Tutorial

GMG ColorServer Profile Editor

Creation of New MX4 Conversion or Separation Profiles

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☝ Special notes:

The following forms of typographic emphasis are used to give this Tutorial a clear and informal structure:

Emphasis	Function
`Text in Courier New`	Emphasizes a particular software directory, a path, or a folder.
Italic text	Emphasizes particular software tabs, menus, keys, icons, selection boxes, instructions, commands, and other software elements.
"Text in quotation marks"	Used to emphasize exemplary files and settings.
☝	Indicates important information, notes and warnings.

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1. Introduction

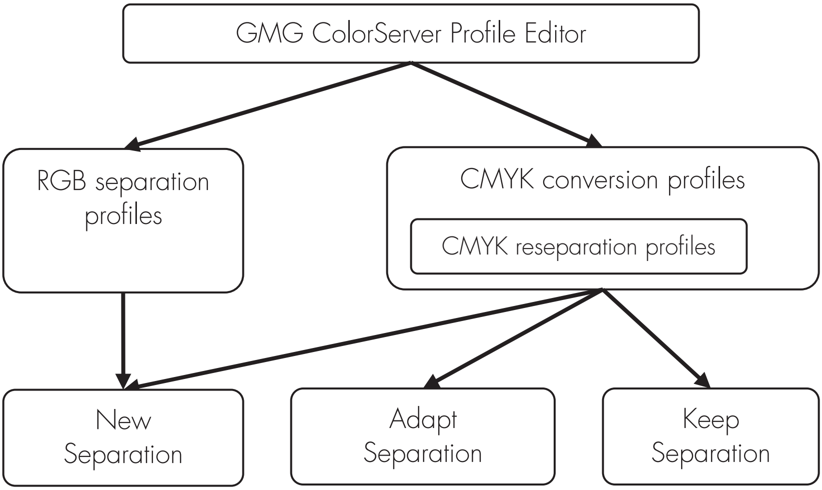
Standardization, flexibility, media-neutral data storage, and multiple utilization are topics that today's almost totally digitized prepress sector has to deal with in order to survive the tough competition. The logical conclusion to be drawn is, of course, the automation of processes and workflows. For example, when it comes to preparing a file for different printing conditions, automatic color space conversion offers enormous savings potential. In addition, the creation of today's printing standards (e.g. ISO standards) enables us to work and communicate on a common basis.

Using GMG ColorServer, fully automated color space conversions can be performed using hotfolder technology. These conversions are defined by GMG's MX4 color profiles. This Tutorial guides you through the process for creating an MX4 color profile with the new GMG ColorServer Profile Editor. Profiles for color transformations between most standard color spaces are included in the delivery of GMG ColorServer. New profiles are published regularly in the Support area at *www.gmgcolor.com* and can be downloaded there.

1.1. MX4 color profile types

MX4 color profiles contain all the information needed for conversion between two color spaces. GMG works with a variety of MX4 color profile types. Proof output is defined by **MX4 CMYK proofing profiles**, on the basis of which the colors are converted for the specific proof output in question. The input data is not changed in this context.

In GMG ColorServer, the automatic color space transformations are controlled via MX4 conversion or separation profiles. The color values in the file that is processed are converted. Therefor the input data is changed in this process. The following overview indicates the different types of conversion or separation profiles that can be created with the GMG ColorServer Profile Editor:



Schematic representation of the different MX4 profile types

The GMG ColorServer Profile Editor offers totally new functions for profile creation. A choice can be made between three different separation modes for the creation of CMYK conversion or reseparation profiles:

- Keep Separation
- Adapt Separation (with limitation of ink application)
- New Separation

RGB separation profiles are created using the *Create new Separation* separation mode.

The GMG ColorServer Profile Editor additionally features an integrated, new and innovative form of Gamut Mapping that controls the mapping of a larger color space onto a smaller color space. The GMG ColorServer Profile Editor offers multiple setting options for separations and Gamut Mapping (see Chapter 1.4.2) to enable accurate control of color transformation.

1.2. Structure of an MX4 color profile

An MX4 file is a four-dimensional DeviceLink profile, in which two color spaces (RGB/CMYK or CMYK/CMYK) are directly linked. During calculation of the profile, there is no intermediate conversion into the CIELab color space, such as in the case of color transformations via ICC profiles. This has the advantage that, in the case of CMYK conversion profiles, for example, the information concerning the generation of the Black channel is not lost, and this channel can be preserved when calculating the profile (if so desired).

The detailed structure of an MX4 file is as follows: it contains a CMYK / RGB index, to which certain CIELab target values are assigned. These values are the target to be achieved.

In the case of a CMYK proofing profile, for example, this would mean the color values of certain printing conditions to be simulated by the proofing system. When creating the profile, the software uses a Gamut File describing the color space of the proofing system to calculate the specific CMYK values of the proofing system with which these given target values can be achieved.

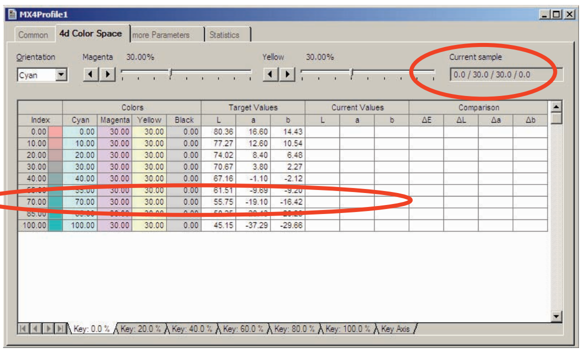
This function is no different than the MX4 conversion or (re)separation profiles. In this case, however, it is not the proofing system that is intended to simulate the given target values; here, it is a different set of printing conditions, under which the same color result is to be achieved as closely as possible.

So, when creating a profile, the color space – in which the data to be processed is presently – defines the target color values. A Gamut File, which describes the color space into which the data will be converted, is used to calculate the specific CMYK values with which these target values can be achieved.

gmg color

Please note that the terms **source color space** and **target color space** are often used when working with ICC conversions. In this context, the source color space defines the color space in which the file is presently. The target color space is the color space into which the data will be converted. Accordingly, when using GMG profiles, the **source color space is defined in the MX4's target values**, while the **Gamut File assigned to the MX4 defines the target color space** which the data will be converted.

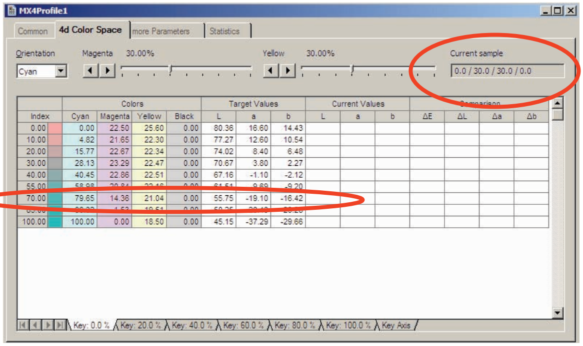
By way of example, a CMYK conversion profile for ISOcoated to Gravure_PSR_LWC is created below. To this end, the FOGRA27L characterization file is imported into an MX4 file as the target values. The values describe offset printing on coated paper (~ ISOcoated):



Linear CMYK MX4 profile with target values already imported

The profile has not yet been calculated, and still displays linear behavior (CMYK input and output values are identical).

Thus, a certain CIELab value is achieved at the fulcrum (70/30/30/0) in the ISOcoated print. Using the Gamut File describing the target color space, the software now calculates the CMYK values at this fulcrum by calculating how the CIELab values of the source color space can be achieved into the target color space:



New CMYK color values following calculation with target values

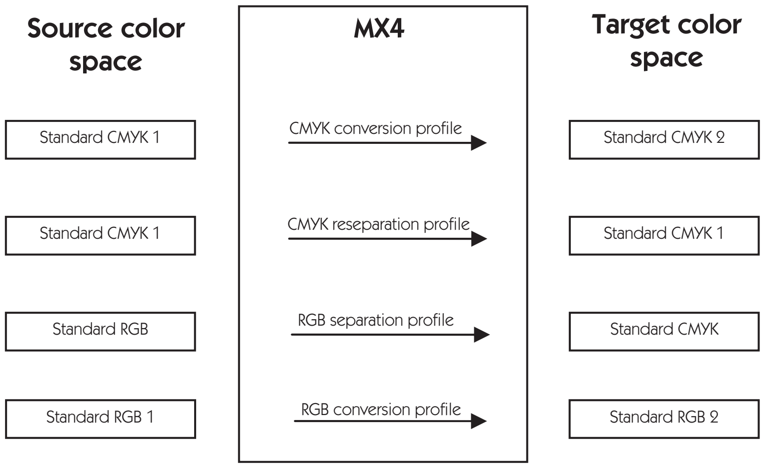
In this instance, the specific CMYK values were calculated using the *Gravure_PSR_LWC.csc* Gamut File, which describes gravure printing on Light Weight Coated paper.

So, the specified CIELab target value at the fulcrum (70/30/30/0) is achieved with the color combination CMYK (79.65/14.36/21.04/0).

When processing an image file in GMG ColorServer, the new CMYK output values (79.65/14.36/21.04/0) will now be assigned to all CMYK input values defined with (70/30/30/0).

1.3. Functions of the different MX4 profiles

The overview in Chapter 1.1 explains the different MX4 profile types that can be created with the GMG ColorServer Profile Editor. GMG ColorServer includes a number of standard color profiles. The profiles are named as follows in accordance with the type of color conversion:



1.3.1. CMYK conversion profiles

CMYK conversion profiles control conversion from one CMYK color space to another CMYK color space (e.g. from offset to gravure). In this context, the image data is optimized for the different printing processes, giving consideration to the respective printing conditions. The separation of the source color space can be retained in the process, with or without adaptation of the total ink application, or a new separation can be created. For conversions between color spaces of different size, there is additionally the option of calculating the profile by Gamut Mapping.

1.3.2. CMYK reseparation profiles

With CMYK reseparation profiles, the original CMYK color composition within a color space is discarded and created anew (~ reseparation). These profiles are eminently suited to the following application: particularly in printing, it is often the case that files from different suppliers are in the color space of the subsequent printing process, but the UCR/GCR settings used for color separation differ and frequently cannot be reconstructed. If these files are printed together, the different UCR/GCR settings, and the resultant different color composition, make it more difficult to maintain the color and gray balance, especially if job-related density tolerances have to be complied with. After conversion using a CMYK reseparation profile, uniform color composition is obtained for all files. At the same time, the visual color impression is preserved, the subsequent printing process is far more stable, and required tolerances can be achieved more easily.

1.3.3. RGB separation profiles

In our digital age, there are growing demands on the multiple utilizations of data in the prepress sector. The inevitable conclusion resulting from this is, of course, a need for media-neutral data storage. For this reason, classical CMYK production environments are often being replaced by RGB-based workflows. In addition, these demands are being further intensified by the almost standard use of digital cameras today. As a result, it is increasingly the case that RGB files are supplied that still have to be separated for the subsequent printing process.

The GMG separation profiles offer a wide range of setting options for this purpose, including calculation with Gamut Mapping. This permits harmonious transformation of the colors into the respective CMYK color space for optimum printing results. The use of GMG RGB separation profiles also ensures that (compared to ICC) a uniform color impression is obtained when converting from one RGB color space into different CMYK color spaces.

1.3.4. RGB conversion profiles

RGB conversion profiles control color space transformation between two RGB color spaces. GMG ColorServer includes RGB conversion profiles for most RGB working color spaces. However, user-defined profiles can not yet be created with the current version of the GMG ColorServer Profile Editor.

1.4. Control of profile calculation

When creating an MX4 conversion or separation profile, the color space conversion is calculated on the basis of the specified source and target color spaces. This calculation is controlled by setting options for the type of separation and Gamut Mapping. These options are described below.

1.4.1. Separation settings

CMYK profiles

For CMYK profiles, there are three separation modes, which influence the color composition of the profile calculation:

- *Keep Separation (classical fileOut mode)* retains the existing color composition of the input data. Chromatic colors are adapted via the gradation of the respective colors, and the Black composition is preserved. In the Black channel, only brightness differences are corrected via the tonal value. This separation mode should be used to calculate profiles in which the source and target color spaces are virtually identical in terms of size, total ink application and separation setting (UCR/Black Width), or if the target color space is larger than the source color space. This would, for example, be the appropriate setting when converting from sheet-fed offset on coated paper (ISOcoated) to continious form offset on coated paper (ISOcofcoated).

- When using *Adapt Separation (fileOut mode)*, the color composition of the input data is retained (as in the preceding mode), but the total ink application can additionally be adapted in this case. In areas with a high level of ink application, the CMY chromatic color component is replaced by Black. This separation mode should be used to calculate profiles in which the source and target color spaces are virtually identical in terms of size, and only the total ink application needs to be adapted slightly, e.g. when converting from ISOcoated (total ink application 350%) to an in-house standard similar to ISOcoated with a lower ink application of 330%, for example.
- *Create new Separation* ignores the original color composition, and the data is separated anew (~ reseparation). The composition of the Black channel is defined via various separation settings – CMYK Ink Limit, Black Start, Black Ink Limit, Black Width, and UCR in the shadows, in the midtones and in the highlights. There is additionally the possibility of retaining the original Black channel and reseparating it only in certain regions. For instance, reseparation in the shadows or expansion of the Black Width permits harmonious reduction of the total ink application.

RGB profiles

RGB separation profiles are always calculated using the *Create new Separation* mode. Calculation of the Black channel is controlled via the various separation settings – CMYK Ink Limit, Black Start, Black Ink Limit, Black Width, and UCR in the shadows, in the midtones and in the highlights.

Predefined separation settings

For the *Create new Separation* mode, the GMG ColorServer Profile Editor comes with predefined and tested separation settings for most standard printing conditions into which data is to be converted:

- Offset Printing: Coated and Uncoated Paper (sheetfed offset), Webcoated Paper (heatset), Cofcoated and Cofuncoated Paper (cof = continious form heatset)
- Newspaper Printing: Uncoated Paper
- Gravure Printing: LWC, SC, MF, HWC Paper
- Flexo Printing: White Foil

The separation settings are based on the common standards. The color impression of a file separated for the different printing standards is preserved in the process.

The user can adapt the separation settings to suit the prevailing requirements.

1.4.2. Gamut Mapping

The following calculation modes are available in the GMG ColorServer Profile Editor when calculating color profiles:

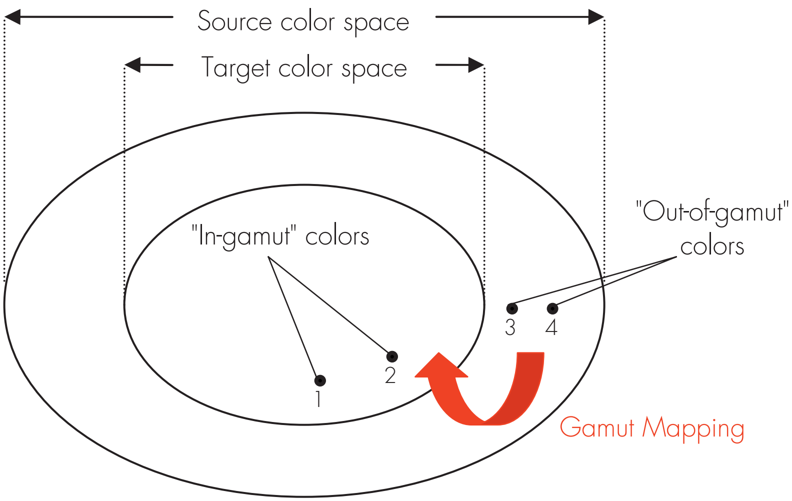
Calculate with Target Values

This mode is suitable for calculating color profiles that control color conversion between source and target color spaces of similar size and with similar white and black points. This mode is likewise suitable if the target color space is larger than the source color space. Since the color only has to be adapted slightly to achieve the given target values in these cases, these target values can be used unchanged for calculating the profile.

Calculate with Gamut Mapping

This mode is available for calculating color profiles that control color conversion from a larger color space to a smaller one with different white and black points.

When converting from a larger color space to a smaller one, there are always some colors that cannot be reproduced 1:1 in the target color space ("out-of-gamut" colors). Consequently, for mapping the larger color space onto the smaller one (~ Gamut Mapping), a method has to be found for identifying the best possible substitute for "out-of-gamut" colors in order to preserve the color impression and the contrast as closely as possible.



Schematic representation of Gamut Mapping

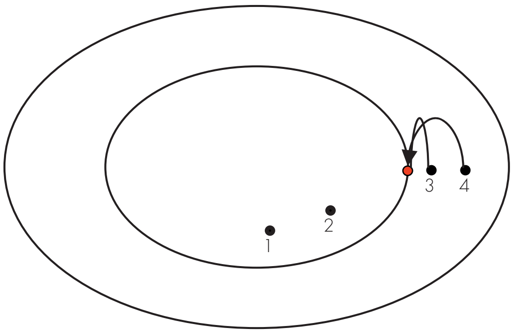
In the diagram above, colors 1 and 2 are within the target color space ("in-gamut"), whereas colors 3 and 4 are outside the target color space ("out-of-gamut").

Since the (CIELab) target values specified by the source color space can therefore not be achieved in this case, they first have to be adapted on the basis of the selected Gamut Mapping method in order to be able to use them to calculate the specific CMYK values of the target color space.

Gamut Mapping function in ICC conversions

For ICC conversions, the type of Gamut Mapping is controlled by selecting a Rendering Intent:

- *Absolute colorimetric* reproduces all "in-gamut" colors colorimetrically in the target color space, while all "out-of-gamut" colors are clipped and shifted to the edge of the color space. In the case of *Relative colorimetric*, the white points of the two color spaces are first mapped onto each other, all non-reproducible colors only then being clipped and assigned to the edge of the color space:

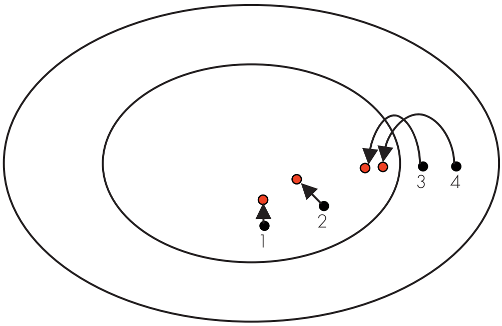


Schematic representation of colorimetric Gamut Mapping

The disadvantage of this Gamut Mapping method is that the detail definition is lost in the particularly saturated image areas at the edge of the color space, and also in the shadows.

Colorimetric reproduction is generally used when outputting proofs, although the target color space is then usually larger than the source color space, meaning that there are no "out-of-gamut" colors to be reproduced.

- *Perceptual* maps all colors onto the target color space in compressed form. The aim is to achieve a match between the source and target color spaces that corresponds to our perception:



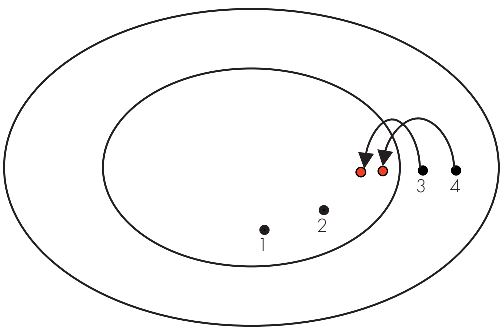
Schematic representation of perceptual Gamut Mapping

However, this method also affects the "in-gamut" colors, which could in fact be reproduced colorimetrically. Another side-effect is a major loss of saturation, caused by the compression of the entire color space. Even "overcompression" often occurs.

- *Saturation-preserving* only makes sense for copy with highly saturated colors, such as in presentation graphics, and usually plays no role in the reproduction of colors for printing. For this reason, many ICC profiles give no particular consideration to this Rendering Intent, and it often corresponds to the perceptual Rendering Intent.

Gamut Mapping function in GMG conversions

During calculation with Gamut Mapping, the target values are changed as follows in the MX4 file: in the first step, the white and black points of the source and target color spaces are mapped onto each other. Initial compression of the entire source color space takes place during this process. In the second step, a *Clip/Perceptual* control is used to set the way in which the remaining "out-of-gamut" colors are to be reproduced at the edge of the color space. Different levels are available for controlling the intensity of this compression:



Schematic representation of GMG Gamut Mapping

This constitutes a compromise between colorimetric reproduction for the "in-gamut" colors (colors 1 and 2 remain virtually unchanged) and perceptual compression of the "out-of-gamut" colors at the edge of the color space. The result is optimum preservation of the saturation and detail definition at the edge of the color space. Calculation with Gamut Mapping is explained in Chapter 4.

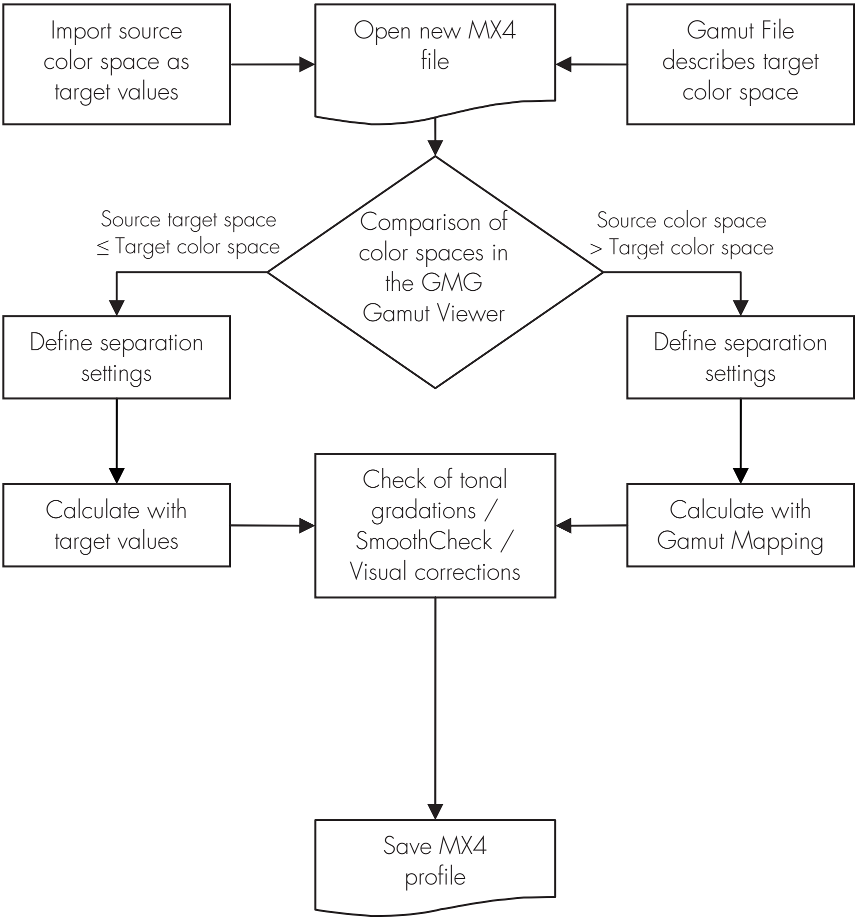
1.5. Special case: CMYK MX3 profile

It is also possible to use an MX3 file to create a CMYK conversion profile. In contrast to the MX4 file, the MX3 file is not four-dimensional, but only three-dimensional. The chromatic colors CMY and the Black channel are considered separately; the MX3 color profile contains no combinations of chromatic colors and Black.

An MX3 profile is primarily suitable for conversion of All-in-CT data for gravure printing that contain black text, for example. Since the Black channel is adapted separately from the chromatic colors, the text retains its monochromatic composition. The colors are accordingly adapted via the CMY values. In the Black channel, only brightness differences are corrected via the tonal values. The MX3 profile has a separation-preserving function as a result of the isolation of the chromatic colors from the Black channel.

1.6. Schematic representation of profile creation

The following page shows you a flowchart giving a schematic description of MX4 color profile creation:



Flowchart of MX4 profile creation

2. Creating a CMYK conversion profile

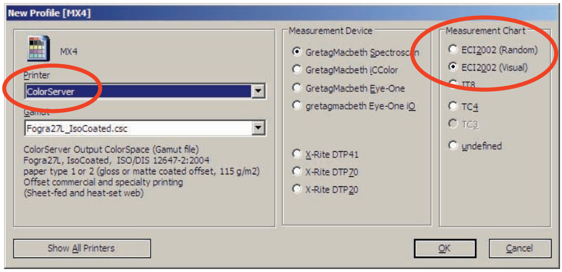
To create a new CMYK color profile, open the GMG ColorServer Profile Editor with *Start* → *Programs* → *GMG ColorProof 04* → *Profile Editor*, or with *Options* → *Start Profile Editor* in GMG ColorServer.

☝ Please note that no detailed instructions can be given here regarding the specific settings with which you have to calculate your profiles. This always depends on the respective color spaces between which you wish to convert, and on the user-defined requirements. The intention here is merely to provide an overview of the functions of the new GMG ColorServer Profile Editor and the respective results of the different setting options when calculating profiles. As a general rule, you will obtain very good results with the predefined separation settings. Recommendations for Gamut Mapping settings can be found in Chapter 4.

2.1. Defining the source and target color spaces

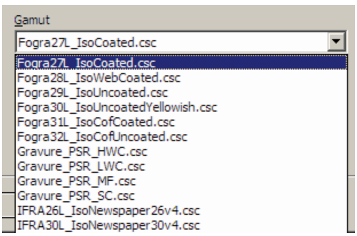
To create a new CMYK conversion or reseparation profile with the GMG ColorServer Profile Editor, you need information on the color spaces – between which conversion or separation is to be performed – in a form that the GMG software can interpret, since color spaces can be described using different file formats. The respective data is imported from existing files below. The colorimetric determination of target values is described in Chapter 5.5.

Open a new MX4 file in the GMG ColorServer Profile Editor with *File → New CMYK MX4*. The following window opens:



General settings for a new CMYK color profile

Select *Printer → ColorServer* as the output option. Under *Gamut*, you can select the following `*.csc` Gamut Files, which describe most standard printing conditions. The files are installed in the `C:\Colorproof\printers\ColorServer\` directory:



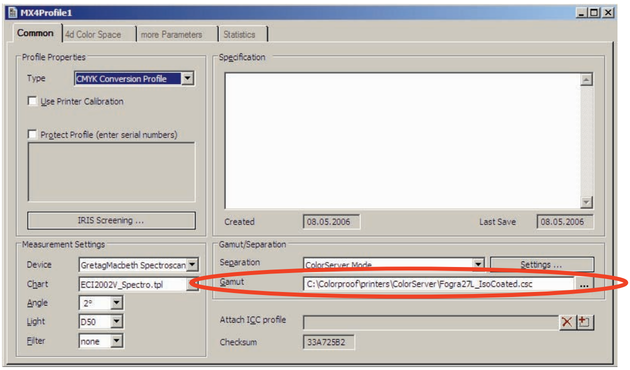
Installed Gamut Files in the .\printers\ColorServer\ directory

The Gamut File describes the target color space into which the data will be converted. The specific CMYK color values for the target color space are also calculated on the basis of this file.

Various test charts can be selected under *Measurement Chart*. This defines how many fulcrums the MX4 file contains.

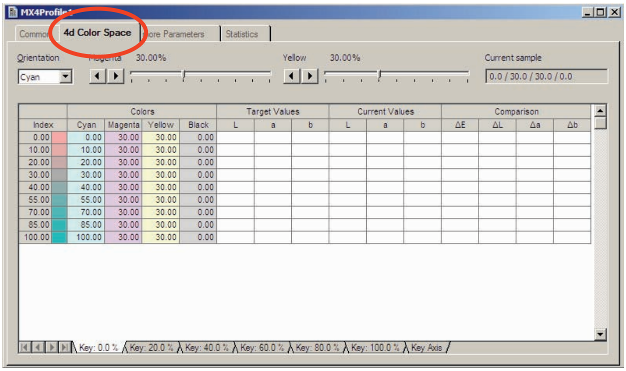
> GMG generally recommends calculation of the color profile on the basis of an ECI2002 test chart. The more fulcrums there are in the file, the longer it takes to calculate the profile, particularly when calculating with Gamut Mapping.

Confirm the settings with *OK*. A new MX4 file opens in the GMG ColorServer Profile Editor, and the previously defined Gamut File is already selected under *Gamut* on the *Common* tab:



New MX4 file, Common tab

Switch to the *4d Color Space* tab:



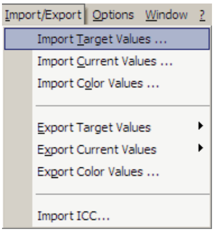
New CMYK color profile, 4d Color Space tab

The GMG ColorServer Profile Editor can interpret the `IT8` and `CSV` text formats for importing the source color space into the MX4 file as target values. The ICC characterization data for the standard printing processes is, for example, in `IT8` text format. Alternatively, you can also import the information from ICC profiles as target values.

Please make sure that you have access to the respective data. Characterization data for the standard ISO color spaces and ICC profiles is available for downloading at *www.fogra.org* or *www.eci.org*. Install the ICC profiles on your system as follows: *Mark profile* → *Right mouse click* → *Install profile*. GMG recommends that you create a separate folder for characterization data in the installation directory `C:\Colorproof\`.

2.1.1. Importing the characterization file

Select *Import/Export* → *Import Target Values*.

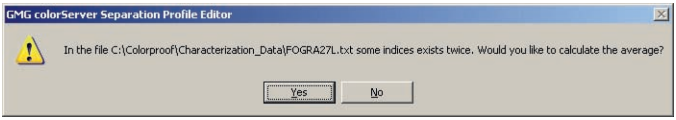


Importing target values

A Windows Explorer window opens, where you can select the required text file.

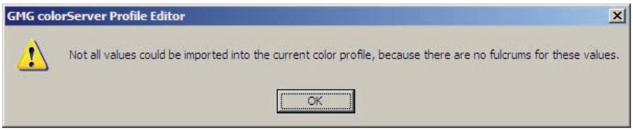
Alternatively, you have the option of selecting several files and importing them simultaneously, e.g. if several measurement files are to be averaged. The software does this automatically during the import procedure.

It may be that the following message appears when importing the color values from a characterization file:



Warning – Indices exist twice in file

Confirm the message with *Yes*. If the following message then appears,

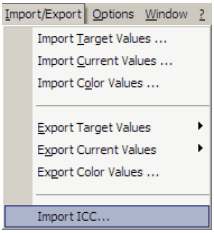


Warning – Not all color values can be imported because fulcrums are missing

again confirm it with *OK*. This message appears if the characterization data contain more fulcrums than have been created in the MX4 file.

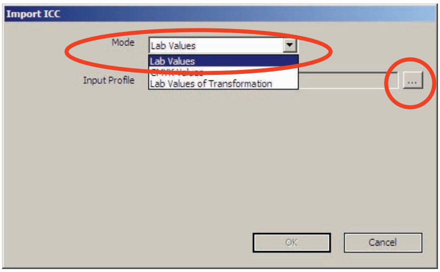
2.1.2. Importing an ICC profile

In addition, you also have the option of importing target values from an ICC profile:



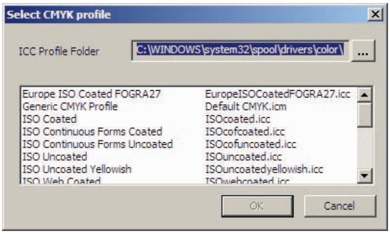
Importing the target values from an ICC profile

Select *Import/Export* → *Import ICC…*, whereupon the following window opens:



Importing the CIELab color values from an ICC profile

Make sure that *Mode* → *Lab Values* is set, and select the required ICC profile under *Input Profile*. If you click on the marked selection icon, the `C:\WINDOWS\system32\spool\drivers\color\` directory opens automatically. It contains all the ICC profiles installed on your system:



Installation directory for ICC profiles

If you confirm the settings with *OK*, the CIELab values from the ICC profile are automatically imported into the MX4 file as target values.

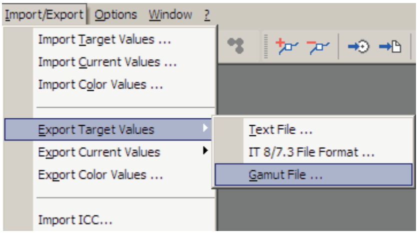
☝ Please note that, when importing CIELab values from an ICC profile, the respective values are calculated, rather than the measurements possibly stored in the profile being imported.

2.1.3. Creating a Gamut File

Should the required target color space not already be selectable as a `*.csc` Gamut File when creating a new profile, you can create your own Gamut Files as follows.

☝ GMG again recommends the use of an ECI2002 test chart when creating Gamut Files.

Import characterization data or an ICC profile as target values, as described in the preceding chapter, and then select *Import/Export → Export Target Values → Gamut File*:



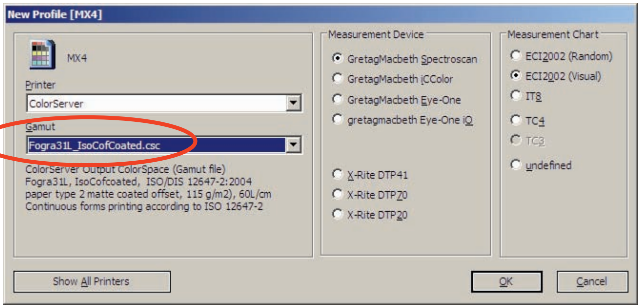
Exporting the target values as a Gamut File

A Windows Explorer window opens. Select the `C:\Colorproof\printers\ColorServer\` installation directory and save the file there with a unique name, e.g. like the printing process the characterization data describes. When you start to create a new CMYK MX4 profile, you will find that the new Gamut File you have just created is available in the selection menu.

2.2. Keep Separation mode

This mode is suitable for conversions between color spaces whose size, separation and total ink application are similar. This method can also be used for conversions between a standard color space and an in-house standard with similar paper and ink application. A conversion profile for ISOcoated (FOGRA27L) to ISOcofcoated (FOGRA31L) is created below by way of example.

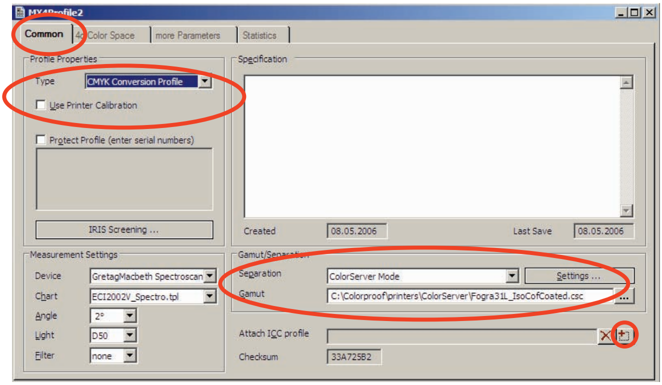
Open a new profile in the GMG ColorServer Profile Editor with *File → New CMYK MX4*:



Basic settings for the new CMYK MX4 file

To create the profile, select *Printer → ColorServer* as the output option and, under *Gamut*, the Gamut File that describes the target color space, i.e. *Fogra31L_IsoCofCoated.csc* in this case. If you want target values based on measurements (see Chapter 5.5), select the equipment you use under *Measurement Device*. Under *Measurement Chart*, you can choose the test chart basis on which you want to create the MX4 color profile. The corresponding fulcrums are then already created in the MX4 file. The characterization data (target values) must match the selected measurement chart in terms of the fulcrums contained. As a general rule, the characterization data is created on the basis of an ECI2002 test chart.

Confirm the settings with *OK*. A new MX4 profile opens in the GMG ColorServer Profile Editor. Switch to the *Common* tab there:



General settings in the new CMYK conversion profile

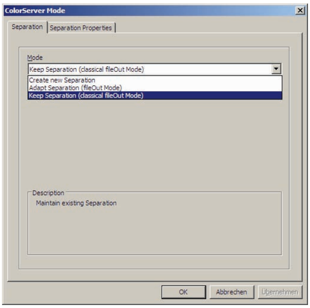
You must select *Type* → *CMYK Conversion Profile* under *Profile Properties*. The *ColorServer Mode* is then automatically selected for this profile type under *Separation*. Make sure that the check mark next to *Use Printer Calibration* is deactivated. This function is only needed for MX4 proofing profiles.

The previously defined measurement device settings have been adopted under *Measurement Settings*. If your target values are to be based on measurements, ensure that the correct measuring conditions are defined under *Angle*, *Light*, and *Filter*.

The previously defined Gamut File, *Fogra31L_IsoCofCoated.csc*, is automatically selected under *Gamut*.

☝ Under *Attach ICC profile*, you can specify an ICC profile that is automatically attached to the converted file after processing with GMG ColorServer. In subsequent processing steps (e.g. Adobe Photoshop, QuarkXPress), it is then possible to reconstruct the color space for which the device-specific CMYK values are available.

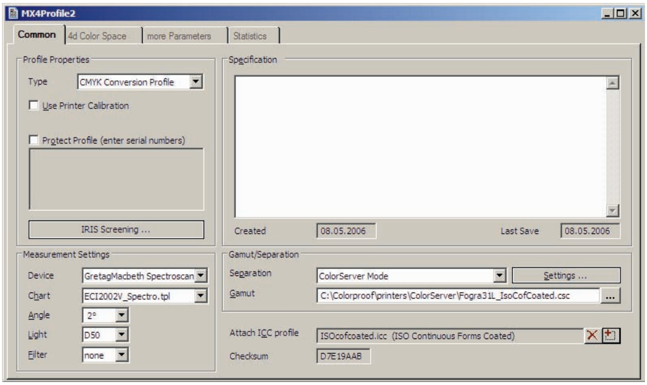
Select the corresponding ICC profile of the target color space here – in this case "ISOcofcoated.icc". Under *Separation*, now switch to the *Settings* of the *ColorServer Mode*. The following window opens:



Separation mode selection

The different ColorServer separation modes can be selected here. For this example, select the *Keep Separation (classical fileOut Mode)* mode and confirm with *OK*. Back on the *Common* tab, you can enter additional information under *Specification*, e.g. the software version used to create the profile, checksum, etc.

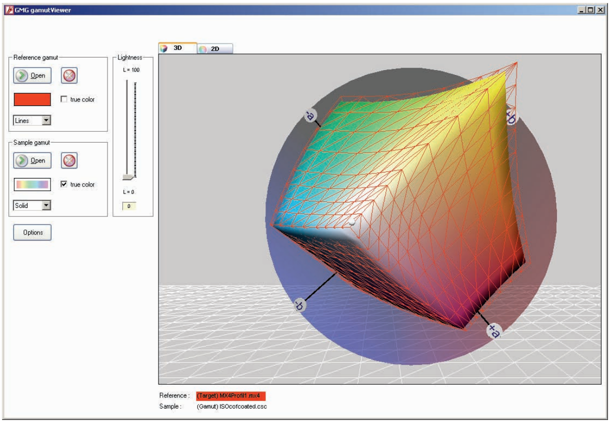
All the required settings have now been made on the *Common* tab of the new profile:



General settings of the new CMYK conversion profile

Now switch to the *4d Color Space* tab and import the color values of the source color space with *Import/Export* → *Import Target Values* or *Import ICC*. In this case, the FOGRA27L characterization data is imported, corresponding to the ISOcoated color space.

Once the target values have been imported, you can perform a visual comparison of the source color space (target values) and the target color space (Gamut File) in the GMG Gamut Viewer. To do so, select *Tools* → *Compare Gamut/Target Values*. Alternatively, you can also start the GMG Gamut Viewer via *Options* → *GamutViewer* and manually load `*.csc` or `*.txt` files for the visual comparison of color spaces:



Comparison of ISOcoated (red lines) and ISOcofcoated (colored body) in the GMG Gamut Viewer

The visual comparison shows that the two color spaces are of roughly the same size and have similar white and black points, i.e. calculation without Gamut Mapping is recommended in this case.

Now that all the necessary settings have been made, the profile can be calculated. To do so, select *Measure* → *Calculate with Target Values*. Save the profile after calculation. GMG uses the following name format for conversion profiles:

CS_con_<CMYK1>_2_<CMYK2>_V1.mx4

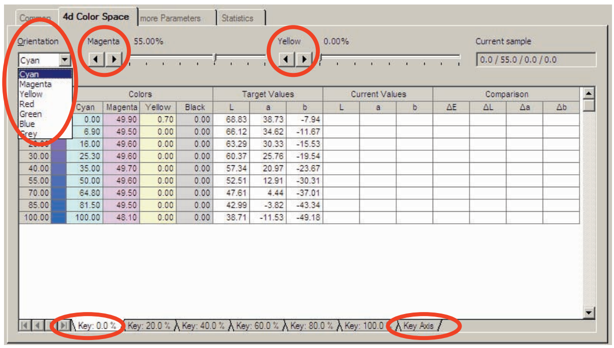
<CMYK1> denotes the source color space in which the data to be converted is present, <CMYK2> denoting the target color space into which the data is to be converted.

In this instance, the profile would be named as follows:

CS_con_Iso27L_2_Iso31L_V1.mx4

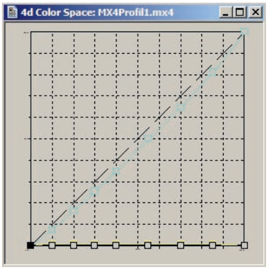
On the *4d Color Space* tab, you can perform a check with *Tools → Show Graphic View*. This visualizes the CMYK tonal gradation, which is displayed in the 4d color space in each case.

Orientation is used to define which tonal gradation is currently displayed in the 4d color space. *Cyan* is selected in this instance, i.e. the tonal gradation from 0 - 100% Cyan is displayed. You can define the further fulcrums with the *Magenta* and *Yellow* slide controls (for *Orientation → Cyan*) and the respective Key tab. A value of 55% was selected for Magenta in this example. In other words, the tonal gradation from 0 - 100% Cyan plus 55% Magenta is displayed in the *4d Color Space*:

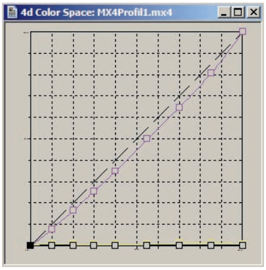


Selection of the color gradations displayed

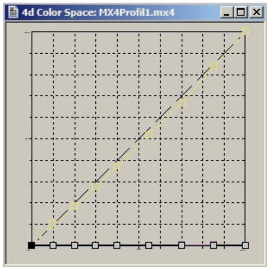
To visualize the tonal gradation of the primary colors and Gray, choose consecutively the tonal gradation in the *4d Color Space* with *Orientation* → *Cyan / Magenta / Yellow / Gray* while leaving the respective slide controls and the Key tab at 0%. By selecting the *Key Axis* tab, the gradation of the K channel will be shown. The respective tonal gradations are visualized with *Tools* → *Show Graphic View*.



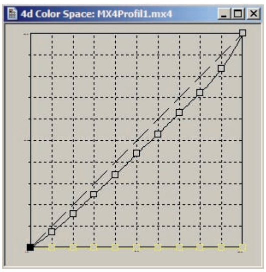
0 - 100% Cyan



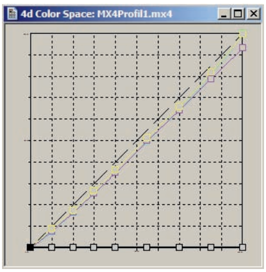
0 - 100% Magenta



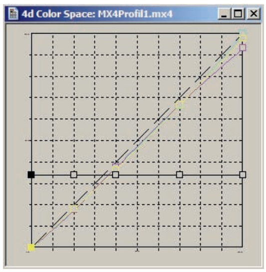
0 - 100% Yellow



0 - 100% Black



0 - 100% CMY Gray



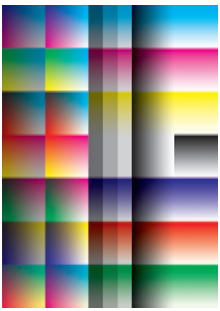
CMY Gray at 40% Black

Following conversion, the tonal value of the chromatic colors is adapted, and the required color is achieved by the (in this case slight) addition of the other colors. In the Black channel, only the brightness differences are adapted via the tonal value (~ Gradation curve).

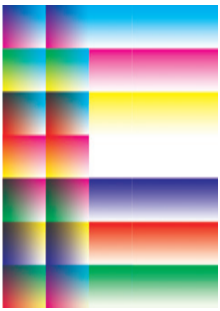
The pure CMY composition is preserved in the Gray, the gray balance being adjusted only via the tonal values. In the CMY Gray plus 40% Black, for the Black component the value is used which was calculated for the input value of 40% pure Black (approx. 34% in this case).

The check of the tonal gradations reveals that the curves are adapted only slightly, and that pure Black is likewise preserved following conversion. This can also be checked using the *GMG_CMYK_smoothCheck_V1.tif* test file (see Chapter 5.2). To perform the check, process the file in GMG ColorServer using the profile that has just been created:

Original file:



CMYK

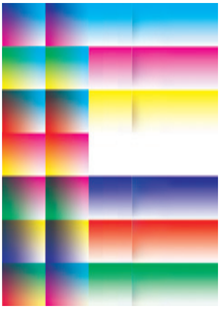


CMY separations

Black separation

After conversion with the GMG color profile:


CMYK


CMY separations

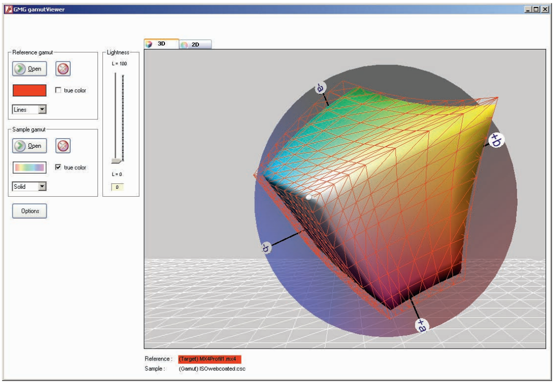

Black separation

The original Black channel is preserved during conversion. Almost the same result is also obtained when converting with a profile calculated using the *Adapt Separation* separation mode (see Chapter 2.3, below).

2.3. Adapt Separation mode

This mode is suitable for conversions between color spaces that are similar in terms of size and separation, but have different levels of ink application. A conversion profile for ISOcoated (FOGRA27L, 350% total ink application) to ISOwebcoated (FOGRA28L, 300% total ink application) is calculated below by way of example.

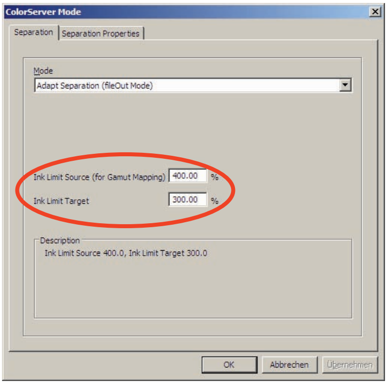
Open a new CMYK MX4 file, load the FOGRA27L characterization file as the target values, and the *Fogra28L_IsoWebCoated.csc* file as the gamut. The *Compare Gamut/Target Values* function in the GMG Gamut Viewer yields the following view:



Comparison of ISOcoated (red lines) and ISOwebcoated (colored body)

In this instance, the two color spaces are of roughly the same size, but the white points differ slightly. Consequently, paper tint correction has to be performed for this profile (see Chapter 2.5). Calculation without Gamut Mapping is recommended.

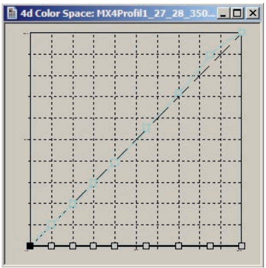
In the MX4 file, now switch to the *Separation Settings* of the *ColorServer Mode* on the *Common* tab, and select the *Adapt Separation (fileOut Mode)* separation mode there.



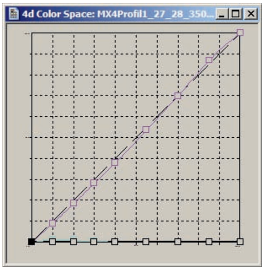
ColorServer Adapt Separation mode

Leave *Ink Limit Source (for Gamut Mapping)* → *400%* and enter *Ink Limit Target* → *300%* for ISOwebcoated, the standard ink limit for offset printing on webcoated paper. Confirm the settings with *OK*. Now that all the necessary information is present in the MX4 file, you can start calculation with *Measure* → *Calculate with Target Values*. Subsequently save the profile.

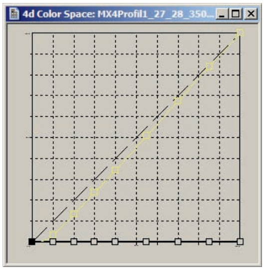
Now switch to the *4d Color Space* tab. You can check the tonal gradations with *Tools* → *Show Graphic View*:



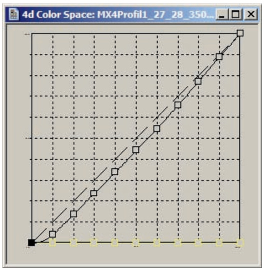
0 - 100% Cyan



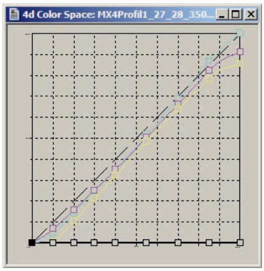
0 - 100% Magenta



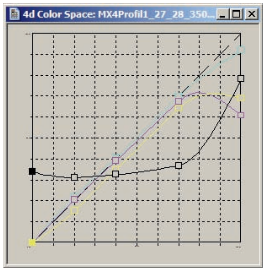
0 - 100% Yellow



0 - 100% Black

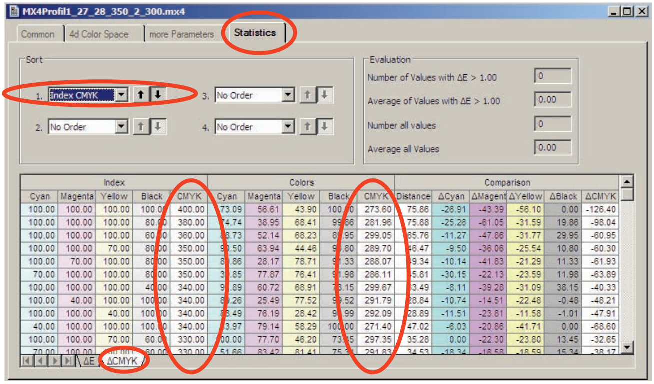


0 - 100% CMY



0 - 100% CMY + 40% Black

The tonal values are correspondingly adapted here, the color being obtained by adding other chromatic colors. The pure CMY composition is likewise retained in the Gray, only the gray balance is adapted via the gradation curve. It can be seen in the curve for Gray plus 40% Black. The software starts to replace CMY with Black upwards of a certain total tonal value in order to adapt the total ink application.



Check of the reduction of total ink application on the Statistics tab of the MX4 profile

You can check the reduction of the total ink application under Δ*CMYK* on the *Statistics* tab. To do so, sort the data under *Sort* → *1.* in descending order by *Index CMYK*, which describes the original total ink application.

Under *Colors CMYK*, you can then see the total ink application after conversion. In this example, the ink application for all input color values was successfully calculated to below 300%.

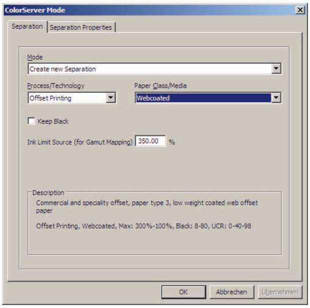
☝ Please note that replacement of the chromatic colors by Black can lead to a loss of definition and flattening of the image motif in the image shadows. Consequently, GMG recommends only slight adaptation of the total ink application in this mode. For higher reduction, you should calculate the color profile with the *Create new Separation* separation mode, or with Gamut Mapping in the case of color spaces of different size.

2.4. Create new Separation mode

In this mode, the original color composition of the input data is ignored, and the data is separated anew (~ Reseparation). The same conversion profile as in the preceding chapter is created below (ISOcoated to ISO-webcoated), but the profile is calculated with the *Create new Separation* separation mode this time.

Open a new CMYK MX4 file, define the *Fogra28L_IsoWebCoated.csc* file as the gamut, and import the FOGRA27L file as the ISOcoated target values.

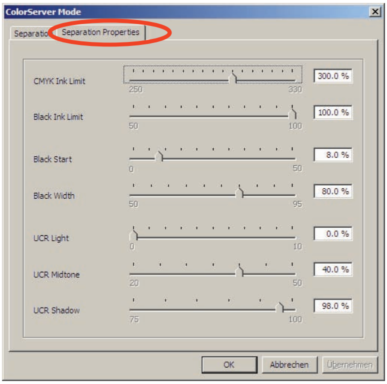
Now switch to the *Separation Settings* of the *ColorServer Mode* on the *Common* tab, and select *Create new Separation* there:



Create new Separation mode

A number of standard printing conditions are already predefined under *Process/Technology*. When a printing process is selected there, *Offset Printing* in this case, the respective associated and available media types are displayed under *Paper Class/Media*. Select *Webcoated* here accordingly.

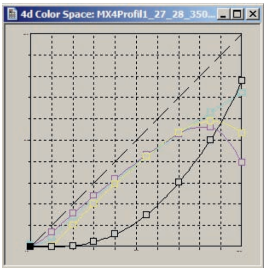
There are predefined separation settings, already tested by GMG, for the respective combinations of printing process and medium. You can find a summary of these settings under *Description*, while the *Separation Properties* tab contains the precise settings. The predefined settings for *Offset Printing/Webcoated* can be seen below:



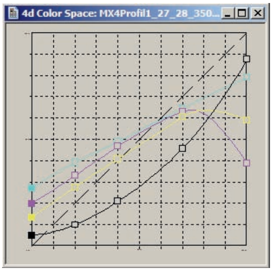
Predefined separation settings for Offset Printing/Webcoated

The settings can be adapted by the user with a certain range. The procedure is explained on the basis of CMYK reseparation profiles in Chapter 2.4.2.

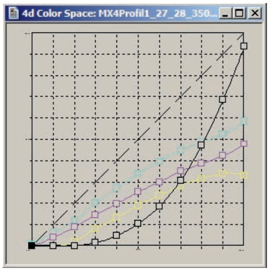
The profile is first calculated with the predefined separation settings. To do so, close the *Separation Properties* of the *ColorServer Mode* by confirming with *OK* (without making user-defined changes). Select *Measure → Calculate with Target Values*. After calculation, you can check the tonal gradations of the respective colors via *Tools → Show Graphic View*. The results are presented below:



0 - 100% CMY



0 - 100% CMY + 40% Black



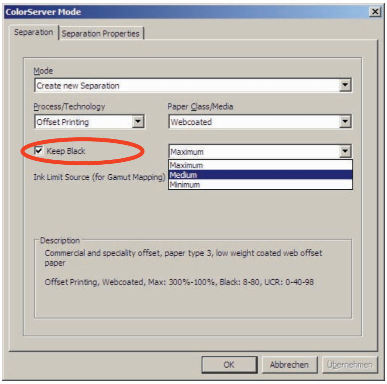
0 - 100% Black

The pure CMY Gray was completely reseparated and now additionally contains Black. The Key axis is now likewise composed of four colors.

2.4.1. Keep Black

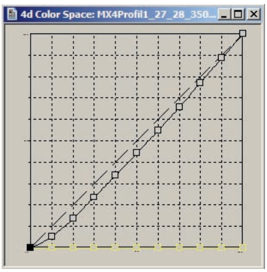
Since reseparation of the Black channel is often not wanted (e.g. in the case of black text), there is the option of preserving the original Black channel when calculating a new separation.

To do so, activate the *Keep Black* checkbox in the *ColorServer Separation Settings* on the *Common* tab of the MX4 color profile:



Keep Black option for creating a new separation

If the profile is now calculated using this option, the Black channel is kept monochromatic during conversion, only the gradation of the tonal value being adapted to compensate for brightness differences:



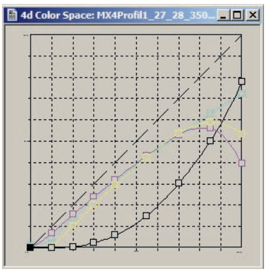
0 - 100% Black with Keep Black

After activating the *Keep Black* checkbox, you additionally have a choice of three intensity levels.

At *Maximum* intensity, the Black is preserved to the maximum (possible) extent, and reseparation intervenes in the profile to a lesser degree. Data previously separated achromatically likewise remain achromatic after conversion.

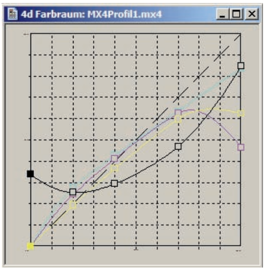
With *Minimum*, the Black is retained to a minimal extent, and reseparation has a more pronounced effect, i.e. data previously separated achromatically is reseparated with less Black and more CMY.

For all input color values composed purely of CMY, this also means that reseparation with Keep Black does not differ from that without Keep Black. This option only has an effect on colors that additionally contain an amount of Black (~ achromatic).

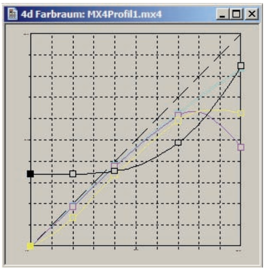


CMY with/without Keep Black

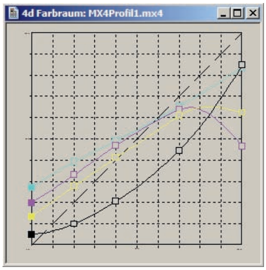
The tonal gradation from 0 to 100% CMY Gray plus 40% Black is illustrated below:



Minimum Keep Black



Maximum Keep Black



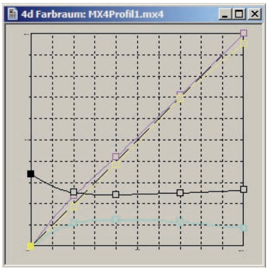
Without Keep Black option

Without Keep Black, the 0% CMY Gray plus 40% Black fulcrum is composed of four colors from the outset; the chromatic color component is much greater in the quarter tone.

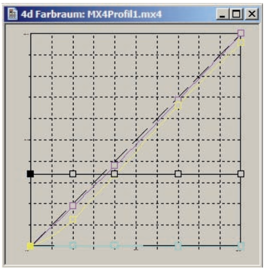
With Keep Black, the Black starts with the tonal value that was also calculated for the pure Black at 40% (in this example: 34%), and the chromatic color component in the quarter tone is smaller. Depending on the selected intensity, the reseparation, which proceeds homogeneously from the Key axis, starts sooner (Minimum intensity) or later (Maximum intensity).

The settings under *Separation Settings* are used for the areas that are reseparated.

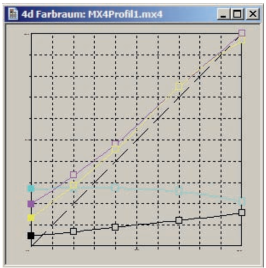
You can additionally see the tonal gradation from 0 to 100% Red plus 40% Black below:



Minimum Keep Black



Maximum Keep Black

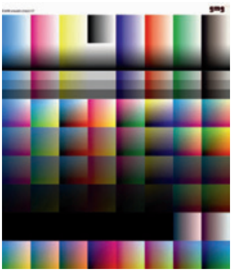


Without Keep Black option

In this instance, the starting point for Black is the same for both intensities of Keep Black. At *Minimum* intensity, reseparation again has a stronger impact on the color composition, while *Maximum* leaves the original color composition almost completely unchanged, adapting it only in terms of the tonal gradations.

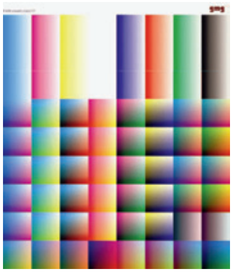
The *GMG_CMYK_smoothCheck_V1.tif* test file is shown below to illustrate the *Keep Black* function (see Chapter 5.2). The file was processed in GMG ColorServer, once with a conversion profile without Keep Black, and once with *Keep Black* → *Maximum*:

Original file:



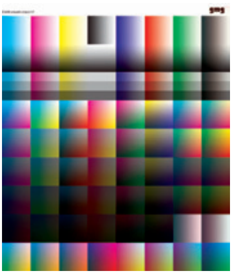
CMYK

Black channel

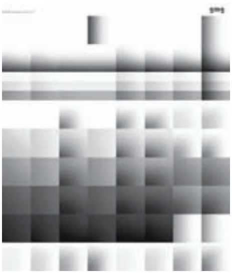


CMY channels

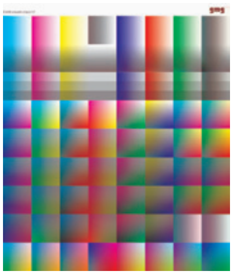
Conversion without Keep Black yields the following color separations:



CMYK



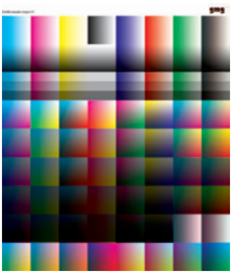
Black channel



CMY channels

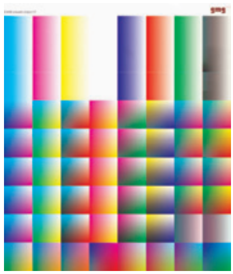
In this instance, the original Black channel is reseparated, being composed of four colors following conversion.

Conversion with *Keep Black* → *Maximum* yields the following color separations:



CMYK

Black channel



CMY channels

In this instance, the Black channel retains its original properties. In addition, CMY is replaced with Black in areas with a high level of ink application.

2.4.2. CMYK reseparation profiles

CMYK reseparation profiles are a subgroup of CMYK conversion profiles. These profiles are used to reseparate data within a color space in order to harmonize different UCR/GCR settings. The source and target color spaces are identical, and *Create new Separation* is used as the separation mode. GMG uses the following name format for reseparation profiles:

CS_res_<CMYK>_V1.mx4

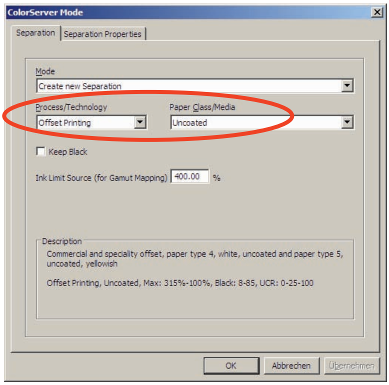
Or, for reseparation profiles with the *Keep Black* function:

*CS_**res**_<CMYK>_**keepK**_V1.mx4*

A CMYK reseparation profile for ISOuncoated (FOGRA29L) – offset printing on uncoated paper – is created below. The profile would be given the following name:

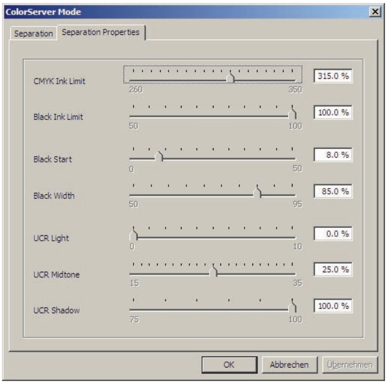
*CS_**res**_ISO29L _V1.mx4* or *CS_**res**_ISO29L_keepK_V1.mx4*

To this end, open a new CMYK MX4 file in the GMG ColorServer Profile Editor, define *Fogra29L_IsoUncoated.csc* as the gamut, and import the FOGRA29L characterization data as the target values. Then switch to the *Separation Settings* of the *ColorServer Mode*, and select *Create new Separation*.



ColorServer mode Create new Separation

Select *Process/Technology* → *Offset Printing* and *Paper Class/Media* → *Uncoated*. Then switch to the *Separation Properties* tab. The predefined settings for ISOuncoated are shown below:



Predefined separation settings for ISOuncoated

CMYK Ink Limit defines the value to which the GMG ColorServer Profile Editor is to restrict the total ink application when calculating the CMYK values of the target color space. In this context, UCR is applied in the image shadows, and the CMY chromatic color component replaced with Black.

Black Ink Limit restricts the maximum tonal value for Black to the value entered.

Black Start restricts the starting point for Black to the value entered. With an early starting point, Black is also used in the highlights. The higher the value, the farther the starting point for Black is shifted towards the image shadows.

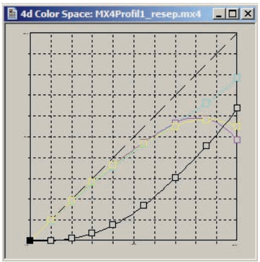
The *Black Width* indicates the effective width of the Black composition. A narrow width results in Black only being used in neutral (gray) areas (skeleton black), while a higher value causes Black also to be used in other tertiary colors. The effective range is partly defined by the *Black Start*.

The *UCR* controllers define the "Under Color Reduction" in the respective *Shadow*, *Midtone* and *Light* areas.

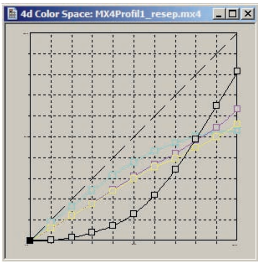
The separation properties affect the way of calculating the Black channel for the target color space. High values for *UCR* and *Black Width* result in GCR that influences the entire color space, and not just the neutral image shadows as in the case of UCR. A detailed description of the extent to which user-defined alterations of the individual separation properties affect the calculation of the Black channel can be found in Chapter 5.1.

To illustrate this function, a reseparation profile will now be created for ISOuncoated, using the predefined separation settings for *Offset Printing → Uncoated*. To do so, leave the settings under *Separation Properties* unchanged and calculate the profile with target values.

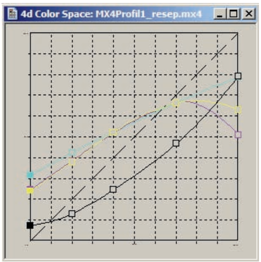
The primary and secondary colors CMY and RGB behave in linear fashion (input and output values are identical). If the *Keep Black* checkbox is not activated, reseparation intervenes fully in the color composition of the tertiary colors and the achromatically composed colors:



0 - 100% CMY

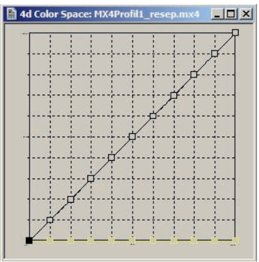


0 - 100% Black

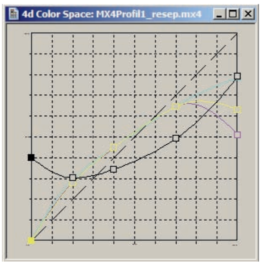


0 - 100% CMY + 40% Black

After reseparation, CMY Gray and Black are composed of four colors. If the profile is calculated using the *Keep Black* → *Minimum* option, the tonal gradations illustrated below are obtained (see Chapter 2.4.1):



0 - 100% Black



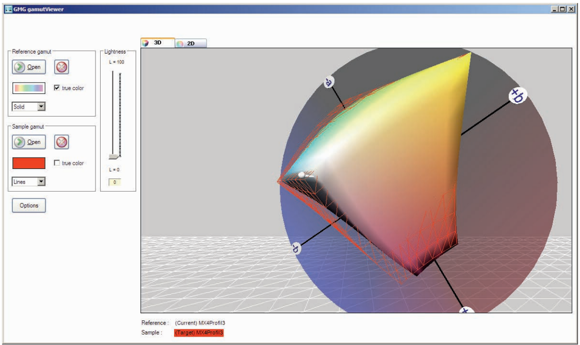
0 - 100% CMY + 40% Black

2.5. Paper tint correction

For CMYK conversion profiles (not reseparation profiles!) calculated without Gamut Mapping, a correction has to be made for the paper tint. This is necessary if the color spaces to be converted between are defined by very different white points (~ Paper tint).

The paper tint influences the printed image not only in unprinted areas, but across the entire color space. Paper tint simulation is prevented when calculating the profile at the fulcrum (0/0/0/0), i.e. unprinted areas also remain unprinted after calculation of the profile, but the next fulcrum is calculated on the basis of the specified target values, and this can lead to undesired effects, especially in the highlights.

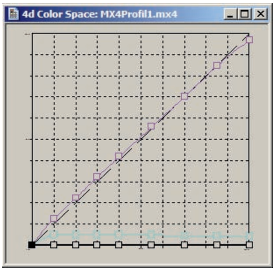
In the example below, a CMYK conversion profile is to be calculated for ISOuncoated (FOGRA29L, paper white L* = 95.71, a* = 0.61, b* = -2.32) to ISOuncoatedyellowish (FOGRA30L, paper white L* = 95.93, a* = -0.77, b* = 3.85). Comparison of the two color spaces in the GMG Gamut Viewer yields the following picture:



Comparison of the ISOuncoated color space (red lines) with ISOuncoatedyellowish (colored body)

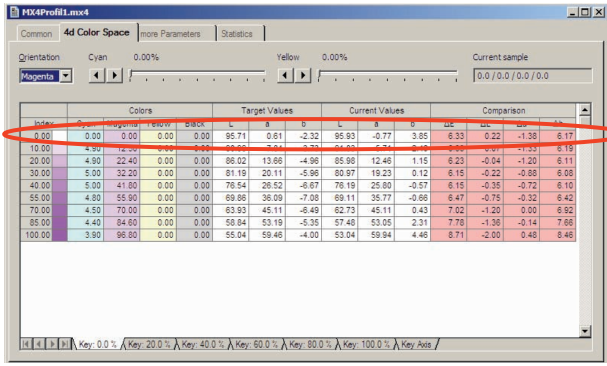
The visual comparison shows that the two color spaces are of roughly the same size, but have very different white points. ISOuncoated is defined by a more bluish white point (b* is negative) and ISOuncoatedyellowish by a more yellowish white point (b* is positive), i.e. the two color spaces are offset relative to each other on the b*-axis.

If the profile is now calculated with target values and preserving the separation, the following tonal gradation is obtained for 0 - 100% Magenta:



0 - 100% Magenta

To achieve the specified "bluish" target values for ISOuncoatedyellowish, Cyan is added to the calculation for the yellowish paper in the Magenta curve (upwards of 10% Magenta). Since the fulcrum (0/0/0/0) remains unchanged, this leads to breaks in the highlights. This effect is prevented by prior paper tint correction of the target values. As an example of how to do so, import the FOGRA30L (ISOuncoatedyellowish) characterization data as the current values, and FOGRA29L (ISOuncoated) as the target values on the *4d Color Space* tab of an MX4 file. Under *Compare*, you can then read off the resultant ΔE difference in the paper tint at the fulcrum (0/0/0/0):

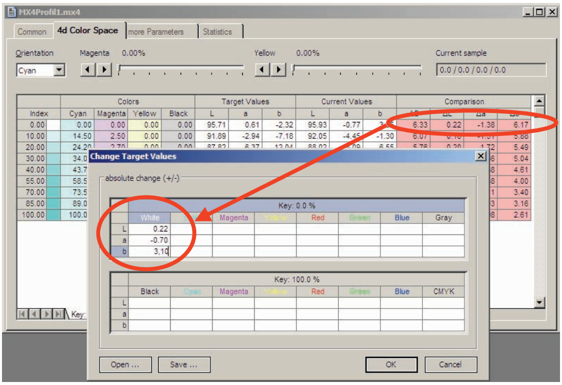


	Colors				Target Values			Current Values			Comparison			
Index	Cyan	Magenta	Yellow	Black	L	a	b	L	a	b	ΔE	ΔL	Δa	Δb
0.00	0.00	0.00	0.00	0.00	95.71	0.61	-2.32	95.93	-0.77	3.85	6.33	0.22	-1.38	6.17
10.00	4.90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-1.33	6.19
20.00	4.90	22.40	0.00	0.00	86.02	13.66	-4.96	85.98	12.46	1.15	6.23	-0.04	-1.20	6.11
30.00	5.00	32.20	0.00	0.00	81.19	20.11	-5.96	80.97	19.23	0.12	6.15	-0.22	-0.88	6.08
40.00	5.00	41.80	0.00	0.00	76.54	26.52	-6.67	76.19	25.80	-0.57	6.15	-0.35	-0.72	6.10
55.00	4.80	55.90	0.00	0.00	69.86	36.09	-7.08	69.11	35.77	-0.66	6.47	-0.75	-0.32	6.42
70.00	4.50	70.00	0.00	0.00	63.93	45.11	-6.49	62.73	45.11	0.43	7.02	-1.20	0.00	6.92
85.00	4.40	84.60	0.00	0.00	58.84	53.19	-5.35	57.48	53.05	2.31	7.78	-1.36	-0.14	7.66
100.00	3.90	96.80	0.00	0.00	55.04	59.46	-4.00	53.04	59.94	4.46	8.71	-2.00	0.48	8.46

Comparison of ISOuncoated (target values) and ISOuncoatedyellowish (current values)

In this example, the difference in the paper tint is ΔE = 6.33, which for the most part results from the different Δa and Δb values.

Now select *Tools* → *Change Target Values*. The following window then opens:



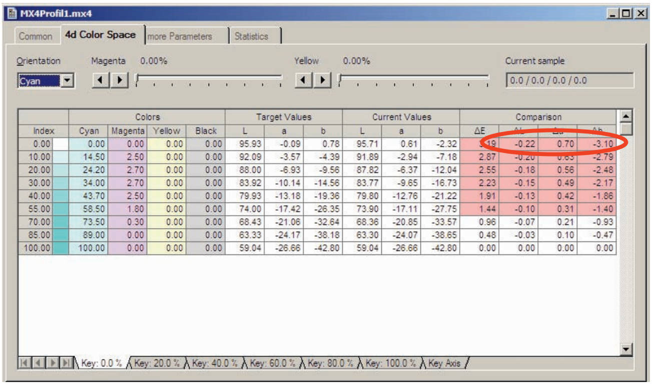
Paper tint correction in the target values

Under *Key 0.0%* → *White*, now adopt the values from the paper tint comparison for *Lab*.

☝ For paper tint correction, GMG recommends complete correction of the brightness difference ΔL, and adoption of half of the Δa and Δb values for the differences in color, as in the above example.

Now confirm with *OK*. The changes made here are calculated directly into the CIELab target values, and are incorporated proportionally into the profile over the entire effective range of 0 - 100%, starting from the paper tint. The solid tone itself is not affected by any correction.

The following differences are obtained when comparing the target values after correction / before correction:



	Colors				Target Values			Current Values			Comparison			
Index	Cyan	Magenta	Yellow	Black	L	a	b	L	a	b	ΔE	[illegible]	[illegible]	[illegible]
0.00	0.00	0.00	0.00	0.00	95.93	-0.09	0.78	95.71	0.61	-2.32	[illegible]	-0.22	0.70	-3.10
10.00	14.50	2.50	0.00	0.00	92.09	-3.57	-4.39	91.89	-2.94	-7.18	2.87	[illegible]	[illegible]	-2.79
20.00	24.20	2.70	0.00	0.00	88.00	-6.93	-9.56	87.82	-6.37	-12.04	2.55	-0.18	0.56	-2.48
30.00	34.00	2.70	0.00	0.00	83.92	-10.14	-14.56	83.77	-9.65	-16.73	2.23	-0.15	0.49	-2.17
40.00	43.70	2.50	0.00	0.00	79.93	-13.18	-19.36	79.80	-12.76	-21.22	1.91	-0.13	0.42	-1.86
55.00	58.50	1.80	0.00	0.00	74.00	-17.42	-26.35	73.90	-17.11	-27.75	1.44	-0.10	0.31	-1.40
70.00	73.50	0.30	0.00	0.00	68.43	-21.06	-32.64	68.36	-20.85	-33.57	0.96	-0.07	0.21	-0.93
85.00	89.00	0.00	0.00	0.00	63.33	-24.17	-38.18	63.30	-24.07	-38.65	0.48	-0.03	0.10	-0.47
100.00	100.00	0.00	0.00	0.00	59.04	-26.66	-42.80	59.04	-26.66	-42.80	0.00	0.00	0.00	0.00

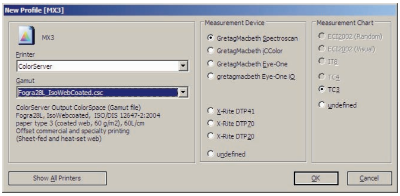
Comparison of corrected target values (Target Values) and original target values (Current Values)

Under *Compare*, the values resulting at the fulcrum (0/0/0/0) are exactly those specified during correction, the corrections becoming weaker and weaker towards the solid tone.

2.6. Creating an MX3 conversion profile

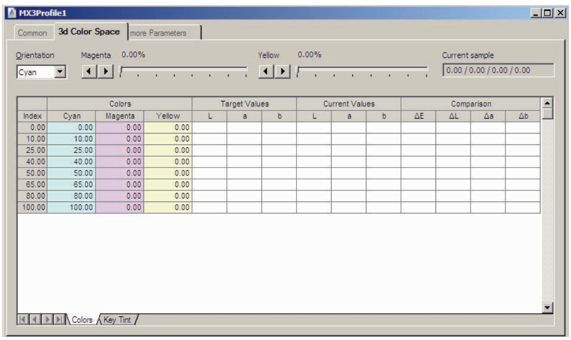
Unlike MX4 profiles, MX3 profiles are three-dimensional and contain no combinations of chromatic colors and Black (~ no achromatically composed colors). The Black channel is considered in complete isolation from the chromatic colors when calculating the profile, meaning that the MX3 profile also has a separation-preserving function.

By way of example, an MX3 conversion profile for ISOcoated to ISO-webcoated is created below. To this end, open a new MX3 profile in the GMG ColorServer Profile Editor with *File* → *New MX3*. The following window opens:



General settings for a new MX3 profile

Select *Printer* → *ColorServer*, and the required target color space under *Gamut*, in this case *Fogra28L_IsoWebCoated.csc*. Leave the setting *Measurement Chart* → *TC3*. A new MX3 file opens, in which the following fulcrums are created accordingly:

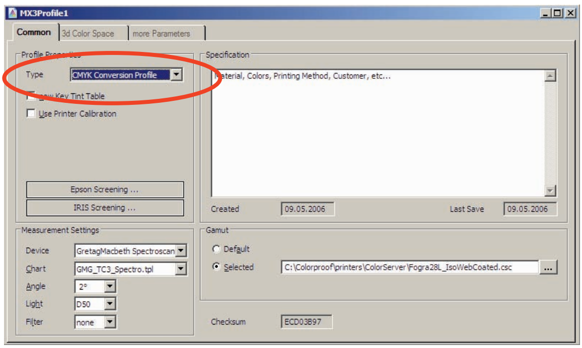


New MX3 file

In contrast to the MX4 profiles, there are no Key tabs in the *3d Color Space* view; only the Black channel can be selected under *Key Tint*.

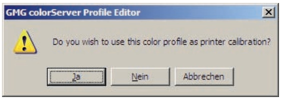
☝ If the profile is to be created on the basis of an ECI2002 test chart (e.g. if target values are to be imported from a FOGRA characterization file), not on the basis of a TC3 test chart, you must additionally create the fulcrums (20/30/55//70/85). You can create fulcrums with *Edit* → *Add Fulcrum*. The fulcrums (25/50//65/80) are then not needed and can be removed with *Edit* → *Delete Fulcrum....*

You can now use *Import/Export* → *Import Target Values* to import the required source color space, in this case the FOGRA27L characterization file as ISOcoated target values. Then switch to the *Common* tab of the MX3 file:



Common tab of the new MX3 profile

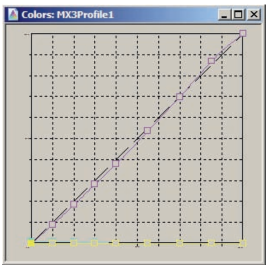
Make sure that you have selected *Type* → *CMYK Conversion Profile*. The *Fogra28L_IsoWebCoated.csc* file defined when opening the MX3 file is already selected under *Gamut*. Once the source and target color spaces have been defined, the profile can be calculated with *Measure* → *Calculate with Target Values*. The following message appears:



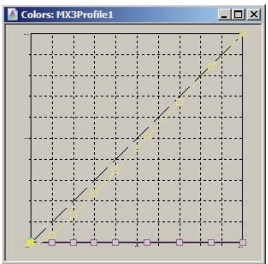
Message - Use of the color profile as printer calibration

Confirm this message with *Yes*. During profile calculation, the Black channel is then only adapted in terms of tonal value, retaining its monochromatic composition. If you confirm this message with *No*, the color of the Black channel is additionally adapted during calculation of the profile by adding chromatic colors (this normally not being wanted for this profile type).

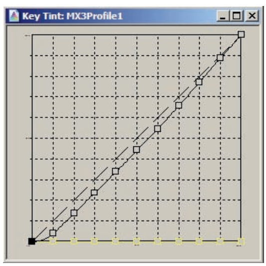
The following tonal gradations are obtained following calculation:



0 - 100% Magenta



0 - 100% Yellow

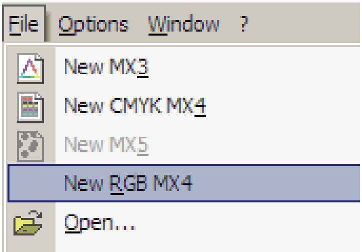


0 - 100% Black

The brightness of the chromatic colors is adapted via the gradation, the color being achieved by addition of small amounts of other chromatic colors. The Black channel retains its monochromatic composition, brightness differences being adapted via the gradation.

3. Creating an RGB separation profile

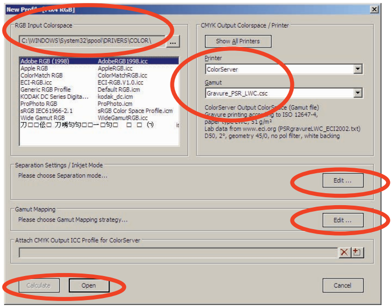
RGB separation profiles control color space conversion from an RGB to a CMYK color space. To create an RGB separation profile, select *File →* *New RGB MX4* in the GMG ColorServer Profile Editor:



Opening a new RGB MX4

3.1. Basic settings

The following window opens, in which all basic settings can be defined that are required for profile calculation (source and target color space, separation and Gamut Mapping settings).



Basic settings for a new RGB profile

By way of example, an RGB separation profile for AdobeRGB to Gravure_PSR_LWC (gravure printing on Light Weight Coated paper) is created below. GMG uses the following name format for separation profiles:

CS_sep_<RGB>_2_<CMYK>_V1.mx4

In this context, <RGB> denotes the source color space in which the data to be converted is present, while <CMYK> denotes the target color space into which the data will be converted. In this instance, the profile would thus be given the following name:

CS_sep_AdobeRGB_2_PSRLWC_V1.mx4

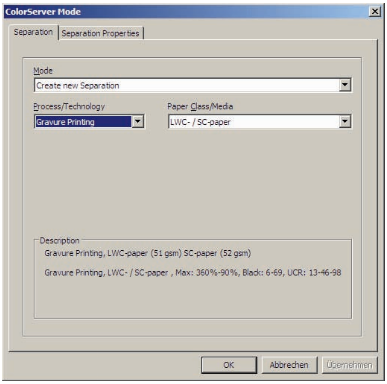
All RGB ICC profiles installed on the system are listed under *RGB Input Colorspace*. Accordingly, you have to select the *Adobe RGB* profile as the source color space here.

If the ICC profile cannot be selected there, you first have to install it on your system. To do so, mark the profile and use the right mouse button to select *Install Profile*. The profile is installed in the `C:\Windows\system32\spool\drivers\color\` directory and can then be selected when opening a new RGB MX4 file.

> Note that the RGB ICC profiles are only used for **importing** the RGB target values. Nevertheless, a GMG profile is still created here, not an ICC conversion profile!

Define the target color space under *CMYK Output Colorspace / Printer*. To do so, select *Printer* → *ColorServer*. Under *Gamut*, you can then select the `*.csc` Gamut Files for most standard printing conditions (similar to Chapter 2.1). Select the *Gravure_PSR_LWC.csc* file accordingly.

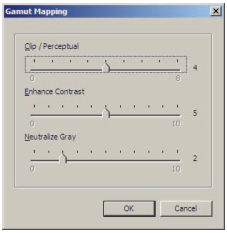
You can define the separation settings under *Separation Settings / Inkjet Mode*. Select *Edit* to do so. The following window opens:



Separation settings

The *Create new Separation* separation mode is available here for RGB separation profiles, and the predefined separation settings for the standard printing conditions are already included here (see Chapter 2.4). Accordingly, select *Process/Technology* → *Gravure Printing* and *Paper Class/Media* → *LWC- / SC-paper*. Confirm the settings with *OK*.

Back in the basic settings, you define the Gamut Mapping strategy under *Gamut Mapping*. Select *Edit* to do so. The following window opens:



Gamut Mapping controls

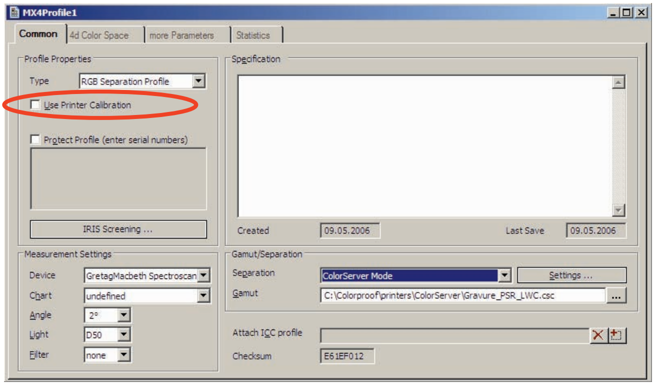
The common Gamut Mapping settings for RGB separation profiles are already predefined here. The values can, of course, be adapted by the user. The Gamut Mapping settings are explained in more detail in Chapter 4.

You can specify an ICC profile under *Attach CMYK Output ICC Profile*. After the processing of image data with GMG ColorServer, the profile is automatically attached to the converted image file. In subsequent processing steps (e.g. Adobe Photoshop, QuarkXPress), it is then possible to reconstruct the color space for which the output device-specific CMYK values are available.

Once you have defined the basic settings, you can either immediately *Calculate* the profile, or *Open* it first.

3.2. Structure of an RGB profile

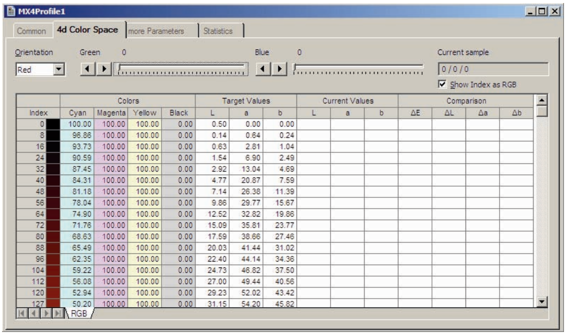
Open opens the MX4 file. Switch to the *Common* tab:



Common tab of the new RGB MX4 profile

Make sure that you have selected *Type* → *RGB Separation Profile*, and that the *Use Printer Calibration* checkbox is not activated. This function is only required for MX4 proofing profiles. The previously defined basic settings have already been adopted here. The *ColorServer Mode* must be selected under *Separation*. You can switch to the *Separation Properties* by clicking on *Settings*. The *Gravure_PSR_LWC.csc* Gamut File has already been selected accordingly under *Gamut*.

The Adobe RGB source color space has already been imported into the target values on the *4d Color Space* tab:



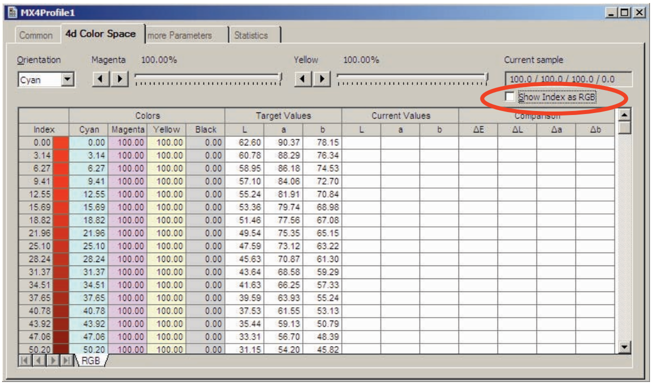
Index	Colors				Target Values			Current Values			Comparison			
	Cyan	Magenta	Yellow	Black	L	a	b	L	a	b	ΔE	ΔL	Δa	Δb
0	100.00	100.00	100.00	0.00	0.50	0.00	0.00							
8	96.86	100.00	100.00	0.00	0.14	0.64	0.24							
16	93.73	100.00	100.00	0.00	0.63	2.81	1.04							
24	90.59	100.00	100.00	0.00	1.54	6.90	2.49							
32	87.45	100.00	100.00	0.00	2.92	13.04	4.69							
40	84.31	100.00	100.00	0.00	4.77	20.87	7.59							
48	81.18	100.00	100.00	0.00	7.14	26.38	11.39							
56	78.04	100.00	100.00	0.00	9.86	29.77	15.67							
64	74.90	100.00	100.00	0.00	12.52	32.82	19.86							
72	71.76	100.00	100.00	0.00	15.09	35.81	23.77							
80	68.63	100.00	100.00	0.00	17.59	38.66	27.46							
88	65.49	100.00	100.00	0.00	20.03	41.44	31.02							
96	62.35	100.00	100.00	0.00	22.40	44.14	34.36							
104	59.22	100.00	100.00	0.00	24.73	46.82	37.50							
112	56.08	100.00	100.00	0.00	27.00	49.44	40.56							
120	52.94	100.00	100.00	0.00	29.23	52.02	43.42							
127	50.20	100.00	100.00	0.00	31.15	54.20	45.82							

New RGB profile with RGB index and target values already imported

In contrast to the CMYK profiles, an RGB index from 0 to 255 is used in this case (graduated in increments of 8). Any required tonal gradation can be displayed using *Orientation* and the *Green* and *Blue* slide controls (for *Orientation* → *Red*).

Alternatively, there is also the option of having the index displayed on a CMY basis. To do so, deactivate the *Show Index as RGB* checkbox, and the view in the profile will change as follows:

gmg color

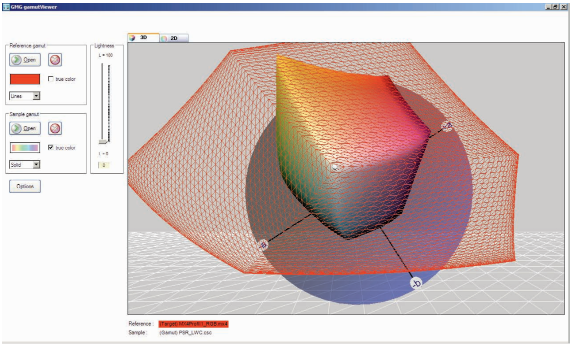


Index	Colors				Target Values			Current Values			Comparison			
	Cyan	Magenta	Yellow	Black	L	a	b	L	a	b	ΔE	ΔL	Δa	Δb
0.00	0.00	100.00	100.00	0.00	62.60	90.37	78.15							
3.14	3.14	100.00	100.00	0.00	60.78	88.29	76.34							
6.27	6.27	100.00	100.00	0.00	58.95	86.18	74.53							
9.41	9.41	100.00	100.00	0.00	57.10	84.06	72.70							
12.55	12.55	100.00	100.00	0.00	55.24	81.91	70.84							
15.69	15.69	100.00	100.00	0.00	53.36	79.74	68.98							
18.82	18.82	100.00	100.00	0.00	51.46	77.56	67.08							
21.96	21.96	100.00	100.00	0.00	49.54	75.35	65.15							
25.10	25.10	100.00	100.00	0.00	47.59	73.12	63.22							
28.24	28.24	100.00	100.00	0.00	45.63	70.87	61.30							
31.37	31.37	100.00	100.00	0.00	43.64	68.58	59.29							
34.51	34.51	100.00	100.00	0.00	41.63	66.25	57.33							
37.65	37.65	100.00	100.00	0.00	39.59	63.93	55.24							
40.78	40.78	100.00	100.00	0.00	37.53	61.55	53.13							
43.92	43.92	100.00	100.00	0.00	35.44	59.13	50.79							
47.06	47.06	100.00	100.00	0.00	33.31	56.70	48.39							
50.20	50.20	100.00	100.00	0.00	31.15	54.20	45.82							

RGB profile with CMY index

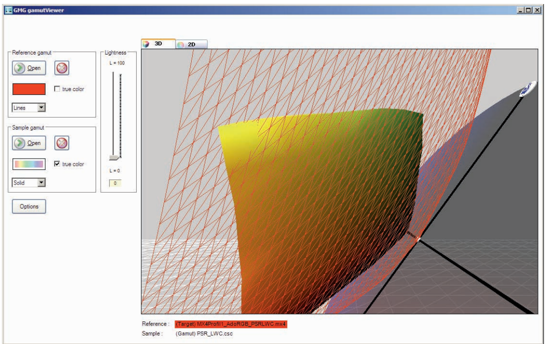
The index now shows the color values from 0 - 100% (graduated in 3.2% increments). Display of the respective color gradations is now controlled via *Orientation* and the *Magenta* and *Yellow* slide controls (for *Orientation → Cyan*).

If you select *Tools → Compare Gamut/Target Values*, the GMG Gamut Viewer opens with the following view:



Adobe RGB color space (red lines) compared with Gravure_PSR_LWC color space (colored body)

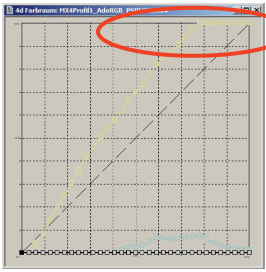
The visual comparison reveals that the Adobe RGB color space is far larger than the Gravure_PSR_LWC color space, but it does not cover it completely in the Yellow direction:



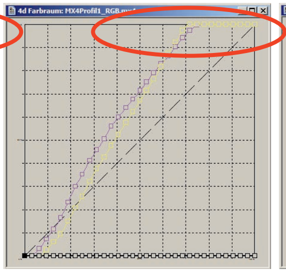
Adobe RGB does not cover the Gravure_PSR_LWC color space completely in the Yellow range

Now calculate the profile with *Measure → Calculate with Target Values*. Depending on your hardware configuration, this process may take quite some time.

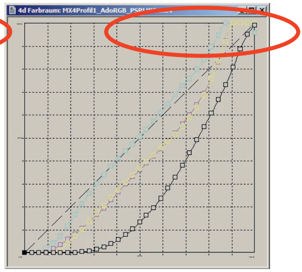
The following tonal gradations are obtained after calculation:



0 - 100% Yellow



0 - 100% Red



0 - 100% Gray

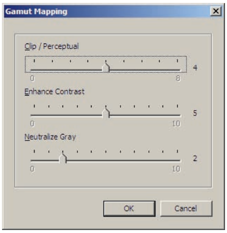
To achieve the AdobeRGB target values, 100% ink is already needed in the Gravure_PSR_LWC output color space for input tonal values of 70 - 80%. In other words, all colors are reproduced colorimetrically as far as possible, "out-of-gamut" colors being clipped and assigned to the edge of the (target) color space. Consequently, detail definition is no longer possible in the respective area upwards of these tonal values. In the event of calculation with target values, this situation always results if the source color space is substantially larger than the target color space. This does not provide satisfactory reproduction, which is why the profile has to be calculated using *Measure → Calculate with Gamut Mapping*. This is explained in detail in the following chapter.

4. Calculation with Gamut Mapping

In the preceding examples, the MX4 conversion or separation profiles were calculated with the respective target values. The specified target values of the source color space remain unchanged in this context.

You also have the *Measure → Calculate with Gamut Mapping* function at your disposal for conversion from a larger color space to a smaller one. GMG Gamut Mapping is based on the following strategy: In the first step, the CIELab target values, which are defined by the source color space, are adapted to the target color space in terms of their white and black points using special algorithms. The other "out-of-gamut" colors of the source color space are then transformed to the target color space on the basis of the user-defined Gamut Mapping settings. So, when calculating with Gamut Mapping, the target values defined by the source color space are adapted in such a way that they can be reproduced in the target color space. These "mapped" target values are then used to calculate the specific CMYK values of the target color space. In other words, the initially imported target values of the source color space are changed after calculation with Gamut Mapping.

If you have defined the Target Values/Gamut File and the separation settings, and then select *Measure → Calculate with Gamut Mapping*, the following window opens:



Gamut Mapping controls

It contains three controls that can be used to control the second step in Gamut Mapping.

When calculating with Gamut Mapping, the target values are adapted on the basis of the selected Gamut Mapping settings – which is why a new MX4 file opens for profile calculation. In this way, the originally imported data is preserved in the original MX4 file, which can be used as the basis for further profile calculations, e.g. using different Gamut Mapping settings ("master").

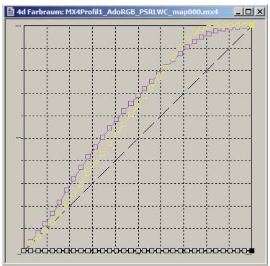
4.1. Clip/Perceptual Gamut Mapping control

If the *Clip/Perceptual* control is set to Level "0", the "out-of-gamut" colors are clipped and assigned to the edge of the color space (cf. Chapter 1.4.2). At Level "8", the "out-of-gamut" colors are reproduced at the edge of the color space in (maximally) compressed form, meaning that the detail definition in this area can be preserved. The *Clip/Perceptual* setting affects only the colors that are still "out-of-gamut" following initial adaptation of the white and black points. Colors within the color space are reproduced colorimetrically and no longer changed, if possible.

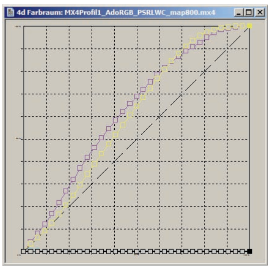
In contrast, **all** colors would be compressed in the case of ICC conversion with the "perceptual" Rendering Intent – even those that could in fact be reproduced colorimetrically.

The charts below illustrate the impact of different *Clip/Perceptual* settings on calculation of the RGB separation profile for AdobeRGB to Gravure_PSR_LWC, and calculation without Gamut Mapping for comparison:

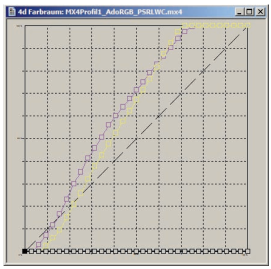
Tonal gradation 0 - 100% Red:



Clip/Perceptual Level "0"



Clip/Perceptual Level "8"



Without Gamut Mapping

Without Gamut Mapping, Red is already clipped at 70% in this instance. At *Clip/Perceptual* Level "0", the Red continues much farther with maximum colorimetric matching. At Level "8", the Red is compressed in the saturated areas in such a way that detail definition is preserved to the greatest possible extent, although the colors are not colorimetrically reproduced as exactly as at Level "0".

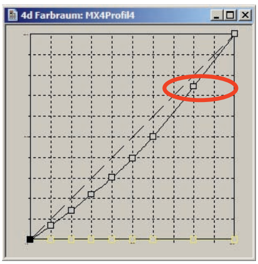
☝ Even if an image file is defined by a large color space, such as AdobeRGB, not every possible color of this color space need necessarily be used in the file. Consequently, there is mostly no need to use a high value for the *Clip/Perceptual* setting, since this would lead to excessive compression of the colors. GMG recommends use of a *Clip/Perceptual* Level between 2 and 5 for RGB profiles. No standard recommendation can be given for CMYK profiles. In this case, it is a question of how much larger the source color space is in comparison with the target color space. However, it is also advisable to use a *Clip/Perceptual* Level of no more than 5 here.

4.2. Enhance Contrast Gamut Mapping control

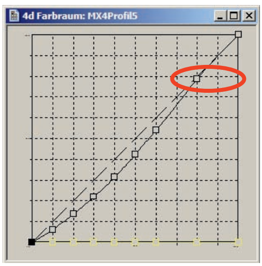
The *Enhance Contrast* control offers a further setting option for Gamut Mapping. In many cases, Gamut Mapping leads to a loss of contrast if the darkest (lightest) color in the CMYK target color space is much lighter (darker) than the darkest (lightest) color in the RGB source color space. As a result, the brightness range is reduced during profile conversion. The *Enhance Contrast* control additionally bends an "S-curve" into the brightness profile of the color space, i.e. the colors become lighter in the quarter tone and darker in the three-quarter tone. Level "0" keeps the axes almost linear, while Level "10" produces visible contrast enhancement.

☝ For creating RGB separation profiles, GMG recommends use of the standard Level setting "5". Please note that the colorimetric accuracy is reduced as a result, but a better visual match is obtained. No standard recommendation can be given for CMYK profiles, the setting again being very much dependent on the magnitude of the differences between the white and black points of the source and target color spaces. The greater the differences, the higher the value that should be selected for *Enhance Contrast*.

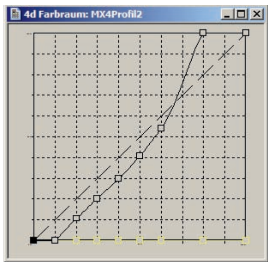
The charts below show the impact of different *Enhance Contrast* settings on the 0 - 100% Black tonal gradation when calculating a separation-preserving CMYK conversion profile for ISOcoated to ISOnewspaper26v4 (newspaper printing). The calculation without Gamut Mapping is shown for comparison:



Enhance Contrast Level "0"



Enhance Contrast Level "10"



Without Gamut Mapping

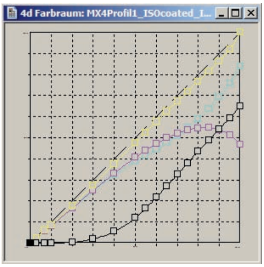
When calculating without Gamut Mapping, the Black already fills in at 80%. When calculating with Gamut Mapping, it can be seen that the tonal value for Black in the three-quarter tone was increased slightly at *Enhance Contrast → Level 10*, compared to Level 0. The tonal value was (slightly) reduced in the quarter tone.

4.3. Neutralize Gray Gamut Mapping control

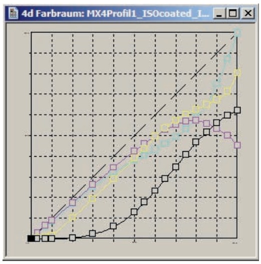
When calculating with Gamut Mapping, the white and black points of the source color space are mapped onto the target color space in the first step, but the Gray axis continues to run relative to the white point of the source color space. If the source color space is defined by a neutral white point, a neutrally calculated Gray axis likewise results during profile calculation. If the target color space is defined by a yellowish paper, for example, the calculated "neutral Gray axis" likewise appears yellowish on the yellowish paper.

For certain applications, however, it may make sense for the Gray axis also to appear neutrally on the yellowish paper, e.g. if an image is to be printed both by the offset process on white paper and by the gravure process on yellowish paper, but the visual impression is to be identical in both cases. In such cases, Gamut Mapping can be calculated with the *Neutralize Gray* function: At Level 0, the Gray axis of the source color space is adopted, whereas the Gray axis is kept as neutral as possible at Level 10, i.e. the tonal value for Yellow has to be reduced accordingly for a yellowish paper. The charts below show the effects that result when calculating ISOcoated (paper white L* = 95.97; a* = 0.5; b* = -3.3) to ISOuncoatedyellowish (paper white L* = 90.65; a* = -0.09; b* =

3.16) using different Levels for *Neutralize Gray*. ISOcoated is defined by a "bluish" paper (b* is negative), ISOuncoatedyellowish by a "yellowish" paper (b* is positive).



Neutralize Gray Level 0



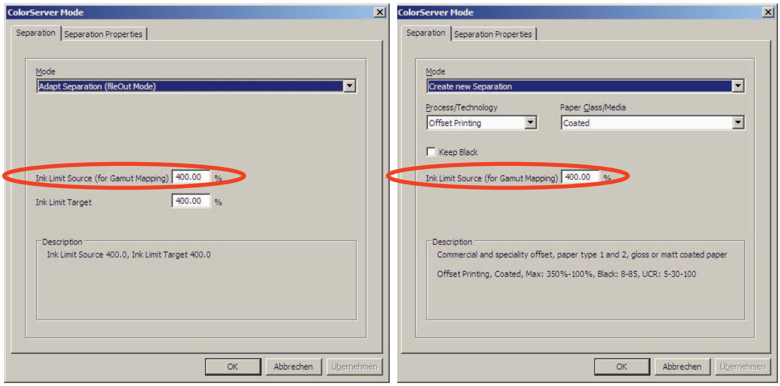
Neutralize Gray Level 10

Neutralize Gray Level 0 results in a yellowish Gray axis for the yellowish paper. At Level 10, the tonal value of the Yellow is reduced, the Gray axis appearing more neutrally on the yellowish paper.

Since the human eye adjusts adaptively to different conditions (~ White alignment), a yellowish Gray axis on yellow paper also appears to be "neutral". For practical purposes, this means that *Level 5* for *Neutralize Gray* is sufficient in the majority of cases. To compensate for a slight color cast, GMG recommends Level 2 for *Neutralize Gray* with white papers, and Level 3-5 for yellowish papers.

4.4. Other Gamut Mapping settings

For CMYK conversion profiles calculated with Gamut Mapping, an *Ink Limit Source (for Gamut Mapping)* has to be defined in the separation settings for the *Adapt Separation* and *Create new Separation* separation modes.



Definition of the ink limit of the source color space for calculation with Gamut Mapping

At this point, enter the total ink application (ink limit) used as standard for the respective printing conditions (source color space!).

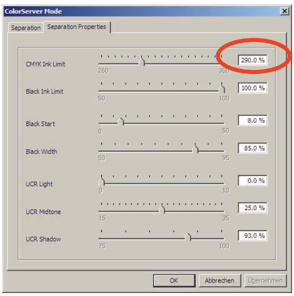
5. Additional functions

5.1. User-defined separation settings

In the *Create new Separation* mode, all settings for the Black composition can be adapted within predefined limits. The following is a step-by-step description of the impact of user-defined changes in the individual separation settings on the calculation of a reseparation profile. The tonal gradations illustrated result when calculating a reseparation profile for ISOuncoated (see Chapter 2.4.2).

5.1.1. Reducing the total ink application

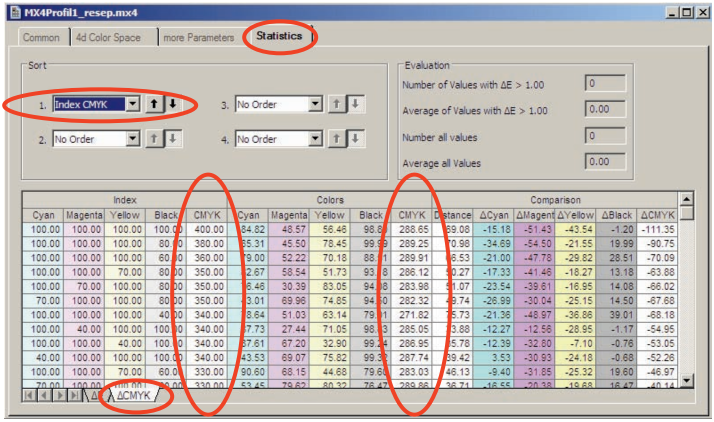
For this purpose, leave the separation settings of the ColorServer Mode unchanged at *Create new Separation* → *Offset Printing* → *Uncoated* and *Ink Limit Source (for Gamut Mapping)* → *400%*, and, by way of example, enter *CMYK Ink Limit* → *290%* on the *Separation Properties* tab.



Changing the ink limit (total ink application)

Now calculate the profile with the target values. Then switch to the *Statistics* tab of the MX4 color profile, and select the *ΔCMYK* tab there. You can sort the values according to specific criteria here.

If you would now like to check the reduction of the total ink application, select *Sort* → *1.* → *Index CMYK*, and additionally the "down arrow". The input color values are displayed under *Index CMYK*, whereas *Colors CMYK* shows the output color values:



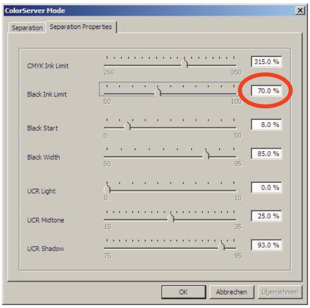
Checking the reduction of the total ink application

In this instance, the total ink application for all values was calculated as a maximum of 290%.

To obtain harmonious reduction of the total ink application, the profile must additionally be calculated with a high *Black Width*, a high value for *Black Ink Limit* and a high value for *UCR Shadow*.

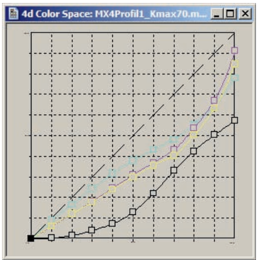
5.1.2. Changing the Black Ink Limit

Switch back to the separation settings of the ColorServer Mode, leave the predefined Separation Properties unchanged, and change only the *Black Ink Limit* to *70%*. This means that the maximum tonal value used for Black is restricted to *70%*.

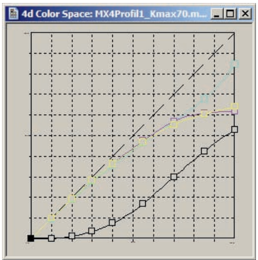


Restriction of the Black Ink Limit

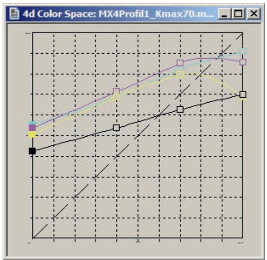
This need not necessarily be ideal for the selected printing conditions, but it clearly illustrates the influence of this option on calculation of the profile. The following tonal gradations are obtained after calculation with the target values (without the *Keep Black* function):



0 - 100% Black



0 - 100% CMY Gray

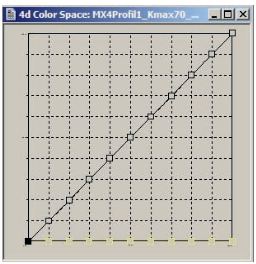


0 - 100% CMY + 80% Black

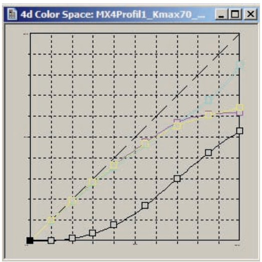
The tonal value for Black was calculated based on a maximum of 70%.

Keep Black option

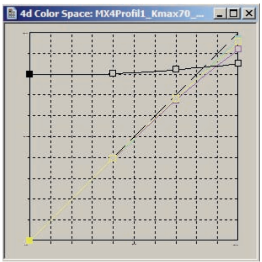
If the calculation is additionally performed using the *Keep Black → Maximum* option, the following tonal gradations result:



0 - 100% Black



0 - 100% CMY Gray



0 - 100% CMY + 80% Black

Pure Black is preserved in this case. The Keep Black function has no effect on the pure CMY Gray (see Chapter 2.4.1). Only in the CMY plus 80%

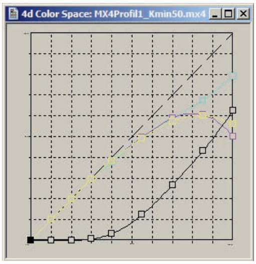
Black range can it be seen that Keep Black has higher priority in this case than the reduction of the maximum tonal value to 70%.

☝ Please note that the reduction of the value for *Black Ink Limit* behaves contrarily to the *UCR*, *Ink Limit* and *Keep Black* options, since the Black is to be limited in the shadows, whereas CMY is to be replaced by Black, or the Black is to be preserved. Consequently, GMG recommends use of the predefined separation settings, since these always lead to sensible results.

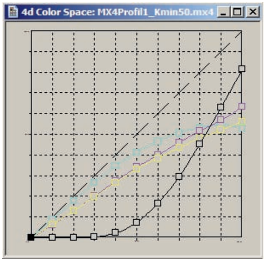
5.1.3. Changing the Black Start

This option is suitable for applications where too much Black in the highlights lead to graying of these areas, or of skin tones. Also, an early starting point for Black can lead to noise in the highlights, e.g. in newspaper printing. Moreover, if too much Black is used, there is little room for color corrections on the press.

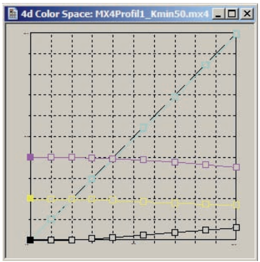
Switch to the separation settings of the ColorServer Mode, leave the predefined separation settings for *Create new Separation* → *Offset Printing* → *Uncoated*, and only change the *Black Start* to *50%*. This value would be fairly untypical for most applications, but it most clearly visualizes the impact on profile calculation.



0 - 100% CMY

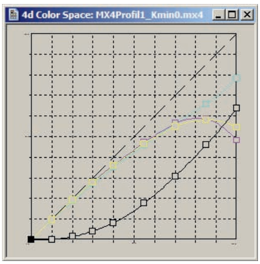


0 - 100% Black

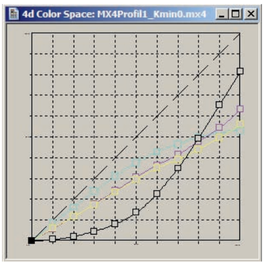


0 - 100% Cyan + 40M + 20Y

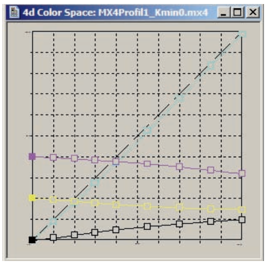
The effect of the settings is that, when calculating the profile, Black is not used in the highlights, but only upwards of the specified value. To obtain a homogeneous Black gradation, Black already starts at 40% in this instance. For comparison, here is the same profile again, but calculated with a starting point of 0% Black:



0 - 100% CMY



0 - 100% Black

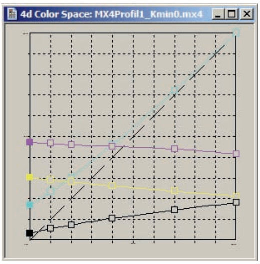


0 - 100% Cyan + 40M + 20Y

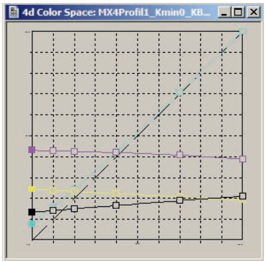
Here, Black is also used in the highlights. In darker image areas, the two profiles with the different starting points differ only insignificantly.

Keep Black option

If the profile is additionally calculated with the *Keep Black* option, this results in the following differences in the tonal gradation at 0 -100% Cyan plus 40% Magenta, 20% Yellow and 20% Black:



Without Keep Black

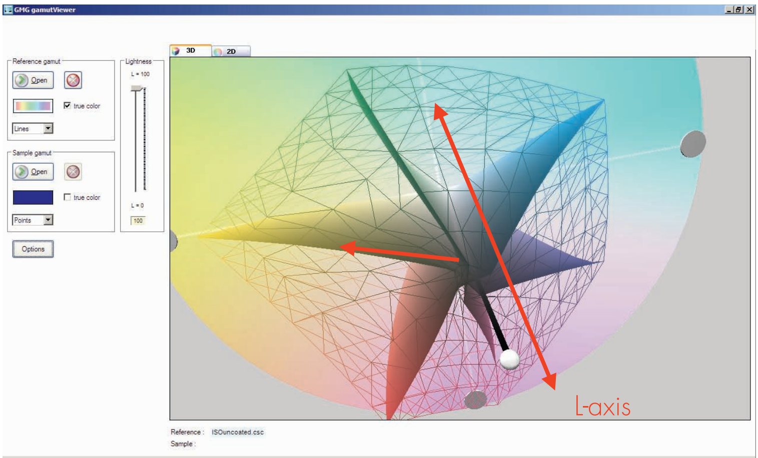


With Keep Black

In the case of achromatically composed colors, Keep Black has higher priority than the starting point for Black. Keep Black has no effect in the case of pure CMY colors (see Chapter 2.4), which is why no differences result in these colors when calculating the profile with/without the Keep Black function.

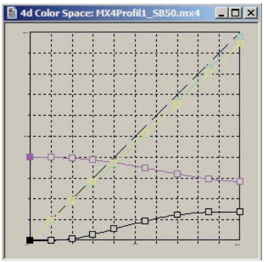
5.1.4. Changing the Black Width

The *Black Width* indicates the effective width of the Black composition. A narrow width results in only neutral shadows (Gray) being composed with Black, whereas a higher value means that Black is also included in other tertiary colors. The effective range is partly defined by the starting point for Black.

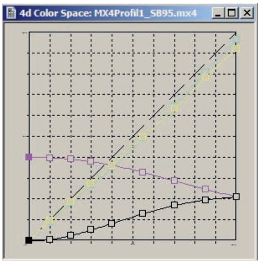


ISOuncoated color space in the GMG Gamut Viewer, indicating the color space axes

The visual effect of the Black Width can be seen very clearly when examining the "ISOuncoated.csc" color space in the GMG Gamut Viewer: with a narrow Black Width, Black is only used in the vicinity of the L-axis; the higher the Black Width, the more Black is also included in the areas towards the edge of the color space. Consequently, the Black Width has an effect on the use of Black in the tertiary colors. If the profile is now calculated with different Black Widths – in this case with the two extreme values of 50% and 95% by way of example – the following tonal gradations are obtained at 0 - 100% Green plus 40% Magenta and 0% Black:

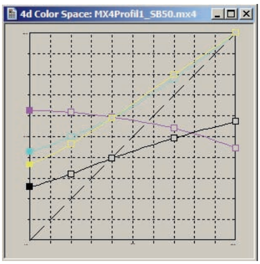


Black Width 50%

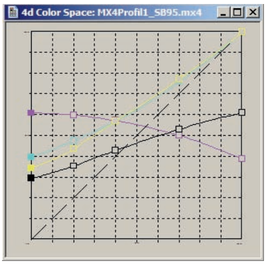


Black Width 95%

With a higher Black Width, more Black is used. This can also be seen in the following charts for 0 - 100% Green plus 40% Magenta and 60% Black:



Black Width 50%

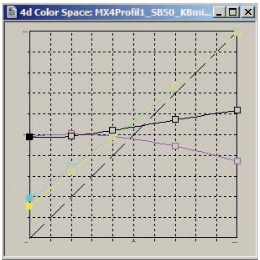


Black Width 95%

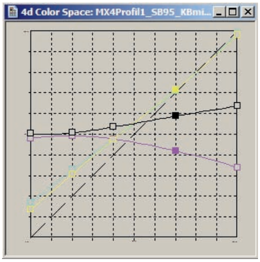
The difference in the Black Width has less effect on colors containing large amounts of Black than on colors containing little or no Black.

Keep Black option

If the profile is additionally calculated with the *Keep Black* option, the following slight differences result for different Black Widths in the tonal gradations at 0 - 100% Green plus 40% Magenta and 60% Black:



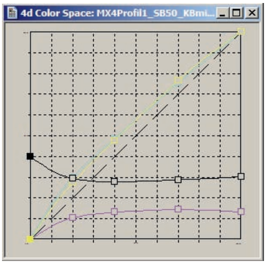
Black Width 50%



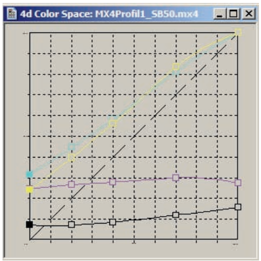
Black Width 95%

The difference in the Black Width has hardly any impact here, since the Keep Black function has higher priority in the achromatically composed colors (similar to Chapter 2.4.1).

At 0 - 100% Green plus 40% Black, the following differences result when calculating the profile with a Black Width of 50% with/without the Keep Black function:



With Keep Black



Without Keep Black

Due to using Keep Black, far more Black is additionally used from the outset, the chromatic color component being reduced accordingly.

5.1.5. UCR settings

UCR settings can be defined separately for Light, Midtone and Shadow areas in a range matched to the respective printing process parameters and printing medium.

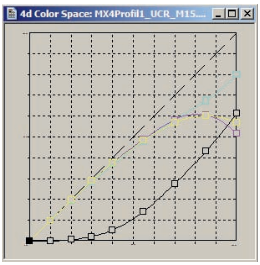
UCR Light

The settings for *UCR Light* have an effect only in the highlight areas of the tertiary colors and achromatically composed colors. The chromatic color component is replaced by Black in this range. If, for example, a CMYK reseparation profile for ISOuncoated is calculated with the two extreme values *0%* and *10% UCR Light*, the differences between the two UCR settings can best be seen in the Black channel, where there are differences in the tonal value range from 0 - 60%. The differences are greatest in the 30% tonal value range, declining harmoniously before and after.

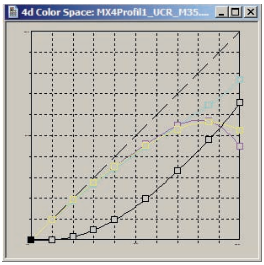
☝ Please note that the *UCR Light* option and the *Black Start* option must be coordinated. The earlier the starting point for Black is selected, the better the chromatic color component in the highlights can be reduced.

UCR Midtone

The settings for *UCR Midtone* primarily affect the midtones of the tertiary colors and achromatically composed colors. The chromatic color component is replaced by Black in this range. If, for example, the CMYK reseparation profile for ISOuncoated is calculated with the two extreme values *15%* and *35% UCR Midtone*, the maximum differences between the two UCR settings are to be seen in the tonal value range in the region of 55%. The values decrease harmoniously before and after. The tonal gradation for 0 - 100% CMY Gray with different UCR settings is shown below:

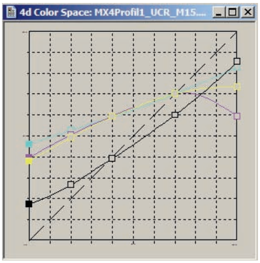


UCR Midtone 15%

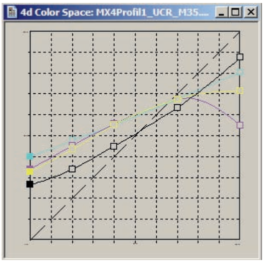


UCR Midtone 35%

The following are the tonal gradations for CMY Gray at 60% Black:

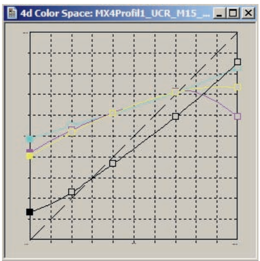


UCR Midtone 15%

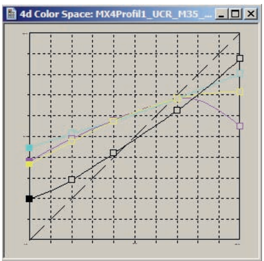


UCR Midtone 35%

If the starting point for Black is additionally moved backwards, e.g. to 50% in the diagrams below, the Black component is reduced again. This setting behaves contrarily to the UCR settings. The resulting tonal gradations for CMY Gray at 60% Black are shown below:

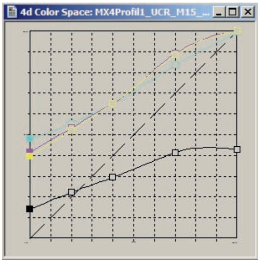


UCR Midtone 15%

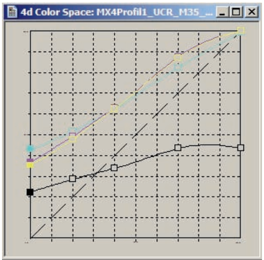


UCR Midtone 35%

Restriction of the *Black Ink Limit* to a particular value likewise behaves contrarily. The following illustration is based on a profile that was additionally calculated with *Black Ink Limit → 50%*. The tonal gradation for CMY Gray with 60% Black is shown below:

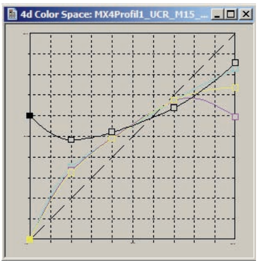


UCR Midtone 15%

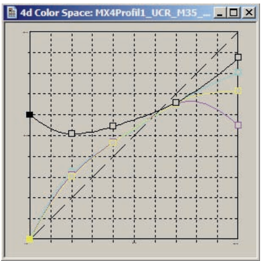


UCR Midtone 35%

If the *Keep Black → Minimum* option is activated alternatively, the following tonal gradations are obtained for CMY Gray with 60% Black:



UCR Midtone 15%



UCR Midtone 35%

Again, Keep Black has top priority with regards to achromatically composed colors, the result being that only marginal differences are seen with different UCR settings.

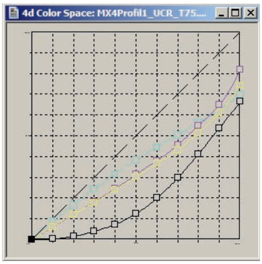
☝ If the *Keep Black* option is activated, additionally increasing the *UCR Light* and *Midtone* settings will result in further reduction of the chromatic colors, but this is usually only marginal, and a check must be made in each instance to determine whether it is at all capable of achieving the desired effects.

UCR Shadow

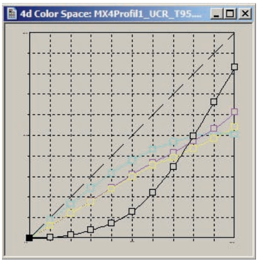
The settings for *UCR Shadow* primarily affect the shadows of the tertiary colors and achromatically composed colors. If, for example, the CMYK reseparation profile for ISOuncoated is calculated with the two extreme values *75%* and *95% UCR Shadow*, the maximum differences between the two UCR settings can be seen in the tonal value range in the region of 100%. The values decline harmoniously before this point. The difference in the tonal value for Black between the two UCR settings begins upwards of 50%, reaching a tonal value difference of 17% in the Black in this example.

☝ To obtain most UCR Shadow effect, the value for the Black Ink Limit should be set simultaneously as high as possible.

The following charts show the tonal gradation from 0 to 100% Black, calculated with different UCR settings:

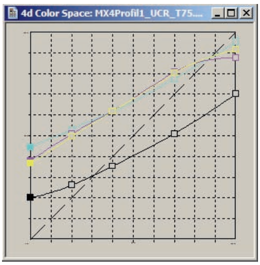


UCR Shadow 75%

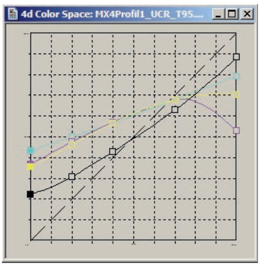


UCR Shadow 95%

0 - 100% CMY Gray with 60% Black:



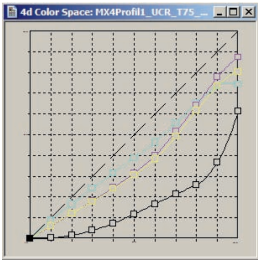
UCR Shadow 75%



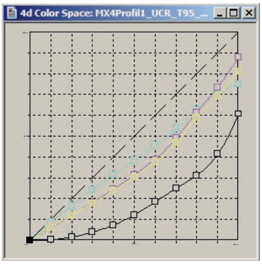
UCR Shadow 95%

The higher the value for *UCR Shadow*, the greater the amount of Black used in place of the chromatic colors in this area.

If the value for the Black Ink Limit is now additionally reduced (again to the extreme value of 50% in this case), the following tonal gradations are obtained for 0 - 100% Black:

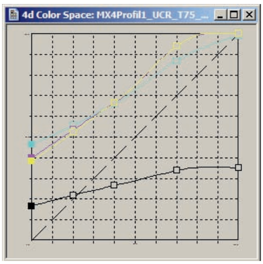


UCR Shadow 75%

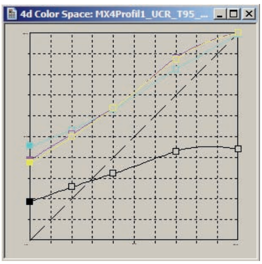


UCR Shadow 95%

0 - 100% CMY Gray with 60% Black:



UCR Shadow 75%



UCR Shadow 95%

Restriction of the *Black Ink Limit* to a particular tonal value reduces the Black component again, but this behaves contrarily to the *UCR Shadow* option. As a result, the chromatic color component cannot be reduced and replaced by Black to such a great extent.

5.2. Visual checking of the color profiles

5.2.1. Checking the separation settings

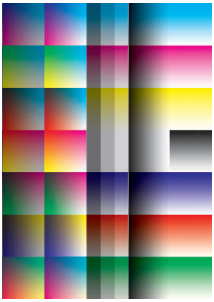
The different separation settings can be visually checked on the basis of two test files:

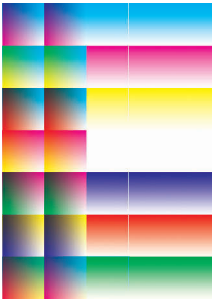
- *GMG_CMYK_smoothCheck_V1.tif*
- *GMG_RGB_smoothCheck_V1.tif*

The test files are available for downloading in the Support area at *www.gmgcolor.com* and contain various color gradations. The smoothness of the individual color channels after conversion permits conclusions to be drawn regarding the quality of the separation settings.

By way of example, the following diagrams illustrate the differences that result when converting from ISOcoated to ISOwebcoated with ICC profiles, on the one hand, and with the *CS_con_Iso27L_2_Iso28L_V2.mx4* color profile from GMG, on the other. The profile was calculated using the *Keep Separation* separation mode.

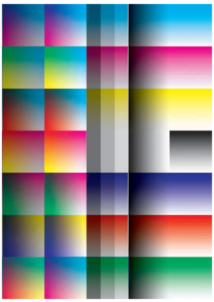
Original file:

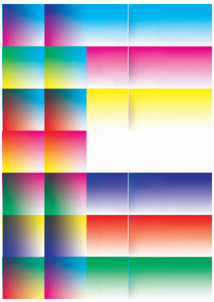

CMYK


CMY color separations


Black separation

After conversion using the GMG color profile:

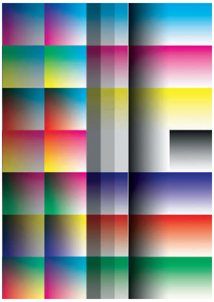

CMYK


CMY color separations

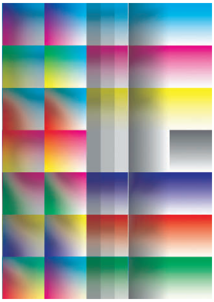

Black separation

The Black channel is preserved here, and the chromatic color component was additionally replaced by Black in areas of high ink application.

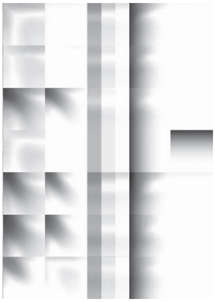
After conversion using ICC profiles:



CMYK



CMY color separations



Black separation

Distinct breaks and edges in the individual separations can be seen in the test file here, in addition to which the Black channel is composed of four colors following conversion.

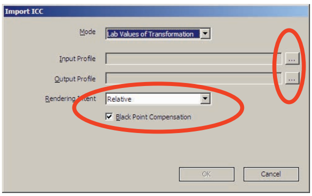
5.2.2. Checking the color conversion

The color conversion can also be checked visually. To do so, process a test file – e.g. the Altona Test Suite – in GMG ColorServer using the respective color profile (e.g. the "CS_con_Iso27L_2_Iso31L_V1.mx4" profile). Subsequently output the processed file on a proofing system, using the proofing profile that describes the target color space of the conversion profile (i.e. the proofing profile for ISOcofcoated/FOGRA31L in this example). Then compare the proof with a reference print in order to check the quality of color conversion (in this case, for example, the reference print of the Altona Test Suite for ISOcofcoated/FOGRA31L). If differences can still be determined visually, you can in some cases adapt the profile by iterative measurement, or perform color corrections. The procedure for this is described in Chapter 5.6.

5.3. Additional ICC import functions

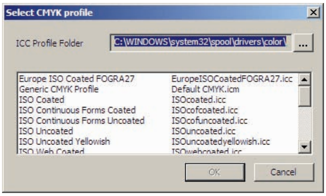
5.3.1. Import of Lab transformation values

The *Lab Values of Transformation* can also be imported from ICC profiles. In other words, the CIELab values are imported that result on the basis of the ICC Gamut Mapping method:



Import of the Lab values of transformation

Select the ICC profile of the source color space under *Input Profile*, and the profile of the target color space under *Output Profile*. Clicking on the marked selection icon automatically opens the `C:\WINDOWS\system32\spool\drivers\color\` directory, which contains all the ICC profiles installed on your system.

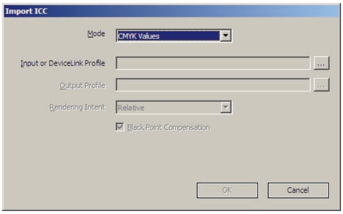


Installation directory for ICC profiles

Specify a *Rendering Intent* that defines the ICC Gamut Mapping method (see Chapter 1.4.2). You can additionally select the *Black Point Compensation* function, which influences the absolute and relative colorimetric Rendering Intents. In ICC Gamut Mapping, this results in not only the white points of the two color spaces being mapped onto each other, but also the black points. Confirm the settings with *OK*.

5.3.2. Import of CMYK values

Another option is the import of the *CMYK Values* calculated when converting via ICC profiles. In this context, you use the separation settings defined in the ICC profiles. To do so, define the *Input Profile* and *Output Profile*, and a *Rendering Intent*. In addition, you can again activate the *Black Point Compensation* function here.

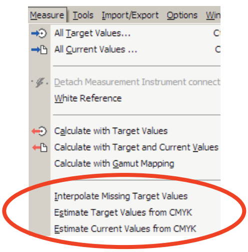


Import of the CMYK values from an ICC profile

If you confirm your settings with *OK*, the CMYK values are imported into the MX4 file.

5.4. Interpolating target values / Estimating from CMYK

The GMG ColorServer Profile Editor offers you additional useful functions: If you want to add further fulcrums to a color profile, but have no target values for the purpose, you can use *Measure → Interpolate Missing Target Values* to have the software calculate the missing target values.

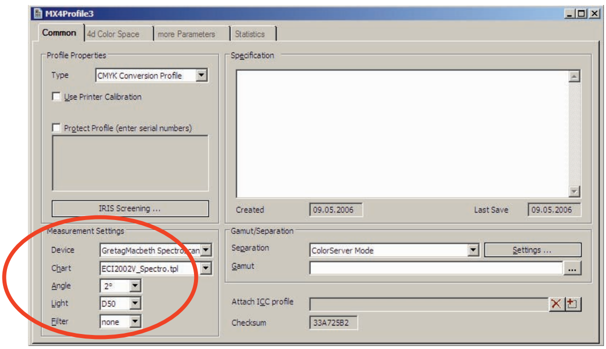


Measure menu

If you only have certain CMYK color values, but no CIELab target values, you can specify a Gamut File and calculate the target or current values from the CMYK color values. To do so, select *Measure → Estimate Target / Current Values from CMYK.*

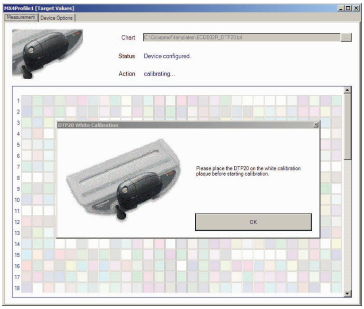
5.5. Measuring in the GMG ColorServer Profile Editor

If you do not want to import color values for profile calculation from a characterization file or an ICC profile, you can also determine them by measuring on the basis of a test chart on a reference print. To do so, define the measurement device used, the measurement settings, and the measurement chart (template) on the *Common* tab of the MX4 file. The measurement chart must, of course, correspond to the test chart used on the reference print.



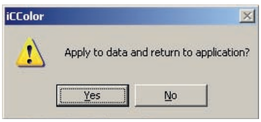
Definition of the measurement settings on the Common tab of the MX4 profile

Start the measurement with *Measure → All Target Values*. The measurement dialog window opens. Follow the instructions on the screen:



Measurement dialog window

Please note that the above illustration may vary, depending on the measurement device and measurement chart used. The following message appears when the measurement is complete:



Accepting the measurement data

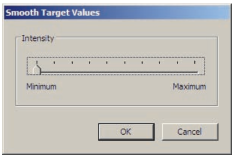
Accept the data by confirming with *Yes*. If you respond to the message by clicking on *No*, the measured values are discarded, and the measurement has to be started again.

If you want to repeat the measurement several times, or measure several reference prints, in order to average the values, export the target values just measured via *Import/Export* → *Export Target Values* → *Text File.*

Subsequently select *Tools* → *Reset Target Values* and repeat the measurement. Export the target values with a different file name or prefix after each measurement.

You can now import the text files together using *Import/Export* → *Import Target Values*. To do so, mark all the files at once, and confirm the import with *OK*. The measurements are now averaged automatically.

Alternatively, you can also smooth the target values. Select *Tools* → *Smooth Target Values* to do so. You have a choice of 5 intensity levels, from *Minimum* to *Maximum* for this purpose.



Intensity of target value smoothing

To check how much the unsmoothed values differ from the smoothed ones, the measured original target values can be exported as a text file beforehand and imported again as current values after smoothing. Under *Compare* on the *Statistics* tab of the MX4 file, you can subsequently check the resultant ΔE (and ΔL, Δa, Δb) values for each index value.

5.6. Optional optimization of the color profile

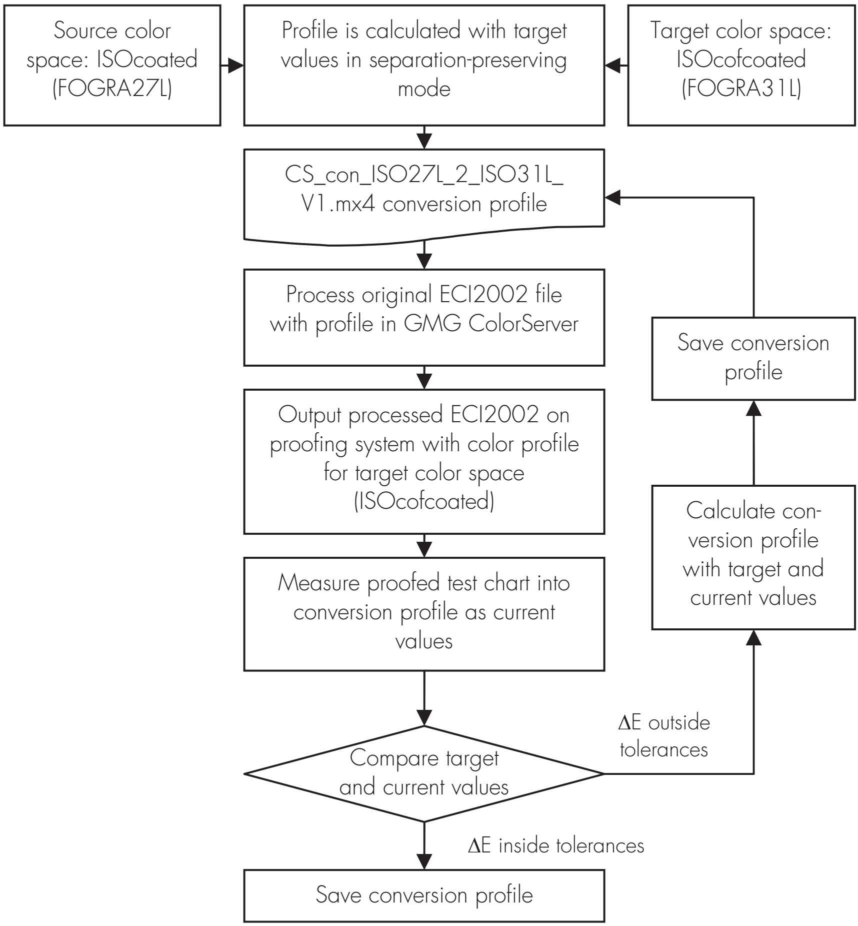
So far, the color profiles have been determined purely mathematically. If you have a proofing system at your disposal, you have the option of checking/optimizing certain color profiles by measuring a test chart or visually on the basis of a proof. Normally, however, purely mathematical creation of a color profile is entirely sufficient.

5.6.1. Iterative colorimetric optimization

The separation-preserving "CS_con_Iso27L_2_Iso31L_V1.mx4" profile created in Chapter 2.2 is to be optimized by measuring in the example below.

> ☝ Since the aim of iterative colorimetric optimization is to obtain a colorimetric "match" between the target and current values in the conversion profile, a very good proofing profile for the target color space must be available. However, this optimization only makes sense for CMYK conversion profiles that were calculated in separation-preserving mode and without Gamut Mapping.

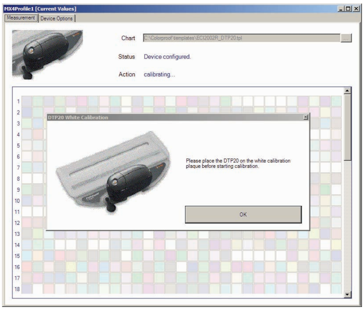
The chart below schematically illustrates the workflow for this iterative colorimetric optimization:



Schematic workflow for iterative colorimetric optimization

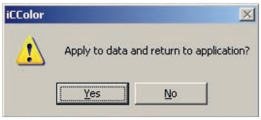
Enter a test chart file, e.g. *ECI2002V_<measurement device name>.tif*, to be found under `C:\Colorproof\Testcharts\`, and process it in GMG ColorServer using the MX4 conversion profile created. The converted test chart is subsequently output on a proofing system with the respective color profile for the target color space, in this case ISOcofcoated (FOGRA31L).

The output test chart is now measured into the conversion profile as the current values. To do so, open the profile in the GMG ColorServer Profile Editor and set the *Measurement Device* used, the *Measurement Chart* and the *Measurement Settings (Angle, Light, Filter)* on the *Common* tab of the profile. Then switch to the *4d Color Space* tab and select *Measure → All Current Values …* . The following window opens:



Measurement dialog window

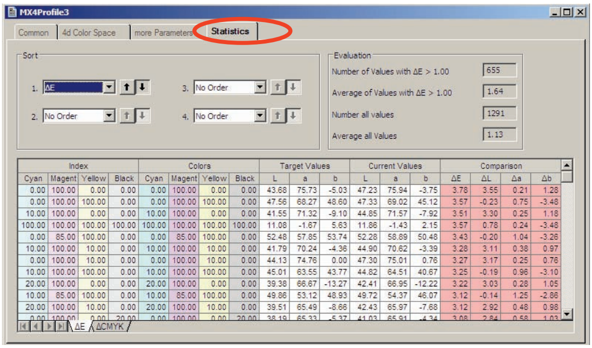
Please note that the above illustration may vary, depending on the measurement device and measurement chart used. Follow the instructions in the measurement dialog window. The following message appears when the measurement is complete:



Accepting the measurement data

Accept the data by confirming with *Yes*. If you respond to the message by clicking on *No*, the measured values are discarded, and the measurement has to be started again.

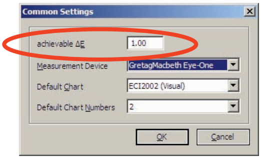
The measured values have now been automatically transferred to the profile as the current values. If you now switch to the *Statistics* tab in the color profile, you can see the ΔE differences between the target and current values.



Comparison of the target and current values in the MX4 profile

If the values are not within the required tolerance, the profile can be calculated again with *Measure → Calculate with Target and Current Values*.

Please note in this connection that a value for the *Achievable ΔE* can be entered under *Options → Common Settings*:



Common settings for measurement devices

In this context, all target and current values in the profile that are above this value are calculated once again, while all values below it are left unchanged. You should specify ΔE = 0 here when calculating the profile. In this way, all values are calculated, and breaks and edges in the profile are avoided.

Save the profile after calculation, and then process the (original) test chart in GMG ColorServer again, repeating the procedure described above (proof output, measurement, calculation) until the ΔE differences are within the required tolerances.

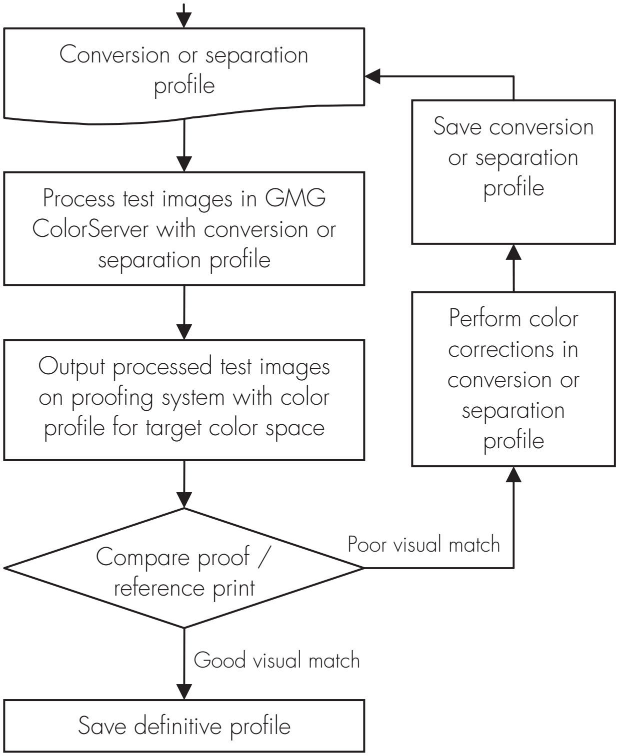
In the case of profiles calculated with Gamut Mapping, the target values of the source color space are modified in the profile on the basis of the Gamut File of the target color space. However, the objective in this context is not colorimetric conversion, but to obtain a good visual match. In this case, additional colorimetric optimization would again have the opposite effect. The same also applies if the target values have been modified by target value correction.

5.6.2. Visual optimization

Another option is visual optimization of a color profile with the help of a proofing system.

Please note that this procedure is again only recommended if a very good proofing profile is available for the target color space!

The chart below is a schematic representation of the workflow for visual optimization:

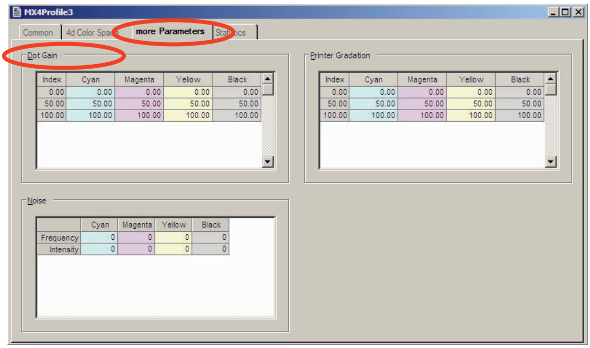


Schematic representation of visual optimization

To visually optimize an MX4 conversion or separation profile, you should have a reference print with various test images for the respective (CMYK) target color space. Process the test images (which must be in the source color space for this purpose) in GMG ColorServer with the respective conversion or separation profile, and subsequently output the converted test images with the proofing profile for the respective target color space. Now compare the proof and the reference print. In the event of a poor visual match, you can correct the profile as follows:

More Parameters tab

Switch to the *more Parameters* tab in the MX4 profile:



More parameters of an MX4 file

Global color corrections are entered under *Dot Gain*. This allows you to correct a global color cast and the Gray axis. These corrections apply across the entire color space. You can make the color corrections in the axes either in the table, or by using the mouse in the chart view. To add further fulcrums here, click in the *Dot Gain* table, select *Edit → Add Fulcrum...*, and indicate the required fulcrum.

If you select *Tools* → *Show Chart View*, the chart of the tonal gradations is opened:

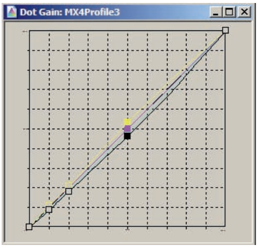


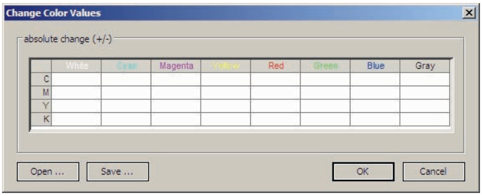
Chart view of the dot gain

You can use the mouse to shift the individual fulcrums here. All corrections entered in the *Dot Gain* window are not incorporated into the conversion table and are preserved separately, meaning that the corrections can be reconstructed at any time.

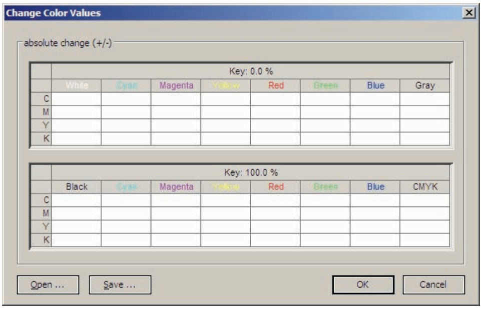
As a rule, no changes are necessary under *Noise* and *Printer Gradation* when working with MX4 conversion or separation profiles.

Global color corrections

If there are still visual differences between the reference and the proof after correcting the dot gain, examine the color axis next. Switch to the *4d Color Space* tab and select *Tools* → *Change Color Values*. Depending on the type of profile (RGB separation profile or CMYK conversion profile), one of the following two windows opens:



Color correction in RGB separation profiles



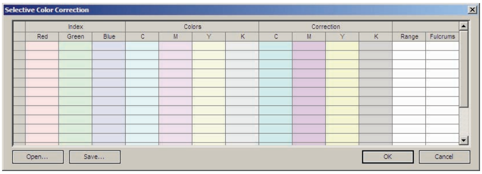
Color correction in CMYK conversion profiles

Changes made here are calculated directly into the CMYK values of the target color space and incorporated proportionally into the profile over the entire effective range from 100 - 0%, starting from the solid tone. For example, if *Cyan → -2% Yellow* is entered, the use of Yellow in the Cyan is reduced.

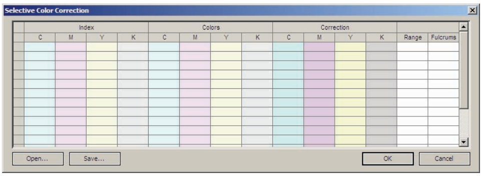
Selective color corrections

Alternatively, you can also correct just certain color ranges. To do so, select *Tools → Selective Color Correction*. Depending on the type of profile

(RGB separation profile or CMYK conversion profile), one of the following two windows opens:



Selective color correction for RGB separation profiles without Black index

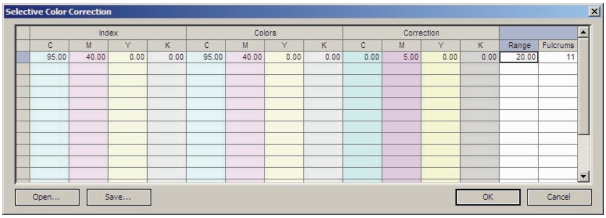


Selective color correction for CMYK conversion profiles with Black index

Entering a color value in the *Index* column defines the starting point for a correction. The *Colors* column indicates the current CMYK color value after profile calculation for the respective index.

A CMYK change in the +/-100 range can now be made in the *Correction* column. The input values are absolute correction values, i.e. entering + 5% Magenta increases the Magenta value by 5 percentage points.

The entry in the *Range* column defines the effective range in the 4d color space. As a result, the correction acts uniformly in all directions of the color space. The number of changed index points in the profile is indicated in accordance with the effective range in the *Fulcrums* column.



Selective color correction

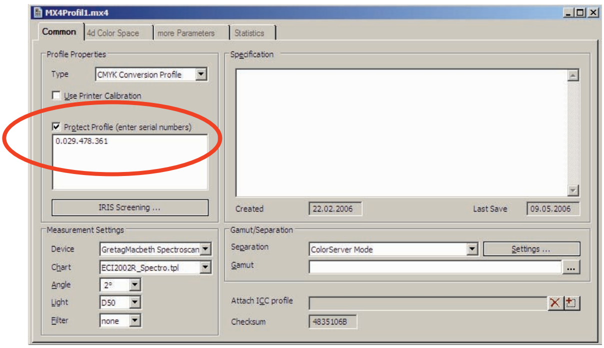
Note that the color corrections described are lost in the event of calculation of target and current values, since the previous CMYK values are overwritten by every new calculation.

Save the profile after each correction, process the test images (source color space) again in GMG ColorServer using the corrected profile, and subsequently output the converted test images once more with the proofing profile for the target color space. Compare the proof to the reference print. If a good visual match has still not been achieved, continue to repeat the procedure described until the required visual match is obtained.

5.7. Protect Profile function

The GMG ColorServer Profile Editor allows you to protect your profiles against unauthorized use or editing. If you activate the checkbox next to *Protect Profile* on the *Common* tab of an MX4 profile, the Serial No. (Dongle No.) of your system is automatically entered in the field.

The profile can then only be used with the GMG ColorServer software licensed under this Serial No. You additionally have the possibility of entering further Serial Nos. – separated by commas – to enable use of the profile on the respective other systems:



Protect Profile function

With *File* → *Save*, you can assign a password to the profile. In that case, this password has to be entered before the profile can be edited with the GMG ColorServer Profile Editor.

5.8. Glossary

Characterization data

A characterization file contains not only the device-dependent CMYK values achievable under given printing conditions, but also the device-independent CIELAB color values. To determine these, a test chart with selected CMYK values is output and measured spectrally. Characterization files can be used to create ICC profiles and GMG color profiles. Standard characterization files are available for the offset, gravure and newspaper printing sectors.

Chromatic composition

With chromatic composition, an image is made up from the three basic colors Cyan, Magenta and Yellow. To obtain a higher-contrast image, Black is additionally printed, although it is not used for gray. However, it is very difficult to maintain the color balance in the case of pure chromatic composition, and the total ink application is relatively high. The UCR/GCR methods were developed to compensate for these disadvantages.

Color separation

During color separation, an image is broken down into its individual color channels. If an image is present in the (three-channel) RGB color space, it has to be converted to the (four-channel) CMYK color space for subsequent printing. Information concerning the composition of the fourth channel (Black = achromatic) has to be provided in this context, for which purpose the various color composition models were developed.

Color space
A color space is a set of colors that can be identified or reproduced by an input or output device (scanner, monitor, printer, eye, etc.) under specific conditions.

Color space transformation
The process of color space transformation converts the colors of a given color space into colors of a different color space.

DeviceLink profile
DeviceLink profiles calculate device-specific RGB/CMYK values directly, without intermediate conversion into the CIELab color space. In CMYK to CMYK conversion, the information concerning the composition of the Black channel is not lost in the process, as would otherwise occur in the event of intermediate conversion from the four-dimensional CMYK color space to the three-dimensional CIELab color space.

Gamut File
A Gamut File describes the color space of a particular set of output conditions in a GMG-specific format.

Gamut Mapping
Gamut Mapping is the color space transformation technique whereby non-reproducible colors are replaced in such a way as to preserve the color impression.

Gray Component Replacement (GCR)
In Gray Component Replacement, equal proportions of the three primary colors Cyan, Magenta und Yellow are removed in colored and neutral

areas, until one of the three basic colors disappears. The quantity of the disappearing color is replaced by Black. Saturated, dark colors come out better in this case than when using Under Color Removal. The gray balance is far more stable since the neutral gray areas are then composed almost entirely of Black.

ICC profile

ICC profiles are created on the basis of characterization data, and contain further instructions, such as on the Black composition (UCR, GCR) and the total ink application (ink limit), providing a colorimetric description, or instructions for conversion into or from a device-independent color space.

Primary colors

Primary colors are the basic colors of a color system, from which all other colors can be mixed. They cannot themselves be mixed from other colors. The basic colors for additive color mixing are Red, Green and Blue (colors from light). The basic colors for subtractive color mixing are Cyan, Magenta and Yellow (colors from printing).

Rendering Intents

The choice of a Rendering Intent defines which Gamut Mapping method is used for conversion with ICC profiles:

- Absolute colorimetric: Colors that lie inside the color space are mapped identically, all non-reproducible colors being replaced by the most similar reproducible color at the edge of the color space. The paper white of the stock used for production printing is also simulated when outputting proofs.

- Relative colorimetric: In this case, the white point of the source color space is additionally mapped onto the target color space. Accordingly, the paper white of the stock used for production printing is not simulated when outputting proofs.
- Perceptual: The color space is shrunk roughly proportionally in this case, in order to very largely preserve the color impression in the eye.
- Saturation-preserving: The color space is compressed, but an attempt is made to maintain the greatest possible saturation of all colors when doing so, even if the color tone is possibly altered as a result.

Secondary colors

Secondary colors result from mixing two primary colors. In the case of additive color mixing, this means Cyan, Magenta and Yellow. The corresponding colors for subtractive color mixing are Red, Green and Blue.

Source color space

The term source color space denotes the color space that is used as the basis for color conversion, and in which the file to be converted is presently.

Target color space

The term target color space denotes the color space into which the colors are transformed during color conversion.

Tertiary colors

Tertiary colors contain all three primary colors, or two chromatic colors plus Black in the CMYK color model.

Under Color Addition (UCA)

In Under Color Addition, not all achromatic components are replaced by Black, part of the Black again being composed according to the principle of chromatic composition (from the basic colors CMY). The purpose is to support neutral image shadows (dark gray tones) if, for example, pure Black would look more like a dark gray in print.

Under Color Removal (UCR)

In Under Color Removal, Cyan, Magenta and Yellow are each replaced to the same extent by Black in the neutral areas. The level of ink application is lower, and the shadows look more brilliant.