OUTWARD "Color Calibration and Profiling" course.



Congratulations! You have now completed the OUTWARD course on "Color Calibration and Profiling".