

Prinect
Color and Quality

HEIDELBERG

DeviceLink Profiles
Fundamentals and Applications
2nd Edition

Contents

4 Color & Quality

- 4 Princt User Guide – Color & Quality
- 5 DeviceLink profiles – fundamentals and application
- 5 Software versions

6 Fundamentals

- 6 What are DeviceLink profiles?
- 9 Applications for DeviceLink profiles

12 Creating DeviceLink profiles

- 12 Selecting profiles
- 16 Selecting the various options
- 16 Rendering intents
- 23 Shadow compensation
- 25 Preserve black
- 27 Preserve color
- 29 Summary

30 Using DeviceLink profiles

- 30 Color Editor and DeviceLink profiles
- 33 Princt Prepress Manager and DeviceLink profiles
- 35 Princt MetaDimension and DeviceLink profiles
- 35 Summary

37 Glossary

Color and Quality

Prinect User Guide – Color and Quality

In the publication series “Prinect User Guide – Color & Quality” we aim to take a closer look at individual aspects of the color workflow, while focusing on practical applications.

Inking up with Prinect is fast and reliable. You can check your quality throughout the entire print run and make sure it remains consistent. Prinect’s integrated color workflow enables you to print to well-defined and standardized values that can be reliably controlled with measurement equipment. The parameters for automatically presetting your press can be defined as early on as in the prepress stage, merging prepress and pressroom into one system.

Prinect enhances cost-effectiveness by giving you control over your color and quality management, ensuring you can reliably reproduce the results again and again and ink up rapidly with fewer waste sheets and shorter makeready times. You benefit from consistent production run quality and get more out of your press. In practice, your print results can be impacted by so many different factors: from the type of paper, to the screen and inks, through to the actual press but you can only coordinate proof, plate and print when you know what these factors are.

Prinect introduces reliability to your production process. Verifiable values and tolerances only need to be defined once to set up a standard that coordinates proofer, platesetter and press. This standardization ensures that both the proof and the print are perfectly matched. You can comply precisely with color values, while optimizing your color and quality management.

Inking is easier and faster. And if there are any deviations or customer complaints, logs documenting the production process are available to make your negotiations that much easier. You can use established standards such as the ISO Standard or the Process Standard for Offset Printing, or you can easily implement other specifications, such as your customer’s.

Standardization brings assurance for both you and your customer. You can be sure you are printing according to your customer’s specifications on each and every press, while your customer can be sure you deliver the quality he is looking for and will want to come to you again. This is the surest guarantee in the long-term that your print shop remains profitable.

The interaction between the individual components in a color workflow is complex. The publication “Prinect User Guide – Color & Quality” aims to make this interaction more transparent for you, the user.

DeviceLink Profiles – Fundamentals and application

DeviceLink profiles are essential for special applications in workflows to prepare the print process. These applications can be, for example, the process conversion between different print processes, or process calibration within a print process. These days everyone is also talking about the potential for saving on chromatic printing inks by producing specific color compositions in the print data (with gray component replacement and reduction of the total area coverage).

In this context, DeviceLink profiles transform data directly (without using an interim color space) from a CMYK input color space to a CMYK output color space. You can also create and use DeviceLink profiles for converting RGB to CMYK or from CMYK to 5 and 6 colors. These profiles, however, are beyond the scope of this user guide.

When using conventional input and output profiles, the data are transformed via a defined device-independent interim color space. Sometimes this can mean that the data on black generation is lost. This can be avoided by using DeviceLink profiles. The disadvantage of using DeviceLink profiles is that one or more profiles need to be created for each combination of color spaces and devices.

The aim of the publication “DeviceLink Profiles – Fundamentals and Application” is to show you the various ways of creating and applying this special type of ICC color profiles in prepress, how you can use them in your workflow and what you need to know in detail.

Software versions

This publication refers to the following software versions for Prinect products:

Prinect Color Toolbox	Version 10.0
Profile Tool (Option)	Version 10.0
Prinect PDF Toolbox	Version 4.0
Color Editor (Option)	Version 4.0
Prinect Prepress Manager	Version 4.0
Prinect MetaDimension	Version 7.0

Higher and sometimes even lower versions of the software will usually support the functions described. This may, however, cause changes in the user interface. You can find hints and tips on this in the various product and user documentation. The products and options described here may not necessarily be supplied as standard with your Prinect modules and may need to be purchased separately. In the case of Prinect Color Toolbox, Version 10.0, as referred to above, or higher is essential for the functions described here.

Fundamentals

What are DeviceLink profiles

ICC profiles are standardized files that describe the color characteristics of devices, images and graphics using colorimetric standards. Devices can be scanners, digital cameras, monitors and all types of color printers and print processes. Images and graphics are files that can be in all kinds of media-neutral or device-independent color formats.

ICC profiles supply color management systems with the information they need to transform color data between the various input and output color spaces. This information can be transfer curves, matrices, multidimensional tables or simply individual color values.

There are various classes of ICC profiles. Input device profiles describe scanners and digital cameras. Display device profiles describe self-luminous or projection output devices, and output device profiles describe print processes, printers, proofers and image exposing devices from all kinds of technologies.

In addition to the profiles for devices, there are also four other profile classifications. DeviceLink profiles¹ are one of these four types of profile. They contain the algorithms for color transformation from an initial device color space to a second device color space.

This clearly differentiates DeviceLink profiles from device profiles, which transform the input color space into a media-neutral color space (PCS, profile connection space) and then the media-neutral color space into an output color space. This means that for device profiles you will always need two profiles to transform data from a device color space into another device color space. DeviceLink profiles can transform data directly, but are not as flexible to use as the other profiles.

¹The term DeviceLink profile has established itself among experts, and we will be using it here throughout.

More about Profile Types

The ICC profile format specification ISO 15076-1 specifies the following seven profile classes:

Input Device Profiles. An input device profile describes the transformation of color from the color space of an input device (scanner, digital camera) to the PCS (profile connection space). The device color space is usually RGB. The PCS is a special variation of the CIELAB or CIEXYZ color space.

Display Device Profiles. A display device profile describes the transformation of color from the PCS to the color space of a self-luminous display device (monitor, projector). The device color space is usually RGB.

Output Device Profiles. An output device profile describes the transformation of the color in the color space of output devices and print processes (offset printing, newspaper printing, etc.) from the PCS into the output device color space and from the output device color space into the PCS. The device color space is usually CMYK, but may also include RGB or color spaces with more than four colors.

DeviceLink Profiles. A DeviceLink profile describes the transformation of the color in the color space of an input device to the color space of an output device. The device color spaces can include RGB, CMYK or more than four printing colors.

Color Space Conversion Profiles. A color space conversion profile describes the transformation of a device-independent color space into the PCS and from the PCS into the device-independent color space. Device-independent colors can be CIELAB, RGB or other color spaces that are precisely defined colorimetrically. Well-known device-independent color spaces are AdobeRGB, eciRGB and sRGB.

Abstract Profiles. An abstract profile describes the transformation from the PCS into the PCS, i.e. a LAB-to-LAB transformation or an LAB-to-XYZ transformation. These profiles can be used for defining color changes in image editing systems and are then linked to an input or output profile.

Named Color Profiles. Named color profiles contain color look-up tables such as Pantone or HKS and assign a color name as well as color measurement values (CIELAB, CIEXYZ) and device-dependent color values (CMYK).

Color transformation using input device, display device and output device profiles is always performed using the three-dimensional PCS (CIELAB or CIEXYZ color space), which means data can sometimes go astray. This is always the case, for example, when data for a print process (CMYK) are converted into data for another print process. In this case, specific information on color composition, especially the data on how black is used, disappears. One extreme example is a text or a grayscale image composed of black which after transformation is suddenly made up

of all four colors. This behavior is very often undesirable and the problem can only be resolved by calculating specific DeviceLink profiles, which react better.

Basically, profiles are always calculated from the characterization data of the various devices. The calculation takes the specific characteristics of the various devices and the print process into account. These characteristics include not only maximum area coverage in overprinting, but also black generation and gamut mapping.

More about Characterization Data

Color management and the digital exchange of documents call for a clearly defined relationship between the digital tonal values and the printed color values. Digital tonal values are usually available as CMYK process color data. In packaging printing, it may be that individual process colors are replaced by different, product-specific colors. The color values that are actually printed depend on the print process (sheetfed, web offset, gravure or screen printing), the process standard (inking, dot gain) and the materials used (substrate, ink). The digital tonal values and the assigned color values (CIELAB, CIEXYZ or spectral colors) are usually described by the term characterization data.

Characterization data sets are generated with the aid of test elements. The best-known test element is the test element according to ISO 12642-2 (formerly also called IT8.7/4), which is made up of defined

color patches for the CMYK process colors. Alongside this standard test element, there are also other vendor-specific test elements, as well as further applications on the basis of ISO 12642-2 for general use that enable even finer scanning of the color space.

Standardized characterization data sets for defined print conditions have been established for the process standards commonly used in Europe and USA (PSO, SWOP). In addition, various organizations, print shops and publishing houses have also defined other individual characterization data sets.



ISO 12642-2:2006 test elements (visual and random)

There are two different methods of calculating DeviceLink profiles. One method starts from scratch and calculates a new profile from the characterization data of the two processes involved or on the basis of the printing conditions. Total area coverage, black generation and gamut mapping are predefined according to the output printing conditions. The other method calculates a new profile either from the existing profiles for both processes or on the basis of the printing conditions. Total area coverage and gamut mapping are taken from the output profile, and black generation is predefined according to the relevant parameters.

The Heidelberg software Prinect Color Toolbox uses the second method based on existing profiles. Our experience has shown that this method, if applied correctly, has no disadvantages in comparison to the first method. It does, however, require an intelligent color management module.

More about Color Management Modules (CMM)

A color management module is software based on mathematical operations that convert color image data from an initial color space into a second color space by using one or more ICC profiles. Several ICC profiles are usually linked with each other to make up one profile before color transformation takes place. This saves time and increases the accuracy of the transformation. A color management module can be a component of either an operating system or an application program. This means that all the main applications for both image and document processing have their own color management module.

The Heidelberg Color Management Module performs the computations necessary to create DeviceLink profiles. The options Rendering Intent, Preserve Black, Preserve Color and Shadow Compensation are parameters in the CMM and not only calculate DeviceLink profiles, but can also be utilized by Prinect Color Editor and Prinect Prepress Manager, as well as the RIP application Prinect MetaDimension. This ensures consistency not only in transformations using DeviceLink profiles, but also when using individual device profiles. The Heidelberg CMM always generates a DeviceLink profile before every color transformation.

Applications for DeviceLink profiles

DeviceLink profiles can be used for process conversions, process calibrations, consistent color composition and ink saving. These different applications require different calculations. The various calculations are supported by Profile Tool in the Prinect Color Toolbox. DeviceLink profiles for purely limiting total area coverage are not directly supported but they are supplied with some Heidelberg software products.

Process conversion. Process conversion is used when transforming between two different print processes. This includes conversions between different printing technologies such as offset and gravure printing or offset and newspaper printing, or conversions within a printing technology such as between coated and uncoated papers in offset printing or conventional and non-periodic screening.

When converting print processes, it is usually the target printing process that determines color composition and gamut mapping. Preserving black generation in images is not totally necessary and frequently is even undesirable. Newspapers are generally printed with moderate gray component replacement due to the lower area coverage in the print. Transforming from offset printing with its high densities into newspaper printing with its lower densities using the option Preserve Black can lead to unwanted limitations and problems in the newspaper printing process and you need to be careful here.

On the other hand, unintentional transformations can occur, especially in text and gray images. Ultimately you need to decide on the strategy you adopt for color composition on a case-by-case basis and it is a good idea to carry out a test print.

Your decision should also be based on whether you want to transform either images or graphics and whether you know the source of the data. This is important when building DeviceLink profiles if you want to avoid a loss in quality. As a basic principle, you should always create and apply separate DeviceLink profiles with optimal characteristics for either images or graphics.

Process calibration. Process calibration is used when transforming between two similar print processes. This includes conversions within a printing process in which, for example, you need to compensate for different papers and inks or different total area coverage and this compensation cannot be performed by one-dimensional dot gain correction.

In process calibration, there is no fundamental change in color composition and gamut mapping. It is generally necessary to preserve black composition so that objects (images, text, graphics) produced using gray component replacement remain unchanged.

Ink saving. DeviceLink profiles are being used more and more to save ink and therefore reduce printing costs. This involves a transformation between two similar processes in which the chromatic inks used to produce the dark areas are replaced by black, using gray component replacement in the color separation. This results in a lower total area coverage for tertiary colors in chromatic images. At the same time, the maximum total area coverage itself is reduced, resulting in even greater savings. Savings can be considerable for long print runs with many color images but naturally are less for short print runs or runs with few color images, which is why it is difficult to give any exact figures on this.

If the objective is to save ink, you should not use black preservation or only use it to a very limited extent when calculating DeviceLink profiles. Since gray components are printed with a high proportion of black, converting black-generated gray components into color-generated gray components is not that critical. Ultimately, the final decision hinges on whether to save inks or go for quality, since extreme gray component replacement and an extreme reduction in area coverage can lead to a noticeable deterioration in the quality of the image. Taking off too little ink within an ink zone can also cause problems with color control in the press.

Consistent color composition. The re-separation of documents is an application that is similar to ink saving. The objective of this application is to homogenize the data generated by various prepress companies for the same color space with differing separation profiles for one and the same product. A new separation ensures consistent black generation and total area coverage for the color images.

Area coverage limitation. Providing the appropriate parameters have been selected, total area coverage is already taken into consideration when computing the ICC profiles. Sometimes, however, it is necessary to define limits to avoid exceeding the defined area coverage in graphic elements.

The standard profiles for offset printing on the paper types 1 and 2 (ISOcoated_v2_eci and ISOcoated_v2_300_eci) have a total area coverage of 330 % and 300 % respectively. If you intend to reduce graphic elements or image data from unknown sources to this area coverage, you should use a DeviceLink profile that can limit black preservation if the total area coverage is exceeded. Heidelberg includes such special profiles with some application programs.

Summary. There are whole series of useful applications for DeviceLink profiles. Using such profiles has, however, inevitable side effects, which is why you will sometimes need to discuss details with the customer first to avoid complaints later on.

Creating DeviceLink profiles

Now we would like to talk about creating DeviceLink profiles and the various kinds of parameterization. We aim to describe the impact the profiles have on images and graphics and how to combine them. We will be using three typical examples.

The DeviceLink Profile dialog box can be called up under the “Special” menu in the main program functions “Create, Calculate or Compare”.

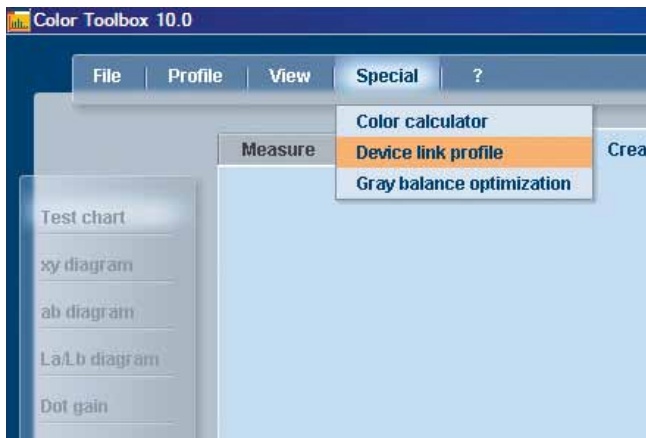


Fig. 1: Color Toolbox user interface with the main program functions – selecting “DeviceLink profile” dialog box under the “Special” menu.

Selecting profiles

In this dialog box, two device profiles are linked to form one DeviceLink profile. Various options can be set.

First of all, the profiles you want to link are opened. Profile 1 is the profile that describes the input device color space and Profile 2 is the profile that describes the output device color space².

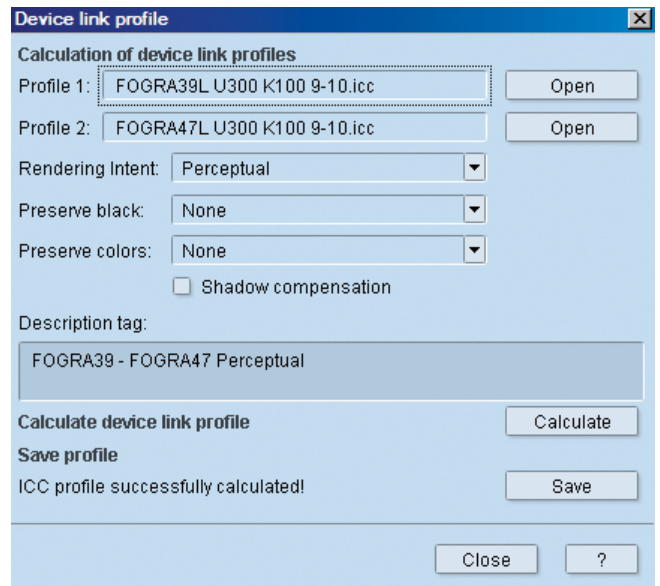


Fig. 2: DeviceLink Profile dialog box – selecting the profiles and parameters, entering the profile description, calculating and storing the profile

²The profiles here are not limited to CMYK. RGB profiles or profiles for more than four colors can be selected but this is beyond the scope of this publication.

Example 1: Process conversion. The first example shows the calculation for a process conversion from an offset printing process on coated paper (Profile 1: FOGRA39L U300 K100 9-10.icc) to an offset printing process on uncoated paper (Profile 2: FOGRA47L U300 K100 9-10.icc). The profiles are characterized by conventional color composition with 300% area coverage, large black width and length. The following figure shows the different color spaces. The dot gain curves are not shown here but can vary by up to 6% in the mid-tones.

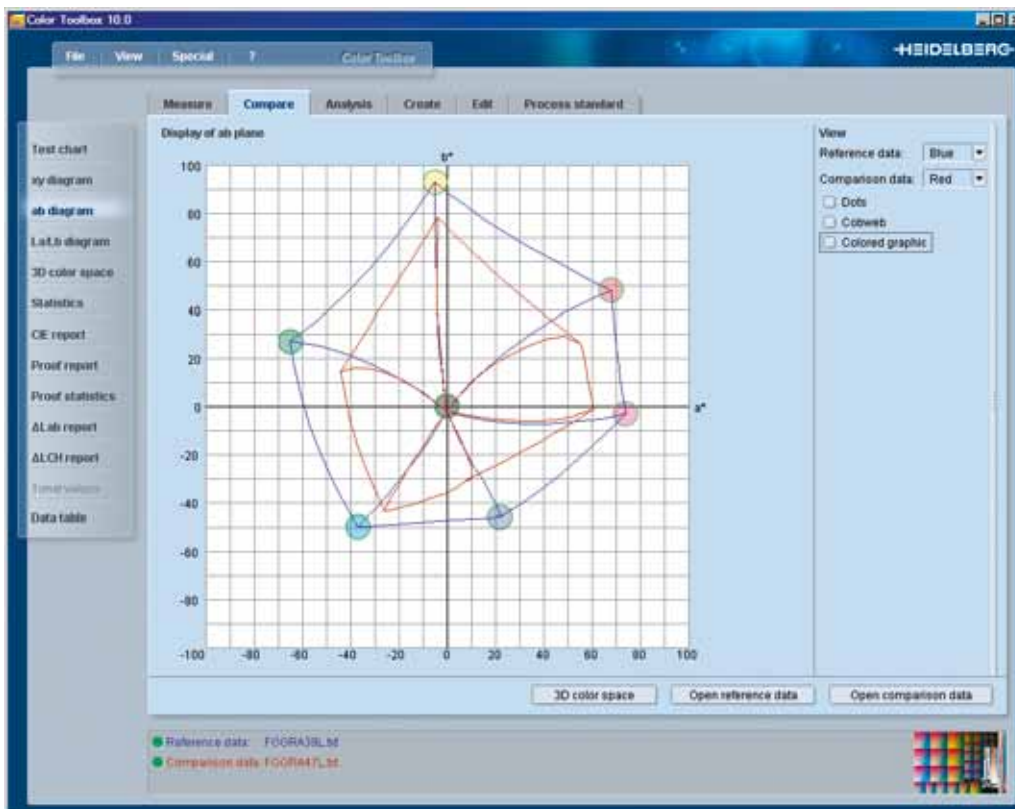


Fig. 3: Compares the color spaces of the FOGRA39 and FOGRA47 characterization data (basis for the FOGRA39L U300 K100 9-10.icc and FOGRA47L U300 K100 9-10.icc profiles)

Example 2: Process conversion/process calibration.

The second example shows the process calibration from an offset printing process on coated paper with conventional screening (Profile 1: FOGRA39L U300 K100 9-10.icc) to an offset printing process on coated paper with non-periodic screening (Profile 2: FOGRA43L U300 K100 9-10.icc). The profiles are characterized by conventional chromatic composition with 300% total area coverage, large black width and length. Apart from the very different dot gains (13% to 28% in the mid-tones) the profiles also show different color gradation curves in the color space (see Fig. 4).

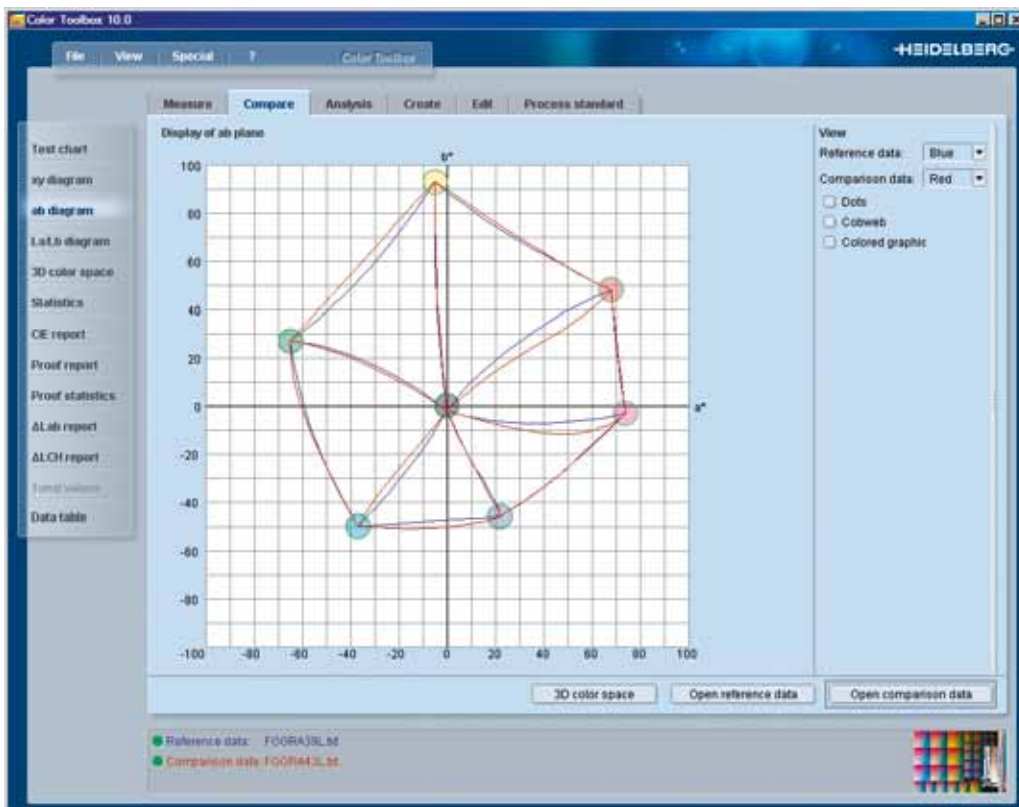


Fig. 4: Compares the color spaces of the FOGRA39 and FOGRA43 characterization data (basis for the FOGRA39L U300 K100 9-10.icc and FOGRA43L U300 K100 9-10.icc profiles)

Example 3: Ink saving. The third example shows the ink savings in an offset printing process on coated paper with conventional screening (Profile 1: FOGRA39L U300 K100 9-10.icc) against a comparable offset printing process (Profile 2: FOGRA39L U280 K100 G80.icc). The second profile is based on the same characterization data as in the first profile but has a separation setting with a reduced total area coverage of 280 % and a high GCR of 80 %.

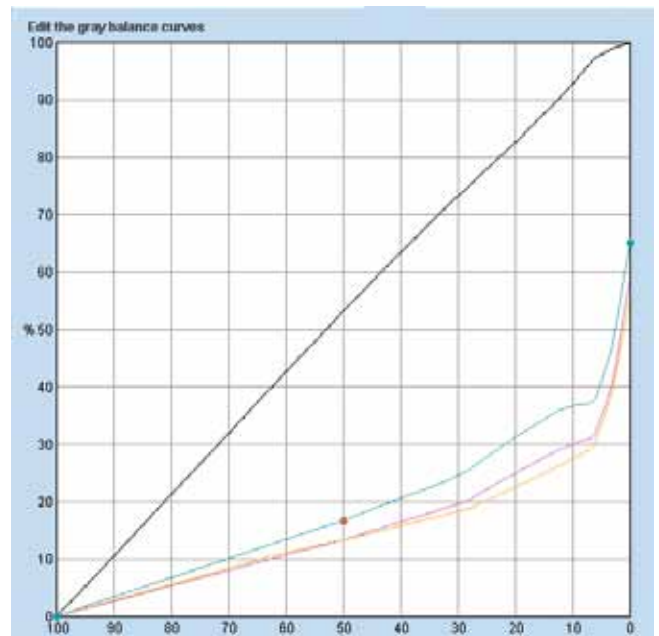
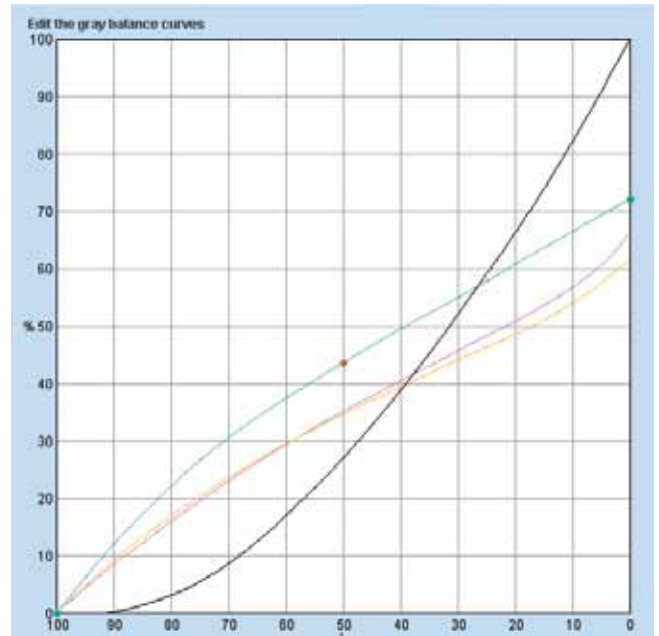


Fig. 5: Compares black generation along the gray axis in conventional chromatic composition (FOGRA39L U300 K100 9-10.icc) and in heavy gray component replacement (FOGRA39L U300 K100 G80.icc).

Selecting the options

There are various options for calculating profiles – Rendering Intent, Preserve Black, Preserve Color and Shadow Compensation. The four rendering intents, the four options for preserving black and the five options for preserving color make up a total of 80 different combinations for calculating profiles. Selecting the option Shadow Compensation in conjunction with the “relative colorimetric” intent boosts the number of possible combinations up to 100. Luckily not all these combinations are worthwhile and the number of combinations you will actually need is easily manageable.

A description for the new profile can be entered in the text field Profile Description. This is the text that is then shown in the Description Tag text field for the profile and this is shown in many applications instead of the file name. The profile can be saved after it has been successfully calculated. To save it, the profile description or a part of the description should be chosen as the file name.

Rendering intents

There is a choice between the four rendering intents defined by the ICC. Which rendering intent the user selects depends on how the DeviceLink profiles are to be used.

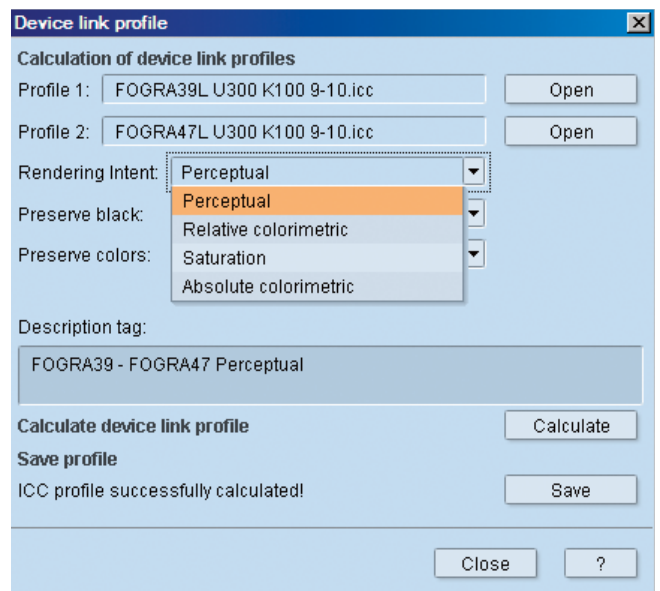


Fig. 6: Selecting the rendering intent options

The following chapters describe the impact rendering intents³ have on color gradation, using the process colors magenta and black as an example.

³The rendering intent Preserve Saturation is not important in this context and is, therefore, not mentioned here. This rendering intent is, however, supported in Prinect Color Toolbox and in Profile Tool.

More about rendering intents

Rendering intents are terms that describe how images and graphics are intended to be reproduced on an output device or in an output process. A rendering intent is closely linked to gamut mapping.

The color gamut of an output process (e.g. offset printing, newspaper printing) is a different size and is usually smaller than the color gamut of a digitalized original or a scene. Four different strategies have been defined to match the differences in color gamut between the original and the output process. Two of these strategies are based on the measured characteristics of the devices and the processes, while the other two strategies are based on the matched values, taking into account the differences in the various output processes, the materials used and the viewing conditions.

Which rendering intent you select depends on the content of the originals as well as the characteristics of the various output processes. Natural-world originals and scenes are generally treated differently than computer-generated graphics. Applying rendering intents is mostly vendor-specific.

Absolute colorimetric. The absolute colorimetric rendering intent is used to exactly reproduce the specified values of the source colors, which are quantifiable by instrument measurement. Absolute colorimetric is used to simulate an output process on a different output device or to output defined color values in print.

The colors of the original in the color space of the output process are correctly reproduced. Colors outside this color space are approximated to the nearest reproducible color. This may mean that very light, very dark or very brightly colored details in the original are no longer reproduced exactly. When an output process is simulated, the substrate is also simulated, providing the lightness and color of the substrate are within the color space of the output process.

Relative colorimetric. The relative colorimetric rendering intent is used to reproduce color values exactly while also including the substrate in the calculation. Relative colorimetric is used for simulations of an output process on a different output device based on the white of the substrate.

The original colors are reproduced in relation to the white of the media used. The white point of the original is matched to the white point of the reproduction. Colors outside the color space are approximated to the nearest reproducible color. This may mean that very dark or very brightly colored details in the original are no longer reproduced exactly. When simulating an output process, there is no simulation of the substrate. If the simulation is performed on paper that is to be used for the print run, the result matches that of the absolute colorimetric rendering intent.

Perceptual. The perceptual rendering intent is used for the harmonious reproduction of color values in the print, while taking into account the differences in the gamuts of the original and the print. Perceptual is mainly used in image color separation.

Gamut mapping is carried out in such a way that all the natural colors of the original are chromatically correct but are reproduced with limited contrast. How gamut mapping is carried out is vendor-specific and sometimes the user can set the parameters when creating profiles. Profile Tool in the Prinect Color Toolbox has a large number of such parameters.

Saturation The saturation intent is used to reproduce the vividness of the original color values in print, while retaining the saturation of the original color values. Saturation is mainly used in color separations of charts and diagrams (business graphics).

Process conversion. Fig. 7 shows how the DeviceLink profile converts the gradation curve for magenta, using as an example the conversion from FOGRA39L U300 K100 9-10.icc to FOGRA47L U300 K100 9-10.icc, i.e. converting from a coated paper to an uncoated paper.

While a harmonious gradation can be seen when the profile is calculated using the “perceptual” rendering intent (the bend in the curve is caused by the different dot gains) the gradation with the other two rendering intents tends towards saturation. This behavior is typical for the tonal gradations of chromatic colors when the output device color space is smaller than the input device color space.

You can also see in the graphs that small quantities of cyan and yellow appear to compensate for shifts in hue and lightness caused by the materials. With the “absolute colorimetric” rendering intent, paper white may contain a small proportion of color. This means that a paper white match or simulation is performed, as is common in proof printing. This effect does not occur in this example, since there is no difference in paper white.

Fig. 8 shows how the DeviceLink profile converts the gradation curve for black, using as an example the conversion from FOGRA39L U300 K100 9-10.icc to FOGRA47L U300 K100 9-10.icc, i.e. converting from a coated paper to an uncoated paper.

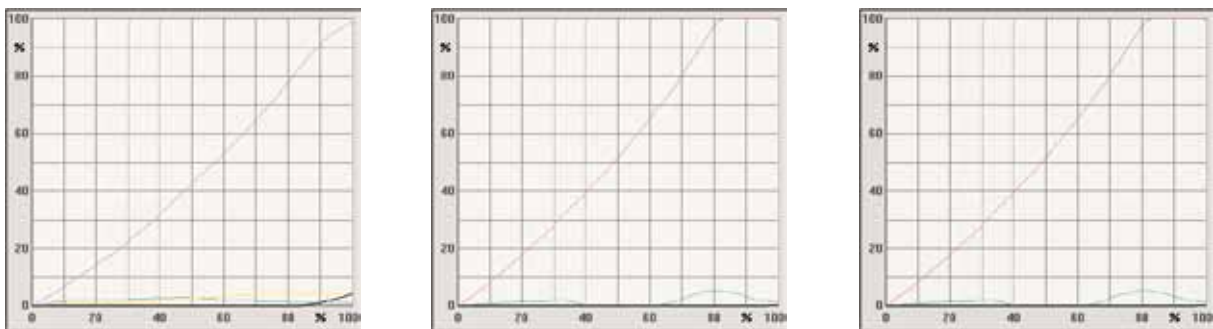


Fig. 7: Tonal gradation for magenta in process conversion: rendering intents perceptual – “relative colorimetric” – “absolute colorimetric” (from left to right)

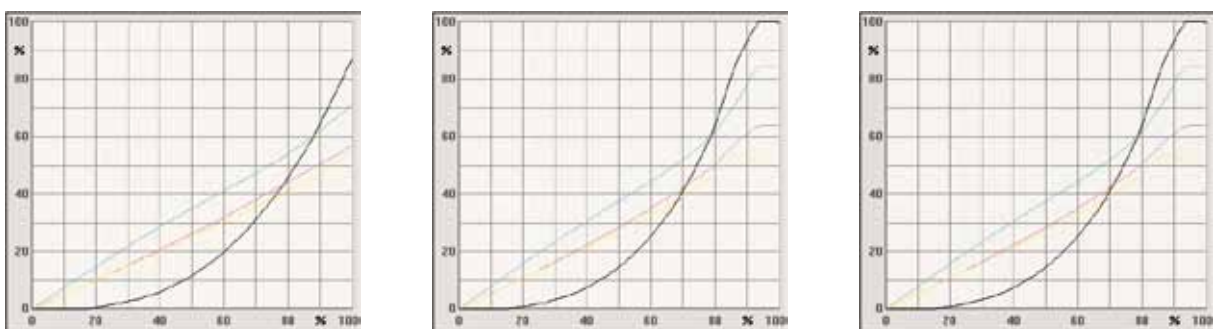


Fig. 8: Tonal gradation for black with process conversion: rendering intents perceptual – “relative colorimetric” – “absolute colorimetric” (from left to right)

The conversion of pure black into a four-color black is clearly visible and you can also easily see the gray balance of the output print process. In this case black is generated using conventional chromatic composition.

As already seen with magenta, the colorimetric rendering intents here also show saturation behavior. All in all, this leads to disappointing results in the transformation of shadows in the image data. For this reason, when converting from a color space with a larger color gamut into a color space with a smaller gamut, the only rendering intent worthwhile using is “perceptual” intent. This is also true when inverting the process conversion, i.e. if you are converting from a process with a smaller color gamut to a process with a larger gamut.

As you can see in the images above, converting pure black into composite black often results in unwanted effects when printing graphics. To understand this better, we can now take a look at a graphic that is made up of various gray fields. One is made up from a composite gray (CMY = 50/40/40), one from a black gray (K= 50) and one from a four-color gray (CMYK = 50/40/40/50). The four-color gray is also typical for the gray in images and the black gray is typical for black text⁴.

The upper part of the graphic shows the values in the input device color space and the lower part of the graphic shows the values in the output device color space after transformation with a DeviceLink profile.

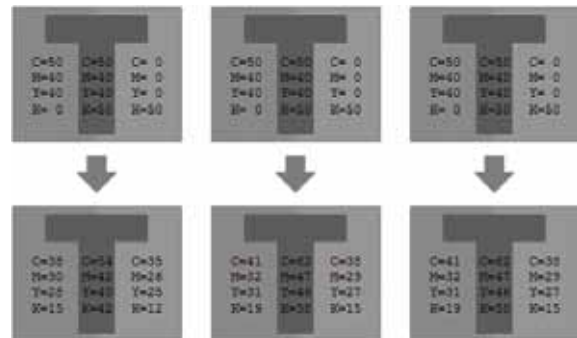


Fig. 9: Tonal values in a process conversion: Rendering intents “perceptual” – “relative colorimetric” – “absolute colorimetric” (from left to right)

In all cases there is a change in color composition. The composite gray contains black, the black gray contains composite process colors and only the four-color gray behaves as you would expect and retains its chromatic composition, but changes its numerical values. The “relative colorimetric” and “absolute colorimetric” intents produce the same result, since paper white is the same for both printing conditions.

Process calibration. Fig. 10 shows how the DeviceLink profile converts the curves for magenta, using as an example the conversion from FOGRA39L U300 K100 9-10.icc to FOGRA43L U300 K100 9-10.icc, i.e. converting conventional screening to non-periodic screening.

All images show a harmonious gradation for the process colors. The bend in the curve is again the result of the different dot gains in the printing processes. The “perceptual” rendering intent does not quite achieve solid magenta (100%). This is due to gamut mapping. Colorimetric rendering intent profiles do not produce this effect. You can also see in the graphs that curves for small quantities of cyan and yellow appear to compensate for shifts in hue and lightness caused by screening.

⁴Here and in the following, all percentages have been rounded up to make it easier. The tonal values were determined using a special application.

Fig. 11 shows how the DeviceLink profile converts the curve for black, using as an example the conversion from FOGRA39L U300 K100 9-10.icc to FOGRA43L U300 K100 9-10.icc, i.e. converting conventional screening to non-periodic screening.

Fig. 12 shows the conversion of the gray components – in the upper part are the values in the input device color space and in the lower part of the graphic are the values in the output color space after transformation.

You can also clearly see here the conversion of pure black into four-color gray. Again, the gray balance of the output printing process is also clearly shown. There is no saturation behavior.

Since paper white is the same for both print processes, there is no calibration for paper white and the curves in relative colorimetric and absolute colorimetric conversion are identical. The “absolute colorimetric” intent has no significance in process calibration. It delivers the same results as the “relative colorimetric” intent.

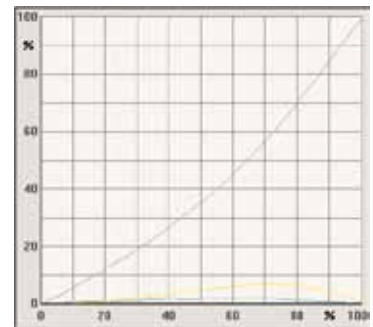
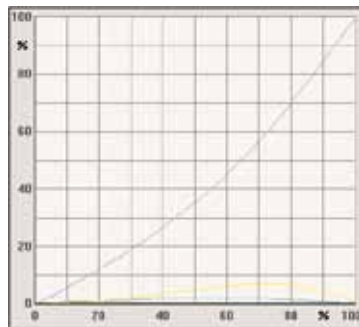
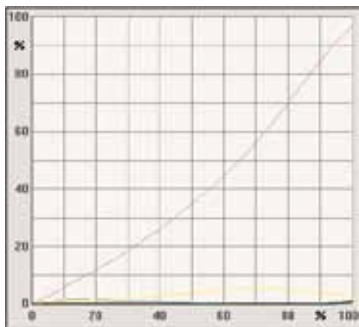


Fig. 10: Tonal gradation for magenta in a process calibration: rendering intents perceptual – “relative colorimetric” – “absolute colorimetric” (from left to right)

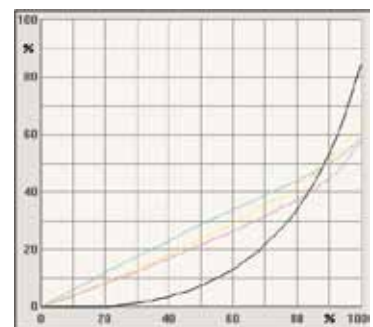
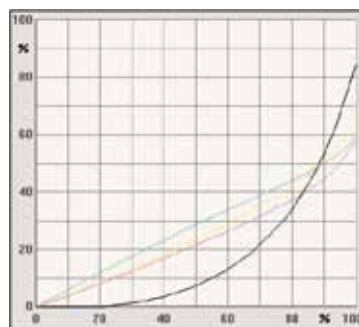
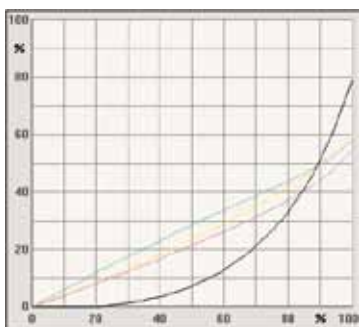


Fig. 11: Tonal gradation for black in a process calibration: rendering intents perceptual – “relative colorimetric” – “absolute colorimetric” (from left to right)

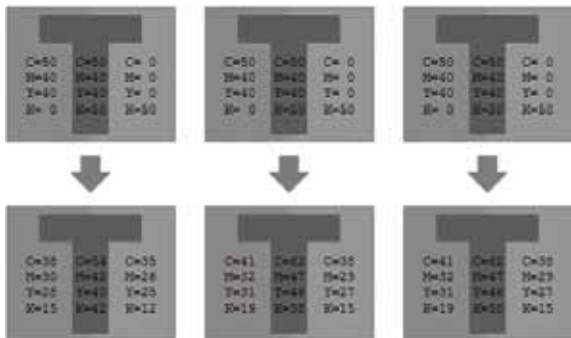


Fig. 12: Tonal values in a process calibration: rendering intents “perceptual” – “relative colorimetric” – “absolute colorimetric” (from left to right)

Again, you can see a change in chromatic composition. The composite gray contains black, the black gray has composite colors in it and only the four-color gray behaves as you would expect and retains its

chromatic composition. The high dot gain in the output print process has caused all the tonal values to fall overall.

Ink saving. Fig. 13 shows how the DeviceLink profile converts the gradation curve for magenta, using as an example the conversion from FOGRA39L U300 K100 9-10.icc to FOGRA39L U280 G80.icc, i.e. converting conventional chromatic composition into heavy achromatic composition with lower area coverage.

All images show a harmonious gradation for the process colors. Cyan and yellow appear only on a very small scale due to inaccuracies in interpolation. The options described below can actually completely suppress this.

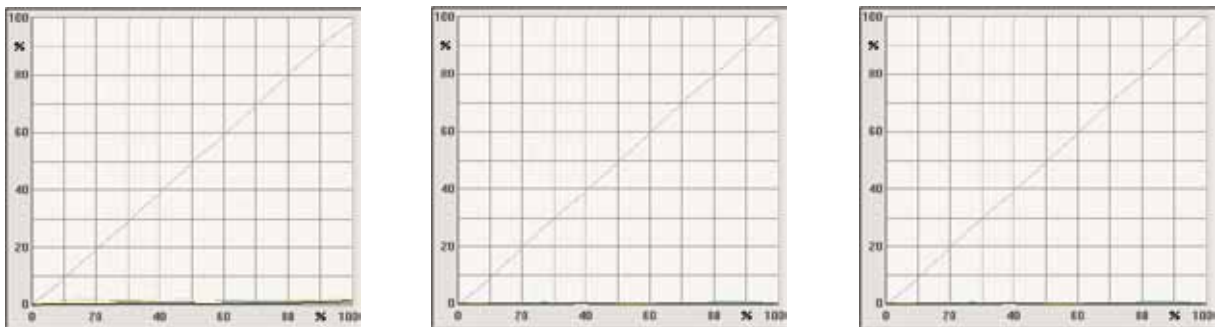


Fig. 13: Tonal gradation for magenta in ink saving: rendering intents “perceptual” – “relative colorimetric” – “absolute colorimetric” (from left to right)

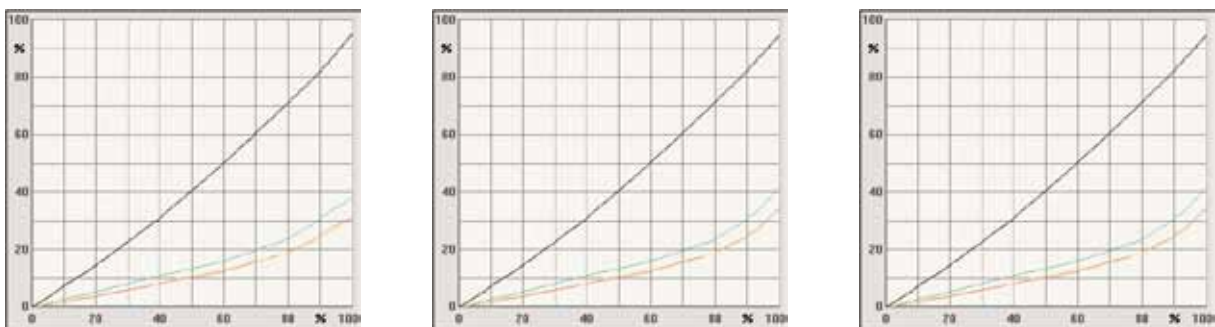


Fig. 14: Tonal gradation for black in ink saving: rendering intents “perceptual” – “relative colorimetric” – “absolute colorimetric” (from left to right)

Fig. 14 shows how the DeviceLink profile converts the gradation for black, using as an example the conversion from FOGRA39L U300 K100 9-10.icc to FOGRA39L U280 G80.icc, i.e. converting conventional chromatic composition into heavy achromatic composition with lower area coverage.

You can also clearly see here the conversion of pure black into four-color black. Again, the gray balance of the output print process is also clearly shown.

Fig. 15 shows the conversion of the gray components – in the upper part are the values for the input device color space and in the lower part of the graph are the values for the output color space after transformation.

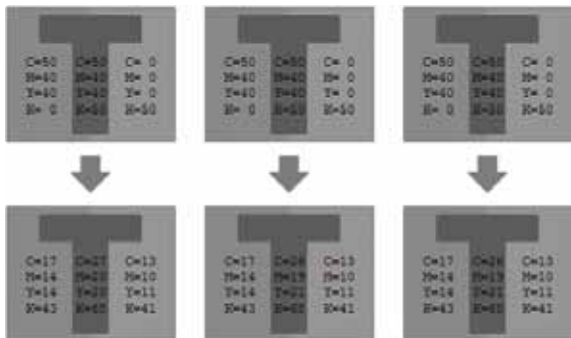


Fig. 15: Tonal values in ink saving: “perceptual” – “relative colorimetric” – “absolute colorimetric” (from left to right)

Again, you can see a change in chromatic composition. The composite gray contains black, the black gray has composite colors in it and only the four-color gray behaves as you would expect and retains its chromatic composition. Heavy achromatic composition means there is more black ink in the black channel and less in composite gray. In the examples above, the sum of the tonal values is overall less (with the exception of black gray).

Summary. “Perceptual” is the intent to choose for process conversion between various print processes, as in the first example above. This is the intent that reproduces the best fit between the different color gamuts of the print processes.

“Relative colorimetric” is most suitable for process calibration between similar print processes, e.g. calibrating different screenings and dot gains within a print process, since the color gamut remains the same.

DeviceLink profiles for ink saving are generally based on the same or a similar print process with varying chromatic composition. The most suitable rendering intent for this is “relative colorimetric”.

If you intend to simulate in the output process the color of the paper used in the input process, as you would, for example, in a proof print, the “absolute colorimetric” rendering intent is the intent of choice. This rendering intent, together with the “saturation” rendering intent, is of little significance when using DeviceLink profiles.

When creating a DeviceLink profile, the number of possible combinations of parameters falls from 100 combinations down to around 60 if you use only the “perceptual” and “relative colorimetric” rendering intents.

Shadow compensation

The option Shadow Compensation only works in Profile Tool in conjunction with the “relative colorimetric” rendering intent. With this option, the different shadows (the maximum achievable four-color black in the print) in the input and the output processes are mapped to each other. At the same time, due to the process, the chromatic colors and the color gamut are also partially mapped.

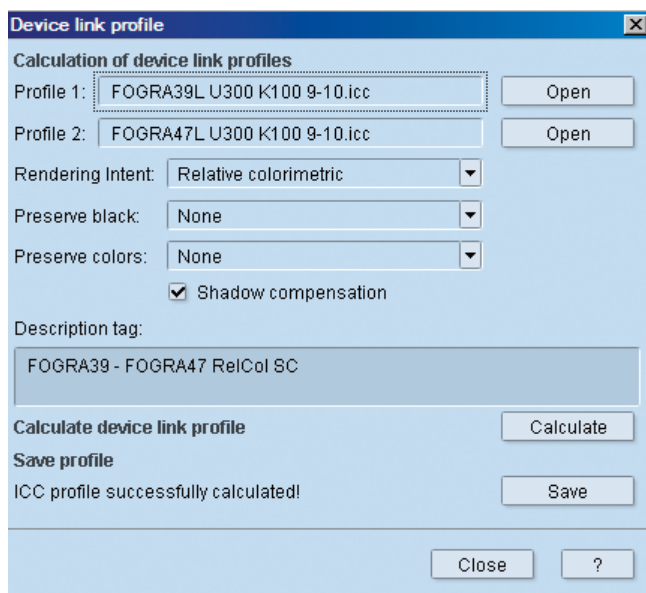


Fig. 16: The shadow compensation option with the “relative colorimetric” rendering intent

This makes shadow compensation a special form of gamut mapping (linear gamut mapping). This option is useful⁵ when the color spaces of two processes are not too far apart and you are looking to obtain the closest possible color rendering.

Fig. 17 shows how the appropriate DeviceLink profile converts the gradation for magenta, using as an example the conversion from FOGRA39L U300 K100 9-10.icc to FOGRA47L U300 K100 9-10.icc, i.e. converting from coated paper to uncoated paper.

As already described in Fig. 7, the color gradation with the “perceptual” rendering intent is harmonious, while the “relative colorimetric” intent shows saturation behavior. Shadow compensation does not completely eliminate this saturation behavior, since the color gamuts for the two processes are too far apart.

Fig. 18 shows how the DeviceLink profile converts the gradation curve for black, using as an example the conversion from FOGRA39L U300 K100 9-10.icc to FOGRA47L U300 K100 9-10.icc, i.e. converting from a coated paper to an uncoated paper.

Shadow compensation behaves in the same way as the “perceptual” rendering intent when mapping the range of lightness values. This avoids the saturation seen earlier.

⁵The author of this user guide does not recommend using the “relative colorimetric” rendering intent together with “shadow compensation”. Results are far better using the “perceptual” rendering intent. Relative colorimetric and shadow compensation are nothing other than a special form of gamut mapping with linear reproduction characteristics and clipping of colors outside the gamut. Both are visually not very successful in highly colored images. Such imperfections can be accepted in images with a color gamut within the color space of the output process. Whenever there is a choice between relative colorimetric and shadow compensation, perceptual can also be selected.

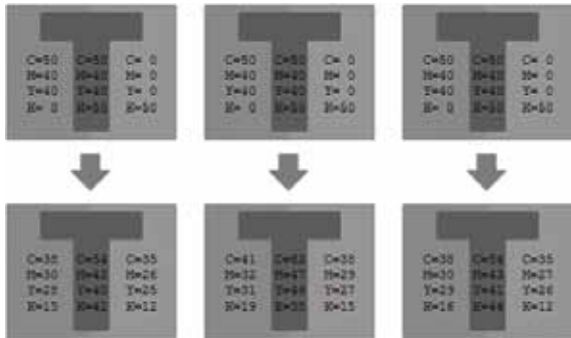


Fig. 19: Tonal values in a process conversion: rendering intents “perceptual” – “relative colorimetric” – “relative colorimetric” with shadow compensation (from left to right)

Fig. 19 shows the conversion of the gray components again – in the upper part of the graphic are the values for the input device color space and in the lower part are the values for the output color space after transformation.

The same behavior can be seen once again. It is worth noting that the tonal values for both the rendering intents “perceptual” and “relative colorimetric” with “shadow compensation” are practically the same.

In summary, “shadow compensation” offers no notable advantages and you can create far better color-graduated profiles using the “perceptual” rendering intent. When creating a DeviceLink profile, the number of possible combinations of parameters falls from 100 to around 40 useful combinations if you only use the rendering intents “perceptual” and “relative colorimetric” without shadow compensation.

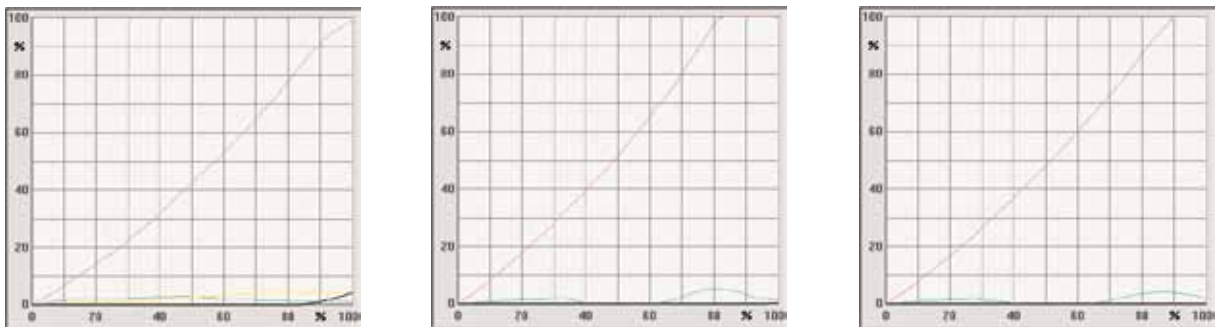


Fig. 17: Tonal gradation for magenta in a process conversion: rendering intents “perceptual” – “relative colorimetric” – “relative colorimetric” with shadow compensation (from left to right)

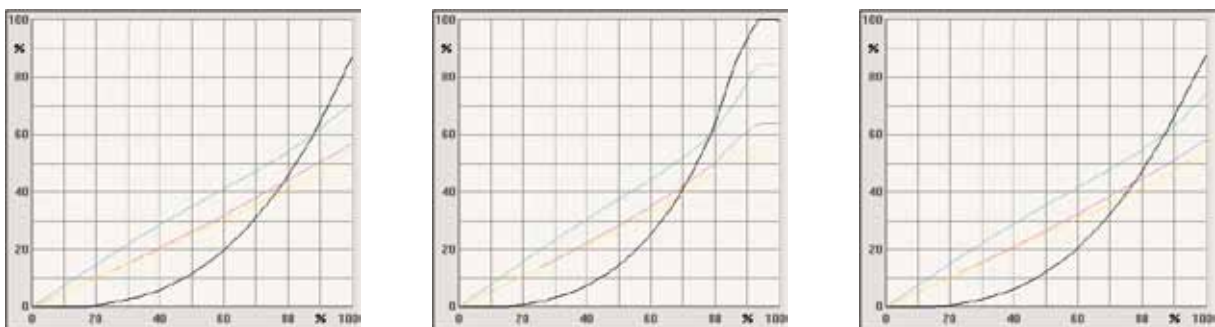


Fig. 18: Tonal gradation for black magenta in a process conversion: rendering intents “perceptual” – “relative colorimetric” – “relative colorimetric” with shadow compensation (from left to right)

Preserve Black

There are four different options for preserving black.

Selecting “None” in Preserve Black takes over the black generation data in DeviceLink profile 2, the output profile. The black generation data in the input profile is overwritten. This always makes sense when the processes are totally different from each other. For instance, an offset process on illustration printing paper with a total area coverage of 330 % needs to be converted to a newspaper print process with an area coverage of 240 %. In the offset print process the separations are carried out with chromatic composition, whereas the newspaper print process uses relatively heavy achromatic composition. This means you need to select “None” in Preserve Black to implement achromatic composition. This also applies to the profiles for ink saving.

In the Preserve Black option “K=K”, the black separation is forwarded from the input process to the output process without any modifications. Only the chromatic color components are converted, which means that the perceived colors are retained as far as possible. This option is useful when, for example, one of the chromatic colors is replaced by a similar color (normal magenta with a reddish magenta) and all other process conditions remain the same. “K=K” is also recommended if a document contains large amounts of text and graphics. Selecting “K=K” ensures that black elements do not suddenly contain a sizable proportion of chromatic colors.

The “Basic” option for preserving black generation adapts the black color separation with the aid of a gradation curve. Different black color values or densities are converted so that they appear as similar as possible (lightness) in the new print process. The chromatic color components are converted as in “K=K” so that the overall color impression is retained to a large extent.

The option “Special” in Preserve Black treats the highlight and mid-tone areas in black differently from the shadow areas in black. In the highlight and mid-tone areas the black of the output process is used. In the shadow areas the original black is used. The chromatic colors are converted in such a way that color perception is preserved as far as possible.

Fig. 21 shows how the DeviceLink profile converts the gradation curve for magenta, using as an example the conversion from FOGRA39L U300 K100 9-10.icc to FOGRA47L U300 K100 9-10.icc, i.e. converting from coated paper to uncoated paper. It shows the tonal gradation in the various options for preserving black.

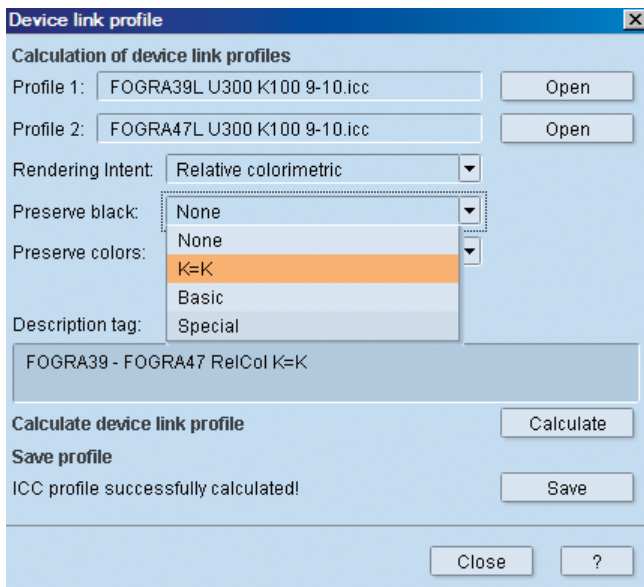


Fig. 20: The various Preserve Black options

There is practically no visible difference in the gradations for the chromatic colors.

Fig. 22 shows how the DeviceLink profile converts the gradation curve for black, using as an example the conversion from FOGRA39L U300 K100 9-10.icc to FOGRA47L U300 K100 9-10.icc, i.e. converting from a coated paper to an uncoated paper. It shows the tonal gradation in the various options for preserving black.

As you might expect, there are no chromatic color components. In “K=K” there is a strictly linear transfer of the tonal values; in “Basic” and “Special” the gradation is adjusted to improve the distribution of the tonal values.

Fig. 23 shows the conversion of the gray components again – in the upper part of the graphic are the values for the input device color space and in the lower part are the values for the output color space after transformation.

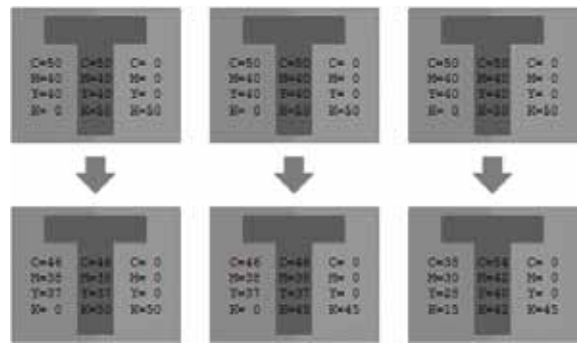


Fig. 23: Tonal values with the option “Preserve Black” (perceptual rendering intent): “K=K” – “Basic” – “Special” (from left to right)

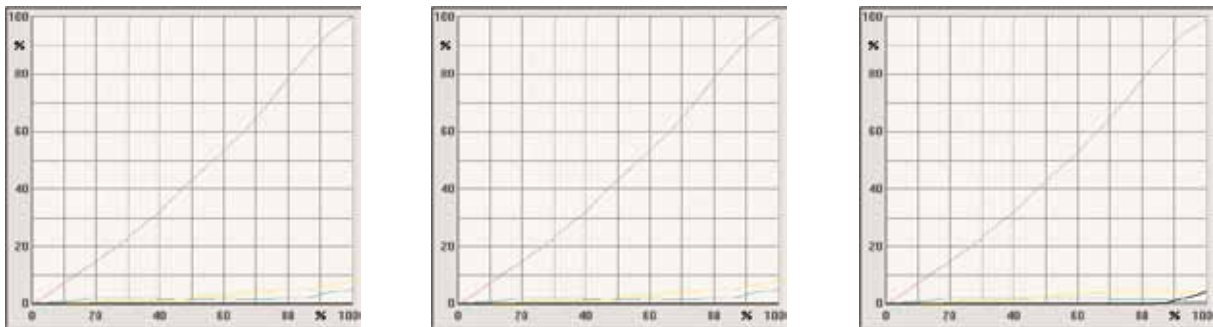


Fig. 21: Tonal gradation for magenta with the option “Preserve Black” (perceptual rendering intent): “K=K” – “Basic” – “Special” (from left to right)

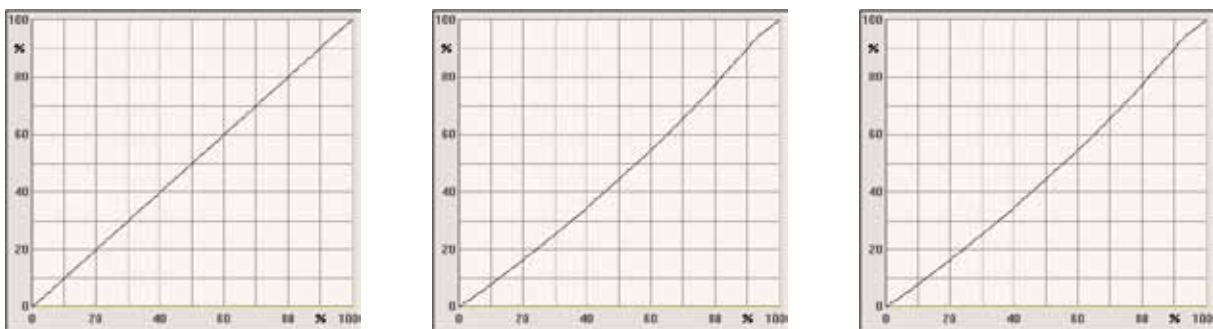


Fig. 22: Tonal gradation for black with the option “Preserve Black” (perceptual rendering intent): “K=K” – “Basic” – “Special” (from left to right)

In “K=K” (left-hand graph) the black value K is retained. In “Basic”, black is modified by calibrating the gradation, but this has no impact on the chromatic colors. In “Special” (right-hand graph) the situation is more complex. Composite gray is given a black component, four-color gray is transformed as usual and pure black is converted as in “Basic”.

In summary, Preserve Black or Preserve Black “Special” should not be used for process conversion. Preserve Black should also not be used for saving ink, since here it is only the color composition of the output process that delivers the desired result. When performing a process conversion, one of the other Preserve Black options – “K=K” or “Basic” – should be selected.

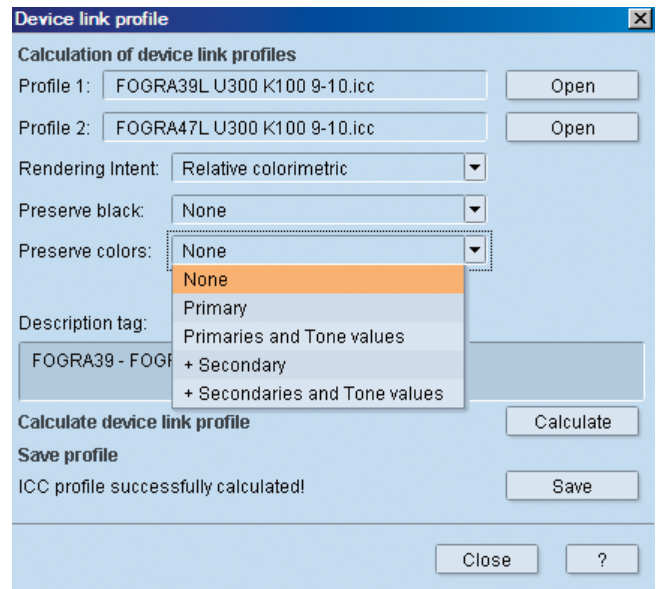


Fig. 24: Options in Preserve Color

Preserve Color

There are five different options for preserving color.

If the option “None” is selected in Preserve Color, the color composition of the tonal values of the primary and secondary colors in the DeviceLink profile is taken over from Profile 2, the output profile. The color composition of the input profile is overwritten. This is always meaningful when the processes differ greatly from each other.

In both the options “Primary” and “Secondary”, only the solids are retained. In “Primary” the solids are the three chromatic colors cyan, magenta and yellow (C, M, Y) and in “Secondary”, the solids are, in addition to the primary chromatic colors, the two-color combinations blue, green and red (CM, CY, MY), as well as the combinations of a chromatic color with black (CK, MK, YK).

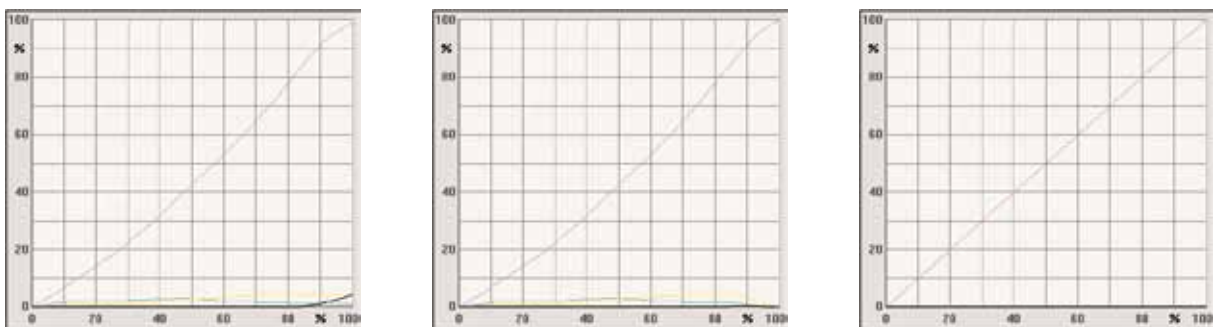


Fig. 25: Tonal gradation for magenta with the option Preserve Color (perceptual rendering intent): “None” – “Primary” – “Primary and tonal values” (from left to right)

In the options “Primary and tonal values” and “Secondary and tonal values”, not only are the solid colors retained but also their relevant gradations.

In “Primary and tonal values” these gradations are the single color tonal gradations for the chromatic colors from 0 % to 100 %; “Secondary and tonal values” also include the two-color gradations for the chromatic colors or one chromatic color and black.

Figure 25 shows the behavior of a gradation using the process color magenta as an example.

The option “None” shows the typical gradation as we have already seen above. The only difference between the option “Primary” and “None” is that Primary reproduces exactly the 100 % solid of magenta. In both cases there are components of the other chromatic colors. Only when using the option “Primary and tonal values”, which preserves the tonal values, are all the pure color values of the primary color transferred without any soiling components.

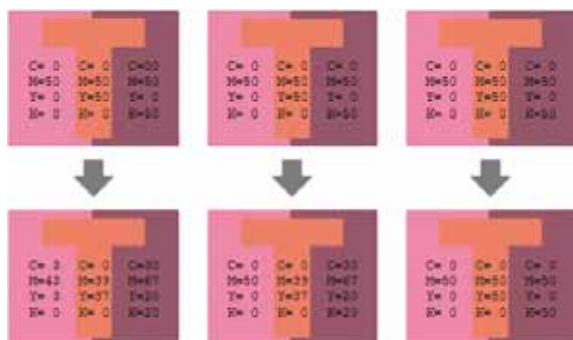


Fig. 26: Tonal values with the option Preserve Color (perceptual rendering intent): “None” – “Primary and tonal values” – “Secondary and tonal values” (from left to right)

Figure 26 shows this numerically again, using as an example 50 % magenta, 50 % red and magenta darkened with 50 % black.

Selecting the option “None” colorimetrically correctly transforms the tonal values of the purely primary and secondary colors as usual, while the color composition of the output profile defines the result (left graphic). With the option “Primary and tonal values” (centre graphic) the pure color is retained and the secondary colors are converted as before. Only the option “Secondary and tonal values” retains all single and two-color tonal value combinations.

Generally, the option “Secondary and tonal values” in Preserve Color should always be selected if color is to be preserved.

Summary

There are so many different ways of combining the various options it is well worthwhile limiting them to a workable number. Table 1 below lists several possible combinations.

When converting print processes, it is usually the target print process that determines color composition and gamut mapping. The “perceptual” rendering intent is best suited for images. Preserving black generation in images is not absolutely necessary and frequently even undesirable. The “relative colorimetric” rendering intent (if necessary with shadow compensation) can be used for graphics. Here, it is worthwhile selecting “Special” in Preserve Black, and “Secondary with tonal values” in Preserve Color. If you cannot distinguish between images and graphics in a job, the “perceptual” rendering intent, “None” or “Special” in Preserve Black, and “Secondary with tonal values” in Preserve Color should be selected.

When converting between two similar print processes, there is no basic change in color composition and gamut mapping. However, to avoid unwanted color conversions in graphics, the parameters for preserving black can be set under “Special” and for preserving color under “Secondary and tonal values”.

Ink saving usually takes place within a specific print process, e.g. offset printing on coated paper with conventional screening. The most suitable rendering intent in this case is the “relative colorimetric” intent. Preserve Black is disabled (you still want the achromatic composition of the output profile), Preserve Color can be enabled so that graphics or pure colors are not soiled with components from other colors.

Objective	Rendering Intent	Preserve Black	Preserve Color
Process conversion, general	Perceptual	None, Special	Secondary and tonal values
Process conversion, images	Perceptual	None	None
Process conversion, graphics	Relative colorimetric	Special	Secondary and tonal values
Process calibration, general	Relative colorimetric	Special	Secondary and tonal values
Process calibration with paper white simulation	Absolute colorimetric	Special	None
Ink saving, general	Relative colorimetric	None	Secondary and tonal values

Table 1: Several worthwhile combinations of the various options

Using DeviceLink profiles

The following describes how to use Prinect link profiles in the Heidelberg applications Prinect PDF Toolbox Color Editor, Prinect Prepress Manager and Prinect MetaDimension.

Color Editor and DeviceLink profiles

The Color Editor in Prinect PDF Toolbox is a plug-in for Adobe Acrobat enabling color management of the objects in a document. With Color Editor, all colors are converted into the process colors required for the current printing method.

Profile Import. DeviceLink profiles are conveniently stored in the relevant profile folder in Color Editor. They can, however, also be stored in a different location. The profiles do not need to be specially imported.

Parameterization. The upper part of the main dialog box shows the current color definitions for the document and how they are converted by the parameter settings for the job. The document in this example contains printable colors that have been separated for the print process “ISO Coated” and device-independent colors such as CIE L*a*b* and RGB.

The window for the color values of the current object shows, for example, the color magenta at 100% as well as a simulation of the conversion based on the settings in Job Settings. The following screenshots show the settings for Job Settings.

The DeviceLink profiles for the transformation of the CMYK images and CMYK graphics are specified under the Device Colors tab. In this example a process conversion from printing on coated paper is parameterized to printing on uncoated paper. Rendering intent and shadow compensation (BPC) are irrelevant and can be ignored.

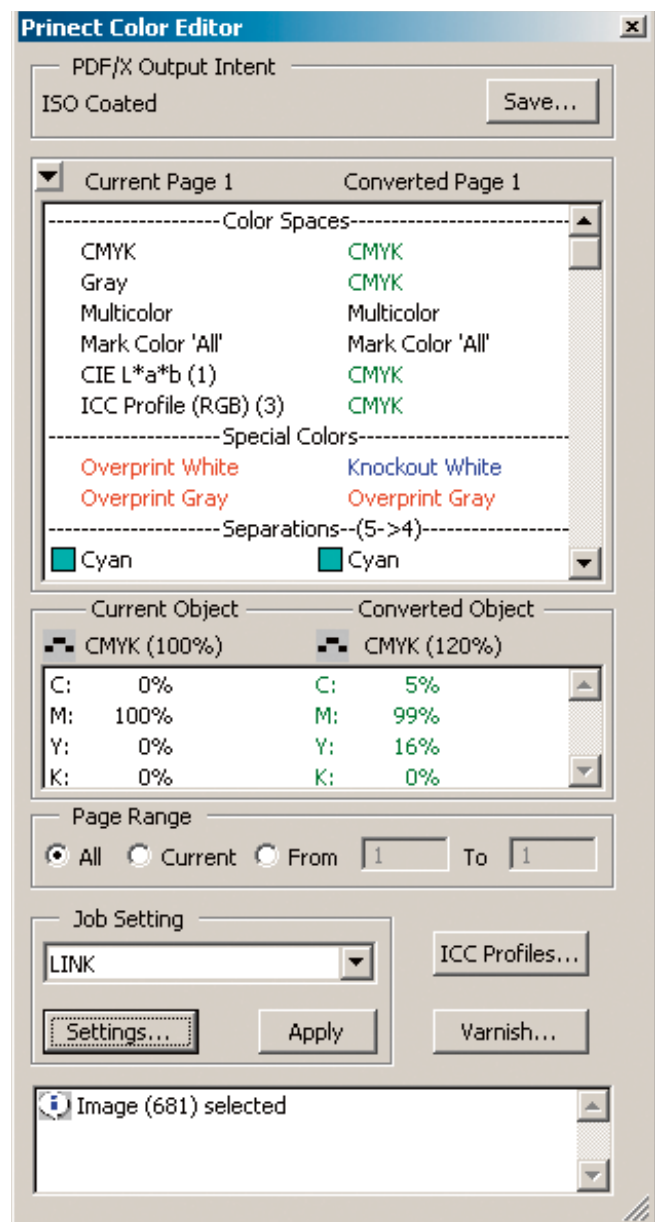


Fig. 27: Shows the document colors and the profile embedded in the document prior to conversion

It is a good idea to use different DeviceLink profiles for images and graphics. For example, one profile can be selected for converting images (“perceptual” rendering intent, Preserve Black and Preserve Color “None”) and another process conversion profile can be selected for graphics (“relative colorimetric” rendering intent, Preserve Black “Special”, Preserve Color “Secondary and tonal values”).

DeviceLink profiles can also be defined for the other device-dependent colors. You may need to do this if the job does not contain any PDF/X documents (there should be no device-dependent RGB elements in PDF/X documents) or when there are multi-image and multi-graphic elements. DeviceLink profiles from RGB to CMYK and from MultiColor to CMYK can be calculated using the Profile Tool as described above.

Gray images and gray graphics should be treated as CMYK elements. The function “Preserve Black” is redundant here.

A press profile must be defined in the Color Management window. This press profile is embedded in the document after conversion. PDF/X Output Intent should not be used for conversion.

In this case, the press profile is the output profile that was used to calculate the DeviceLink profile. A PDF document can also contain media-neutral color data (Lab, RGB), which are transformed directly with the output profile in the destination color space.

The option “Ignore embedded CMYK profiles” should be enabled if specific objects with embedded profiles are also to be transformed.

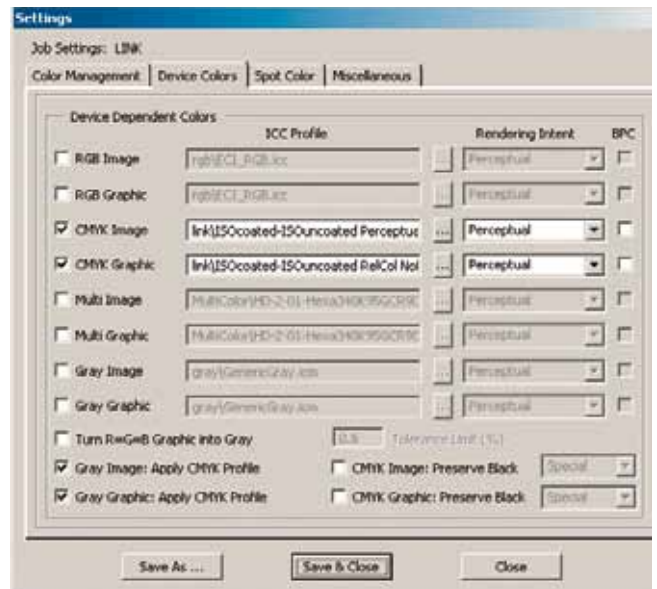


Fig. 28: Device Color settings

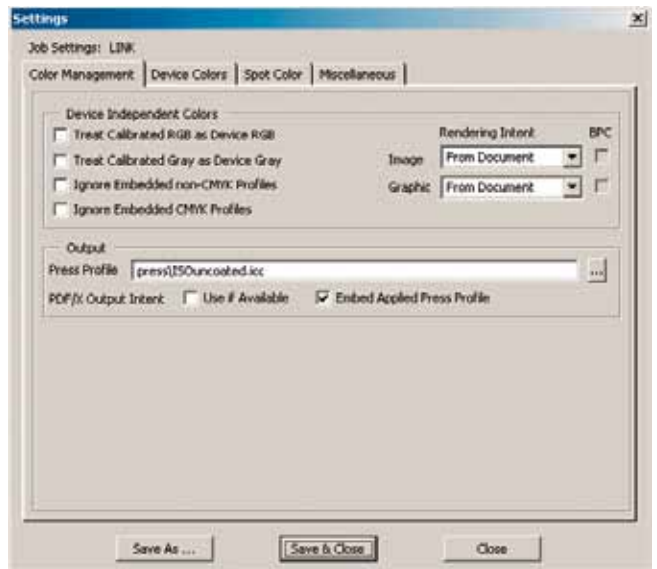


Fig. 29: Color Management settings

You may also need to parameterize overprinting and how the special colors are handled in the document under “Spot Color” and “Miscellaneous” (not shown here).

The parameterization can be stored as a new setting. The settings are applied to the document after returning to the main dialog box.

The window for the color values of the current object shows the new value for the color magenta, for example. The new press profile is embedded in the document, which means there is a PDF/X file again.

Application. Using the settings shown above makes it easy to convert a PDF or a PDF/X document into a PDF or PDF/X document that has been calibrated to the print process. This document can then be output on a proofer or a platesetter.

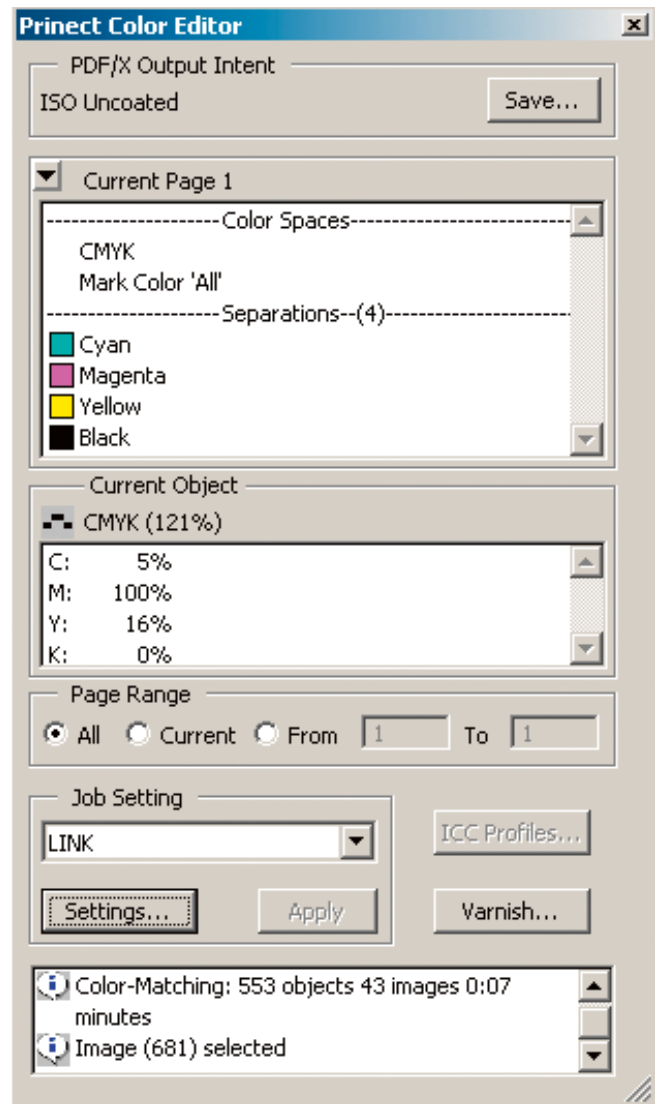


Fig. 30: Shows the document colors and the profile embedded in the document prior to conversion

Prinect Prepress Manager and DeviceLink profiles

Prinect Prepress Manager is a prepress workflow system based on the JDF format for automated processing of prepress data. As part of Prinect, Prinect Prepress Manager is a modular system that brings together various document processing tools in a common user interface.

Profile Import. DeviceLink profiles are conveniently stored in the relevant profile folder in Color Editor. There is no need to specially import the profiles.

Parameterization. The settings for color management are found under “Administration > Templates > Prepare > Color Conversion”. They are the same as the settings in Color Editor.

After opening the dropdown menu, DeviceLink profiles can be selected for CMYK images and CMYK graphics under “Device Colors/DeviceLink”. The example below shows the parameterization for a process conversion from printing on coated paper to printing on uncoated paper. Rendering intent and shadow compensation (BPC) are irrelevant and can be ignored.

DeviceLink profiles can also be defined for the other device-dependent colors. You may need to do this if the job contains no PDF/X documents (there should be no device-dependent RGB elements in PDF/X documents) or when there are multi-image and multi-graphic elements. DeviceLink profiles from RGB to CMYK and from MultiColor to CMYK can be calculated using the Profile Tool as described above.

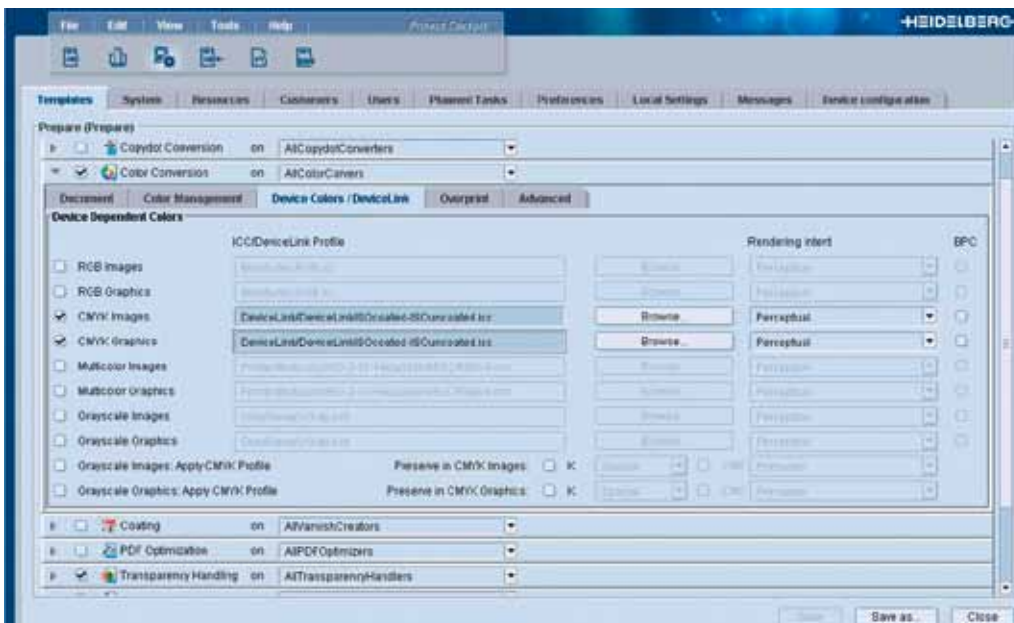


Fig. 31: Parameterizing color conversion – Device Colors/ DeviceLink

Gray images and gray graphics should be treated as CMYK elements. The function “Preserve Black” is redundant here.

A press profile must be defined in the “Output box”. This press profile is embedded in the document after conversion. PDF/X Output Intent should not be used for the conversion.

The option “Ignore embedded CMYK profiles” should be enabled if specific objects with embedded profiles are also to be transformed.

Application. Using the above settings makes it easy to convert a PDF or a PDF/X document into a PDF or PDF/X document that has been calibrated to the print process. This document can then be output on a proofer or a platesetter.

A PDF document can also contain media-neutral color data (Lab, RGB), which are transformed directly with the output profile into the destination color space.

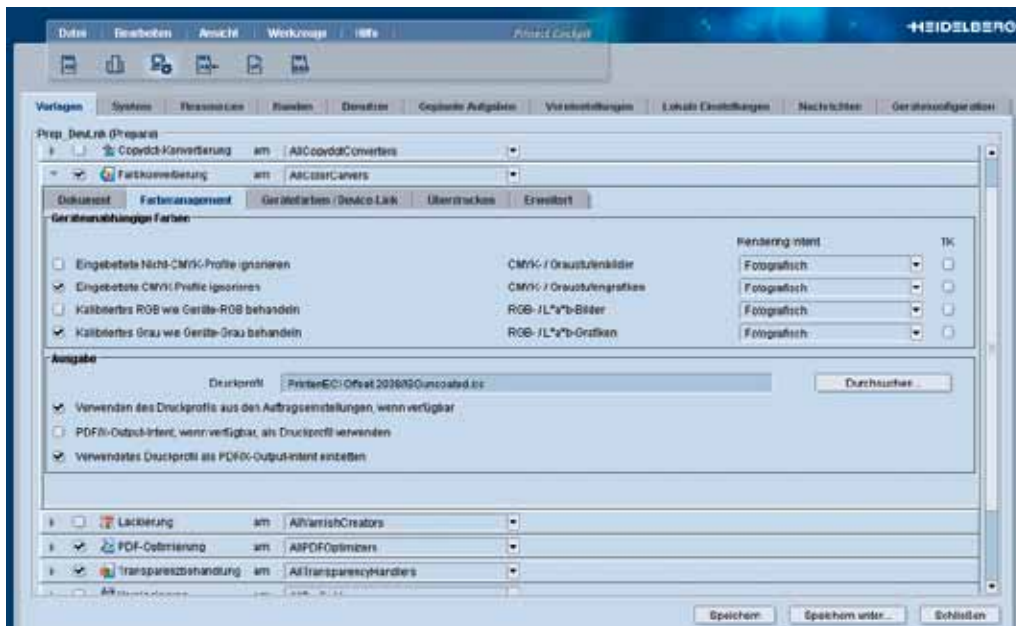


Fig. 32: Parameterizing output

Prinect MetaDimension and DeviceLink profiles

Prinect MetaDimension can process print jobs in Post-Script format or in Adobe Acrobat PDF format. The print output can be configured to be output as a file, on a printing plate or a proofer using “output plans”.

Profile Import. DeviceLink profiles cannot be imported into Prinect MetaDimension. To use these profiles, they need to be copied directly into the profile folder in the Prinect MetaDimension system. After restarting the user interface, the DeviceLink profiles appear in the CMYK profile list and can be selected there.

Parameterization. To enable the color management function, the option Color Management is selected by clicking the checkbox. Once “Color Management” has been enabled, all the jobs that are being processed

according to this output plan are handled by the Color Management function.

After opening the drop-down menu, DeviceLink profiles can be selected for CMYK images and CMYK graphics under “Device-Dependent Color”. In the example below, a process conversion is parameterized from printing on coated paper to printing on uncoated paper. Rendering intent and shadow compensation (BPC) are irrelevant and can be ignored.

A press profile must be defined in the “Output box”. PDF/X Output Intent should not be used for the conversion.

Application. In Prinect MetaDimension, process conversions and process calibrations can be directly carried out during plate imaging or before proof printing (also applies to ink saving).

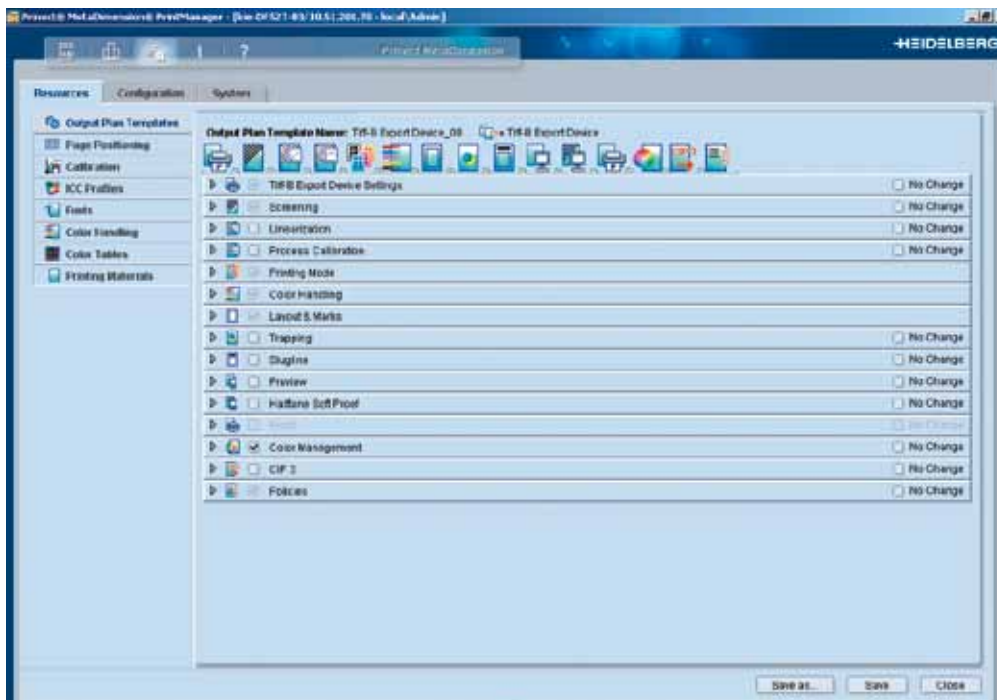


Fig. 33: List of output plan templates available

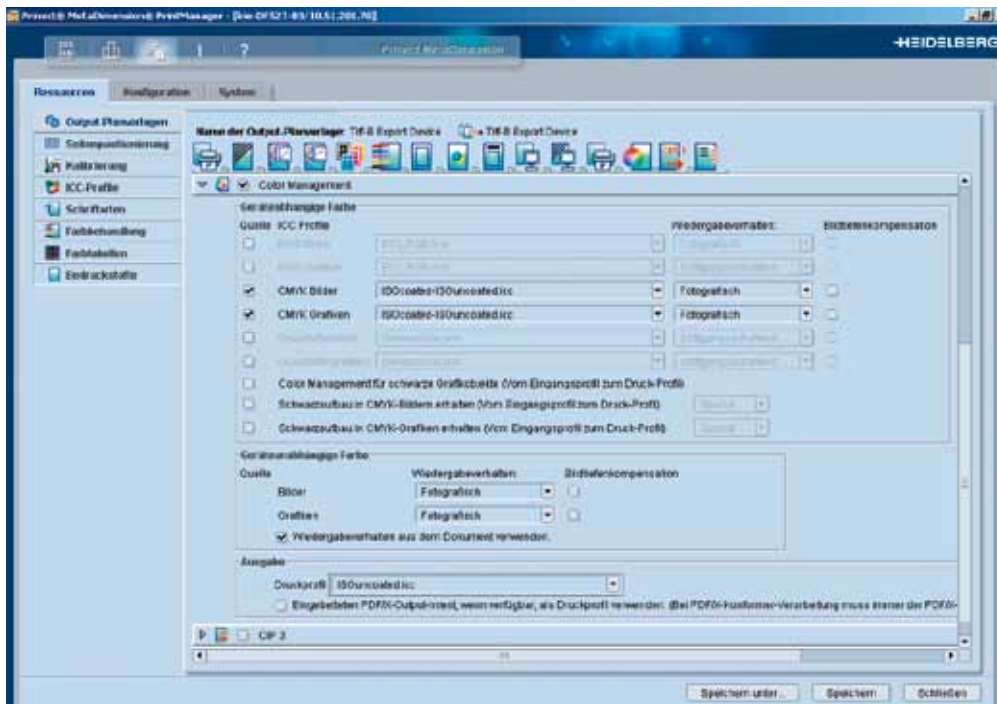


Fig. 34: Parameterizing color management

Summary

Using Heidelberg products, you can create and use DeviceLink profiles in the prepress area, making it easy to perform process conversions and process calibrations. These products even include processes for saving on printing inks and limiting the total area coverage.

The wide range of applications means profiles need to be calculated individually, since standard profiles are of little use here. The workflow should also be set up on an individual basis to avoid quality issues and it is worthwhile carrying out trials using proofing systems.

Glossary

Characterization. The colorimetric definition of a (print) process.

Characterization data. The definition of an unambiguous relationship between digital tonal values and the measured color values in printing (CMYK process color values and CIEXYZ or CIELAB color values). Characterization data are used in color management-based workflows to describe different input and output processes. They are the starting point for calculating device profiles or print process profiles and can also be used to control processes.

Characterization data set. A data format for exchanging characterization data. The international standard ISO 12642 specifies the digital tonal values to be used, as well as the measuring conditions and the file format for print processes.

ICC International Color Consortium. The ICC is a consortium of manufacturers and users in the graphic arts industry. The purpose of the ICC is to develop solutions for exchanging color data in heterogeneous and open, cross-platform color management systems.

ICC profiles. ICC profiles or device profiles are standardized files that describe the color characteristics of devices, images and graphics using colorimetric standards. ICC profiles provide color management systems with the information needed to transform color data between all kinds of input and output color spaces.

Color Management Module (CMM). A color management module is software based on mathematical operations that convert color image data from an initial color space into a second color space by using one or more ICC profiles. Several ICC profiles are usually linked with each other to make up one profile before color transformation takes place. This saves time and increases the accuracy of the transformation. A color

management module can be a component of either an operating system or an application program. This means that all essential applications in color management have their own color management module. In the operating systems Microsoft Windows and Apple Macintosh, this module can be accessed under the names ICM – Integrated Color Management (Windows) or ColorSync (Apple).

Total area coverage, tonal value sum. Total area coverage is the sum of the tonal values for all color separations within a narrowly defined range. Depending on the print process and the substrate used, the maximum tonal value sum should not be exceeded. The maximum sum of tonal values is generally achieved at the darkest point on the gray axis. Unit: %

Rendering intents. Rendering intents are terms that describe how images and graphics are intended to be reproduced on an output device or in an output process. Rendering intents are closely linked to gamut mapping.

Absolute colorimetric. The “absolute colorimetric” rendering intent is used to reproduce color values that are quantifiable by instrument measurement. “Absolute colorimetric” is used for simulating (proofing) an output process on a different output device or printing de-fined color values.

Relative colorimetric. The “relative colorimetric” rendering intent is used to reproduce color values that are media-specifically accurate. “Relative colorimetric” is used for simulations of an output process on a different output device based on the white of the media.

Perceptual. The “perceptual” rendering intent is used for the harmonious reproduction of color values when printing, while taking into account the differences in the color gamut of the original and the print. “Perceptual” is mainly used in image color separation.

Saturation. The “saturation” intent is used to reproduce original color values in print with the focus on coloration, while retaining the saturation of the original color values. “Saturation” is mainly used in color separations of graphics and diagrams (business graphics).

Achromatic composition (GCR, Gray Component Replacement). A process by which gray tones are proportionally removed from chromatic colors and replaced by the corresponding quantity of black ink.

Publishing Information

Printed in: 07/10
Author: Dr. Günter Bestmann
Photographs: Heidelberger Druckmaschinen AG
Platemaking: Suprasetter
Printing: Speedmaster
Finishing: Stahlfolder, Stitcmaster
Consumables: Saphira
Fonts: HeidelbergGothicML
Printed in Germany

Trademarks

Heidelberg, the Heidelberg logotype and Prinect are registered trademarks of Heidelberger Druckmaschinen AG in the U.S. and other countries. All other trademarks are property of their respective owners.

Subject to technical modifications and other changes.

00.000.0000

Heidelberger Druckmaschinen AG

Kurfuersten-Anlage 52-60

69115 Heidelberg

Germany

Phone +49 6221 92-00

Fax +49 6221 92-6999

www.heidelberg.com



The mark
of responsible
forestry

GFA-COC-001569
© 1996 Forest Stewardship Council A.C.