

EFI proServer / Fiery™ XF Version 6.5

Fiery Wide Format Products

LINEARIZATION & PROFILING GUIDE FOR EFI VUTEK / MATAN / REGGIANI



Purpose of this document

This documentation will guide you through the process of creating a linearization and profile for your EFI VUTEk, EFI Matan and/or EFI Reggiani printer. It will also provide hints on how to achieve specific compromises between gamut size and ink saving.

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A brief history of linearizations

When Fiery XF first started supporting EFI VUTEk printers in version 3, the same standard Fiery XF linearization was used as for any other printer.

Later a dedicated Advanced VUTEk linearization was added with “Advanced” color modes for extended control of ink limiting and light/norm ink builds. It was implemented in parallel to the standard linearization, so that, for example, the “CMYK” color mode used the standard linearization, whereas “CMYK, Advanced” used the Advanced VUTEk linearization.

Later still, all new EFI VUTEk printer drivers used only the Advanced VUTEk linearization, and the standard linearization was dropped altogether for these printers.

Although the amount of control the 9-step Advanced VUTEk linearization wizard provided to customers was far superior to the standard linearization, the complexity and time it took to complete a linearization was increased as well.

Fiery XF 6.1 introduced a completely new VUTEk linearization for the standard color modes (e.g. “CMYK”). The wizard provided the same amount of control as the Advanced VUTEk linearization, but required only 4 steps (+ 2 optional steps). This greatly reduced the complexity and time required to create a new linearization and, due to carefully chosen default values, even allowed color novices to achieve excellent results quickly.

Fiery XF 6.3 introduced a new advanced ink limit algorithm, new Advanced Ink Limit charts and made the linearization wizard available to not only EFI VUTEk, but also EFI Matan and EFI Reggiani printers.

Additionally, in Fiery XF 6.3 a new profiling engine was introduced for EFI Matan, EFI VUTEk and EFI Reggiani which offered new controls that are explained towards the end of this document.

Fiery XF 6.4 introduced measurement data smoothing for the EFI VUTEk FabriVU printer.

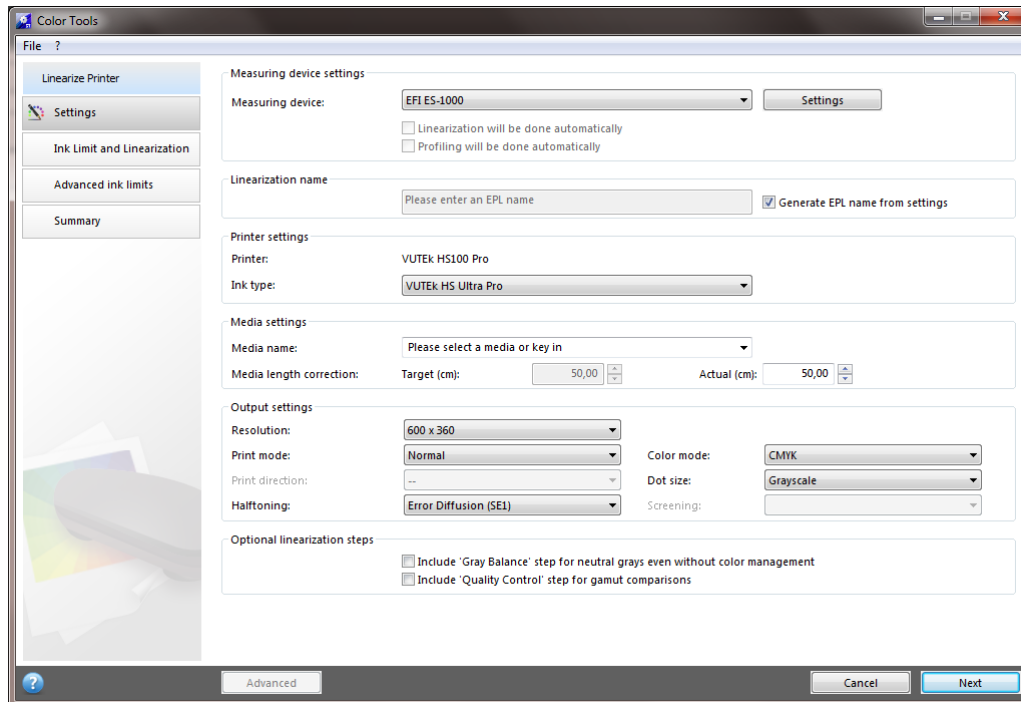
Fiery XF 6.5 supports new color modes for EFI Reggiani printers such as CMYKORB. The Advanced Ink Limit algorithm was replaced by a newly developed Total Ink Limit algorithm introducing a dynamic TIL chart configuration that is highly customizable to find the best total ink limit value for a wide variety of applications. The data smoothing introduced with Fiery XF 6.4 has been made available to all printers supported by the VUTEk linearization.

Linearization wizard

If you are looking for help on how to connect to EFI Matan and EFI Reggiani / EFI VUTEk FabriVU printers specifically, then please consult our printer supplements:

- <http://help.efi.com/fieryxf/Drivers/index.html>

Step 1: Settings



- Purpose of this step
 - The "Settings" step allows you to define the basic parameters of your linearization, such as the resolution, color mode, dot size and halftoning method.

- Measuring device settings

Select one of the supported measuring devices from the drop-down menu. Click the **Settings** button to adjust the options of the chosen device, such as the device mode or patch size.

It is recommended that you use one of the following measuring devices / measurement modes from the table below. (our recommendation in **bold green**):

Measuring device	Comments
EFI ES-2000, M2	<ul style="list-style-type: none"> • UVCut • Dual-pass measurements • Supports any media
EFI ES-2000, M1	<ul style="list-style-type: none"> • Includes a controlled D50-like amount of UV • Dual-pass measurements • Supports any media

Measuring device	Comments
EFI ES-2000, M0	<ul style="list-style-type: none"> • Single-pass measurements • Supports any media without optical brightener
EFI ES-1000, M2	<ul style="list-style-type: none"> • UVCut • Single-pass measurements • Supports any media
EFI ES-1000, M0	<ul style="list-style-type: none"> • Single-pass measurements • Supports any media without optical brightener
X-Rite iSis / EFI ES6000 M2 / M1 / M0	<ul style="list-style-type: none"> • Automated measurement • Does not support thick materials or textiles

Why does EFI recommend M1?

More and more reference profiles (CGATS21_CRPC, GRACoL 2013, SWOP 2013, PSOCOATED_v3, PSOUNCOATED_v3_FOGRA52, etc.) are based on M1 measurement data.

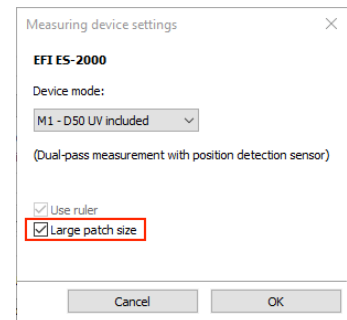
As opposed to M0, M1 includes a controlled amount of UV and follows the idea of “measure it like you see it”. In that way M1 handles UV in a controlled way and does not completely ignore UV (like M2), or include “an undefined” amount of UV (like M0).

Although you can use any other supported measuring device as well, it is recommended that you check the measurement consistency on your media to prevent unwanted side effects.

EFI ES-2000 for textile frontlit (reflected light) applications:

Enabling the “Large patch size” option helps to create smooth linearization curves.

Large patches can also improve the smoothness of the linearization curves for other applications, not only textile.



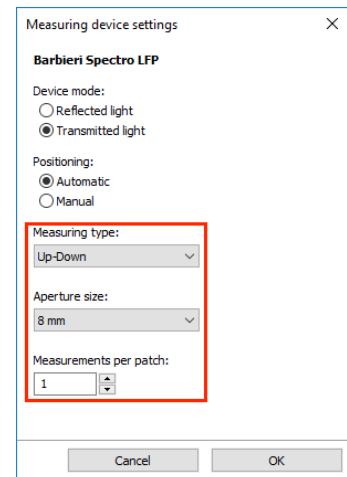
Barbieri Spectro LFP in general:

It is recommended to measure **without the physical UV-cut filter** to avoid a yellowish cast in the prints when printing with color management.

Barbieri Spectro LFP for textile frontlit (reflected light) applications:

8 mm aperture is recommended. Otherwise use the widest aperture supported by your Spectro LFP.

Increasing the number of measurements per patch can help to get smoother linearization curves, although it increases the time needed for measurement.



Barbieri Spectro LFP for textile backlit (Transmitted light) applications:

Up-Down measuring type is recommended as it results in more precise measurements than Fast.

8 mm aperture is recommended. Otherwise use the widest aperture supported by your Spectro LFP.

It is recommended to use **one measurement per patch**.

- Halftoning

A **new** stochastic halftoning (SE2) was introduced with Fiery XF 6.3 which offers smoother and sharper results.

Select the halftoning method that is most suitable for your application.

Halftoning methods in comparison:

Halftoning method	Comments
Error Diffusion (SE1)	Recommended for "fixed dot". Sharpest results on small fonts and fine contour lines.
Stochastic Screening (SE2)	Recommended for "grayscale". Faster processing time than SE1. Potentially smoother results in gradations and full tones.

Halftoning recommendations:

Printer manufacturer/model	Error diffusion (SE1)	Stochastic (SE2)
All EFI VUTEK*	Recommended	Also a great choice and faster!
EFI VUTEk FabriVU	Recommended	Not recommended
All EFI Matan, EFI VUTEk 3r and 5r	Also a great choice, but slower	Recommended
All EFI Reggiani	Recommended	Not recommended

* excluding the EFI VUTEK FabriVU, 3r and 5r printers

- Optional steps

The Fiery XF / Fiery proServer linearization from version 6.3 provides two optional steps:

- Include "Gray Balance" step for neutral grays even without color management
- Include "Quality Control" step for gamut comparisons

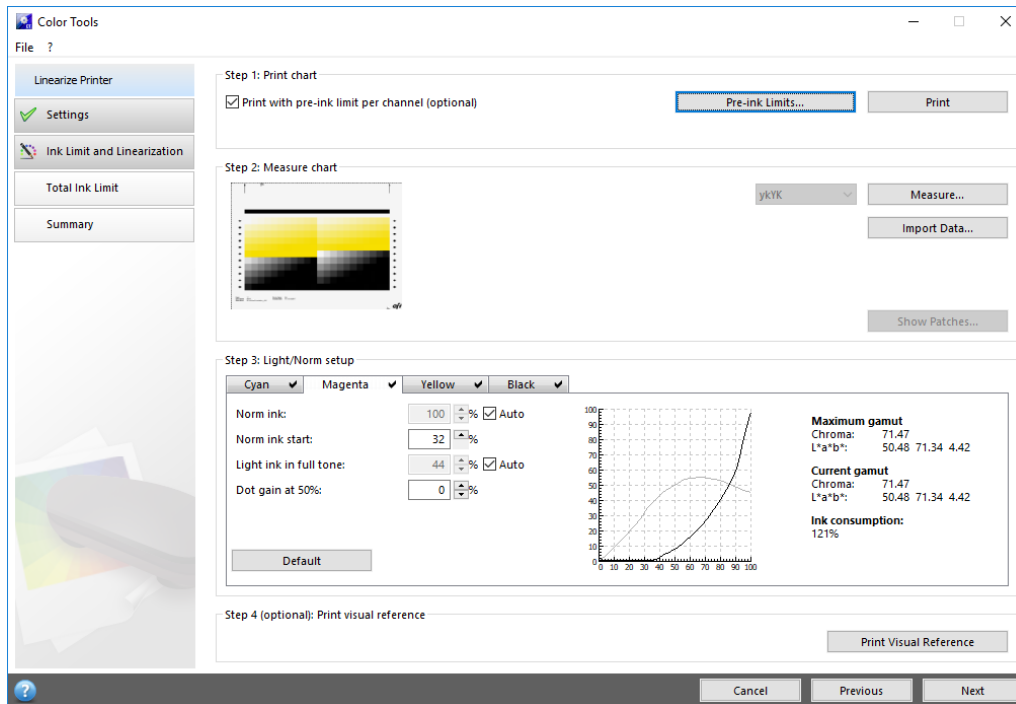
Select the "Gray Balance" step if you want to balance the C, M and Y curves to print more neutral grays without using color management. This iterative step was introduced to help Color Profiler Suite create ICC profiles with an optimized gray reproduction. Due to the updated linearization curve algorithms introduced with Fiery XF 6.1+ this step is typically no longer needed.

It is recommended that you leave this option disabled to save time, ink and media.

Select the "Quality Control" step if you want to evaluate and/or compare the resulting gamut of your linearization before creating a profile (e.g. to change parameters before you decide to print the profiling target). By selecting this step, you can evaluate the gamut and optionally compare it to reference profiles such as GRACoL or ISOcoatedV2 or any custom profile (e.g. one of another EFI VUTEk printer) that you load.

Also note that the linearization report (*Summary*) will not include L*a*b* data for the solids if you do not choose to print and measure the "Quality Control" chart.

Step 2: Ink Limit and Linearization



➤ Purpose of this step

- The "Ink limit and Linearization" step will help you to build the light/norm ink curves (or just norm ink curves for a color mode without light ink) for your printer.
- Defining the behavior of light and norm ink linearization curves and ink limits is important for the gamut size, ink savings and to avoid visual artifacts you may want to target.

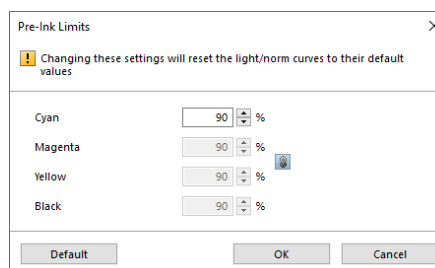
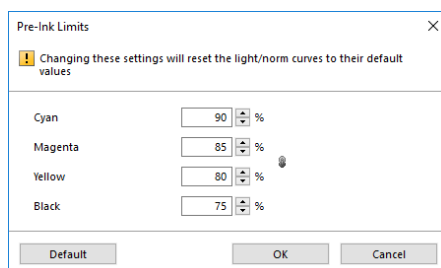
To aid the linearization process, pre-linearization curves are defined and applied when printing the linearization charts for certain printers and ink types.

The check box "Print with pre-ink limit per channel (optional)" allows you to define individual pre-ink limits to prevent your printer/media combination from creating artifacts like bleeding, mottling etc., when printing the linearization charts. It is recommended to change the pre-ink limits only if needed.

Click the *Pre-Ink Limits...* button to enter individual limits.

Clicking the small chain icon limits all channels to the same amount (see screenshots below).

Pre-ink limits for light inks are not handled separately and are therefore limited to the same amount as the norm ink. Effect inks like WHITE and CLEAR (if supported by the driver) can be limited individually.



Note that some printers support a custom pre-linearization which is applied in the background when printing the linearization charts. The pre-linearization is valid only for the default pre-ink-limit it was created for. Any change in the pre-ink-limit results in the linearization charts being printed without the pre-linearization.

Important for VUTEk UV printer drivers:

Pre-ink limits are applied to all 1000 dpi resolutions by default to match the printer gamut at 1000 dpi resolution to the gamut at 600 dpi resolution! This behavior was requested by many users and allows you to align easily the color of 600 dpi and 1000 dpi resolution modes.

However, if you want to use the full gamut capabilities of the 1000 dpi mode (e.g. for backlit applications), reset all pre-ink limits for the 1000 dpi resolution to 100%! *Note that in this case the pre-linearization is not applied when printing the linearization charts.*

If in doubt, leave this check box unchecked, as applying pre-ink limits to your channel(s) may noticeably reduce the gamut you can achieve with the linearization.

Print and measure the linearization charts following the instructions on screen.

Small check marks appear next to the channel name on each tab if measurement data is present. Use the displayed values for Chroma and L*a*b* on the right side of the Color Tools window to evaluate the "Maximum gamut" you can achieve with the current combination of printer, media and ink and compare it with the "Current gamut" you will achieve based on the settings you have chosen.

These values provide reliable feedback if you want to achieve a certain compromise between ink saving and gamut size.

The "*Ink consumption*" value represents the approximate amount of ink used for the reproduction of a primary color gradient (from 0% ink to the full tone) by taking the shape of the light- and norm ink as well as the pre-ink-limit into account.

- Ink consumption of 100% is equivalent to an unlinearized input channel using norm ink only.
- Ink consumption of 200% is equivalent to an unlinearized input channel using a combination of light ink and norm ink (= 100% light ink unlinearized + 100% norm ink unlinearized)."

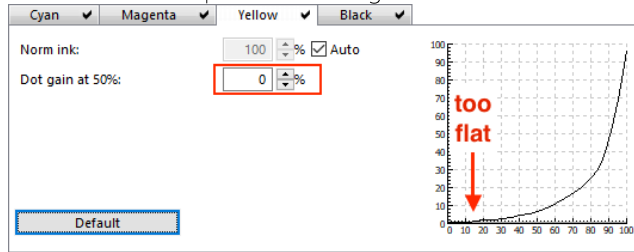
The default values of the linearization will automatically aim for the biggest possible gamut size (up to a maximum of 45% light ink in full tone). You can always return to the default settings by clicking "Default" on each ink channel tab.

The following controls are available to customize the default calculated curves:

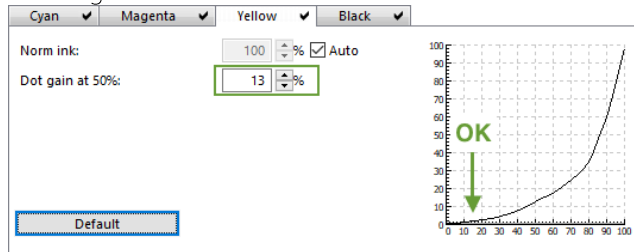
- ***Norm ink - sets the amount of norm ink for an input value of 100%.***
 - If the "Auto" check box is enabled, the linearization automatically determines the amount of norm ink that is used to achieve the biggest possible gamut for this channel.
 - Disabling "Auto" lets you set a custom ink limit manually.
 - Evaluate the dark colored curve in the graph to see how much norm ink is used.

- *The value in the text box and in the graph does not take the pre-ink limit into account. If a pre-ink limit is set, then the value must be multiplied by the pre-ink limit divided by 100%.*
- ***Norm ink start - determines the input value in % at which norm ink is printed***
 - The main intention of light ink is to smoothly print the highlights to quartertones of vignettes and gradients. Norm ink takes over at a certain point and light ink is reduced gradually up to a certain level at the full tone.
 - The starting point of the norm ink curve is automatically determined by the linearization.
 - Lower values reduce the light ink usage (which also saves ink) but may increase graininess in the print (because the norm ink already starts in the quartertones).
 - Higher values increase the light ink usage and may reduce graininess in the print because the norm ink either starts later or in the mid-tones.
 - You can review the smoothness/graininess of the primary color gradients by printing the "Visual Reference" chart at the bottom of the Color Tools window (see below).
- ***Light ink in full tone - sets the amount of light ink for an input value of 100%.***
 - If the "Auto" check box is enabled, the linearization automatically determines the amount of light ink in the full tone to achieve the biggest possible gamut for the channel up to a default maximum of 45% light ink.
 - Disabling "Auto" lets you set a custom ink limit manually.
 - You can use this option to achieve a targeted compromise between maximum gamut (typically a greater amount of light ink the full tone) and ink saving.
 - *Note: The value in the text box and in the graph do not take a pre-ink limit into account. If a pre-ink limit is set, then the value must be multiplied by the pre-ink limit divided by 100%.*
 - You can force the linearization to use no light ink in the full tone by entering 0%.
 - **Recommendations:**
 - Set similar light ink in full tone values across all channels that support light ink.
 - Avoid extreme differences like 0% light ink for Cyan, and 100% light ink for Magenta.
 - Do not use excessive light ink in full tone to avoid "pass-to-pass gloss banding". Up to 45% light ink (default maximum light ink in full tone) is reasonable.
- ***Dot gain at 50% - adjusts the linearization curves mainly in the mid-tones***
 - The dot gain can be adjusted within a range of -30% to +30%.
 - It is recommended to use the default dot gain setting unless needed.
 - 0% dot gain is the default value for most supported printers.
 - The VUTEK FabriVU has the following default dot gain settings:
C = 13%, M = 13%, Y = 13%, K = 16%.
 - If the linearization curve is extremely flat in the beginning you can moderately increase the dot gain to avoid visible steps in the printed highlights.

At dot gain 0% the Yellow linearization curve is too flat in the highlights and may create visible steps in smooth gradients.



At dot gain 13% the Yellow linearization curve starts with a reasonable slope:

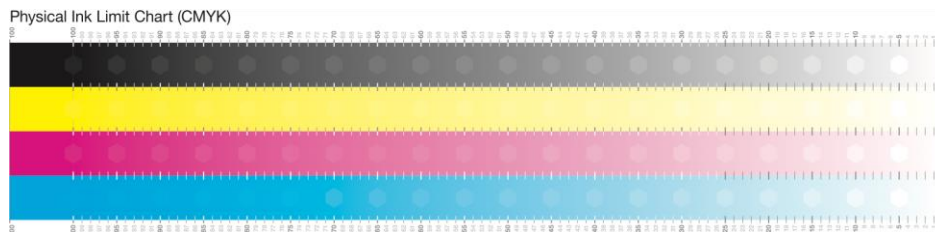


- o Note that increasing the dot gain may increase the light ink usage and overall ink consumption significantly!

Optionally you can review your settings by evaluating primary color gradations by clicking the “Print visual reference” button and printing the respective job in the Linearization Workflow in Fiery XF.



Note: For EFI Reggiani printers, the “Print visual reference” button is not available.



Proceed to the chapter “Linearizing white ink” if you want to learn about how to linearize white ink.

General recommendations for good linearization curves:

- Watch your full tones
 - o An extremely steep norm ink curve between 90% and 100% input is an indication of too much ink. In such a case reduce the Norm ink value and keep an eye on the Chroma and $L^*a^*b^*$ values.
 - For chromatic channels (C, M, Y, O, R, B, V, etc.) most of the time you can “sacrifice” 0.5 to 1.5 Chroma units without a significant loss of gamut. As a result, the norm-ink curve should become less steep.

If no improvement can be made regardless of the settings used, re-print and re-measure the linearization charts and/or check the performance of your measuring device.

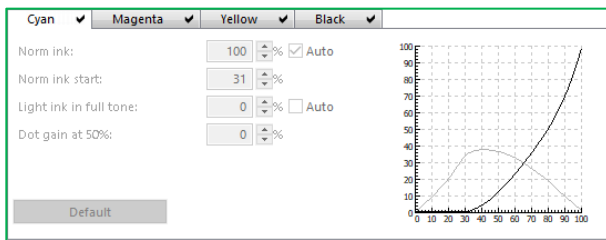
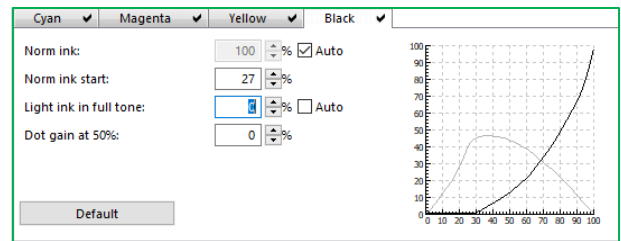
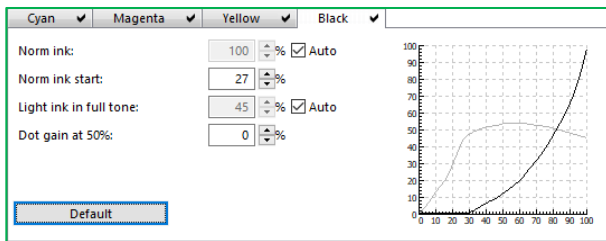
The following screenshots show examples of

- a) recommended light/norm curves,
- b) valid but not recommended light/norm curves,
- c) light/norm curves not recommended.

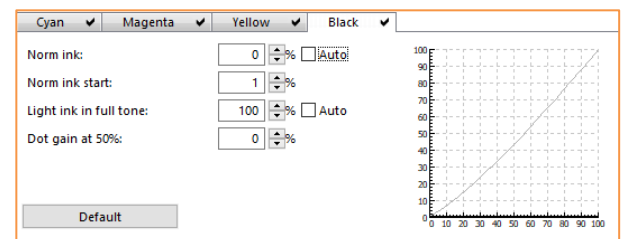
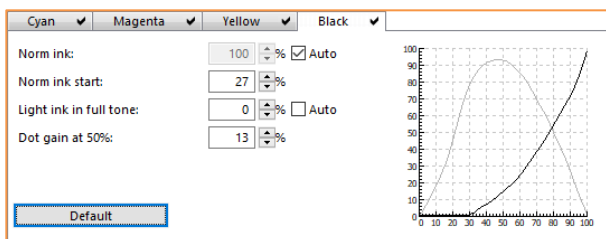
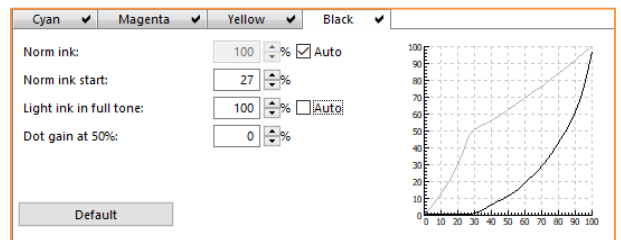
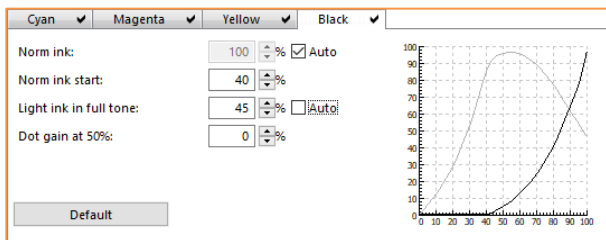
The examples show recommended and non-recommended light ink curves, and the settings used to achieve them in each case.

Note that your light/norm curves will not match these examples as the curves depend on the measurement data of your specific printer/ink/media combination.

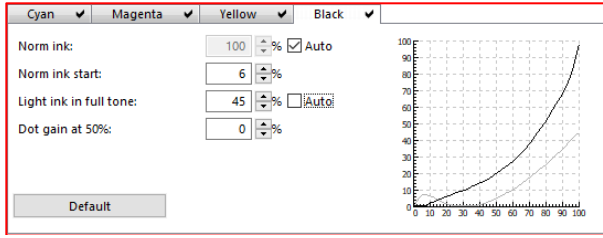
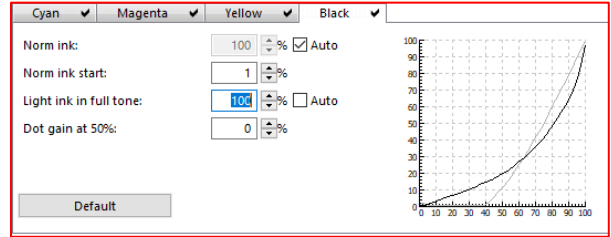
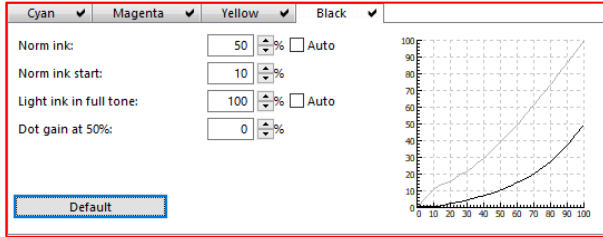
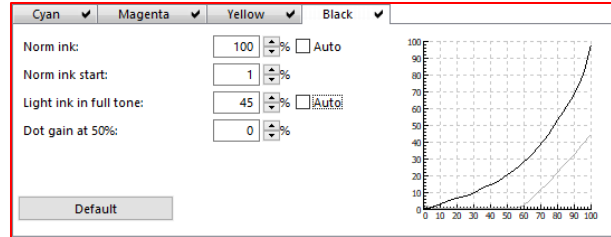
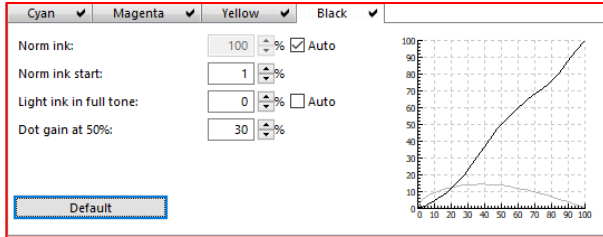
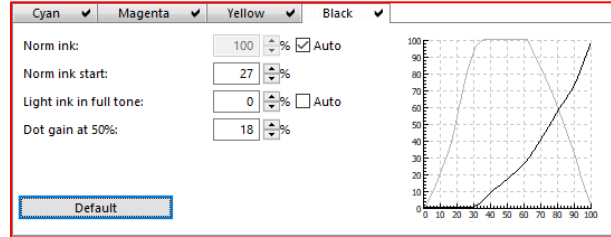
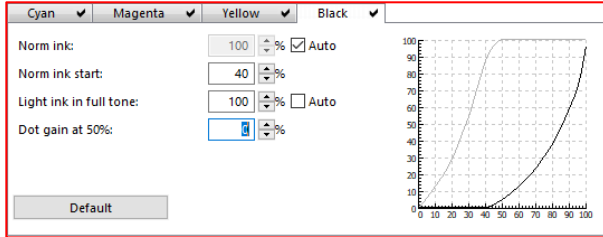
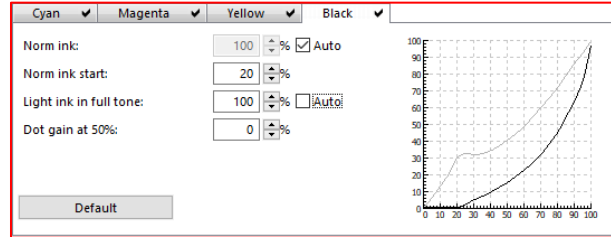
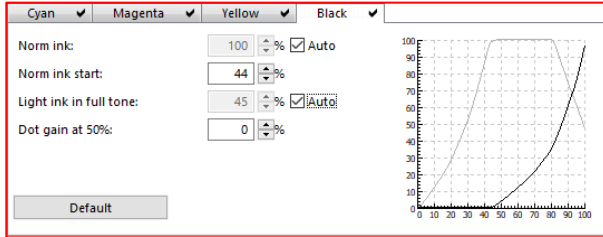
Recommended:



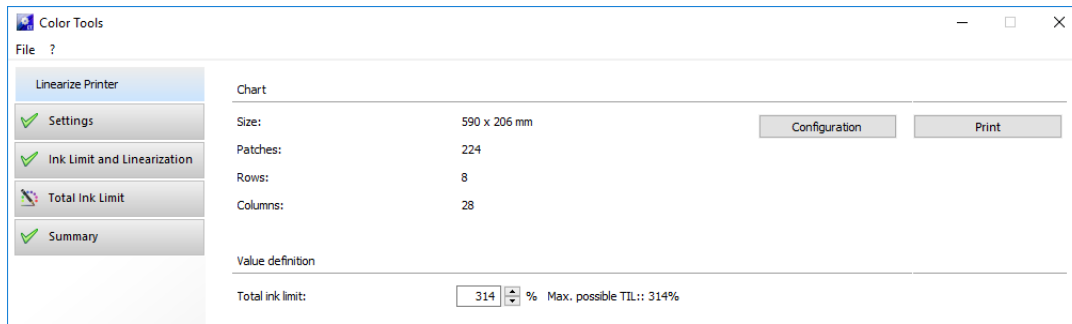
Valid, but not recommended:



Not recommended:



Step 3: Total Ink Limit



Purpose of this step:

The "Total Ink Limit" step allows the user to set a total ink limit (TIL) in percent.

TIL acts as a global ink restriction to serve two main goals:

- avoid over-inking (excessive ink) that can cause printing artifacts and degrade output quality
- optimize the dynamic range of the printer.

The TIL value is determined by printing and reading a special TIL chart.

For some systems a TIL value can be specified even without printing the TIL chart.

The TIL window contains basic information about the chart, using the default settings for the selected printer:

- chart size (width x height in mm),
- number of patches,
- number of rows,
- number of columns.

To print the chart with the current settings, click on the "Print" button.

To customize the chart layout, click on the "Configuration" button. This opens the Chart configuration dialog box. Its options will be discussed later in this chapter.

Below the chart information section is a field to enter the TIL value. The initial value is the maximum possible ink, which is calculated by the sum of all full tone ink limits (norm and light inks) set in the previous step (Ink Limit and Linearization). This also takes the pre-ink-limit for each channel into account. Note that the maximum possible ink value is shown next to the text field; it is not possible to exceed this value in the TIL text field. The minimum value that can be entered is 1%.

In the area below the TIL value definition three different warning messages can be displayed:

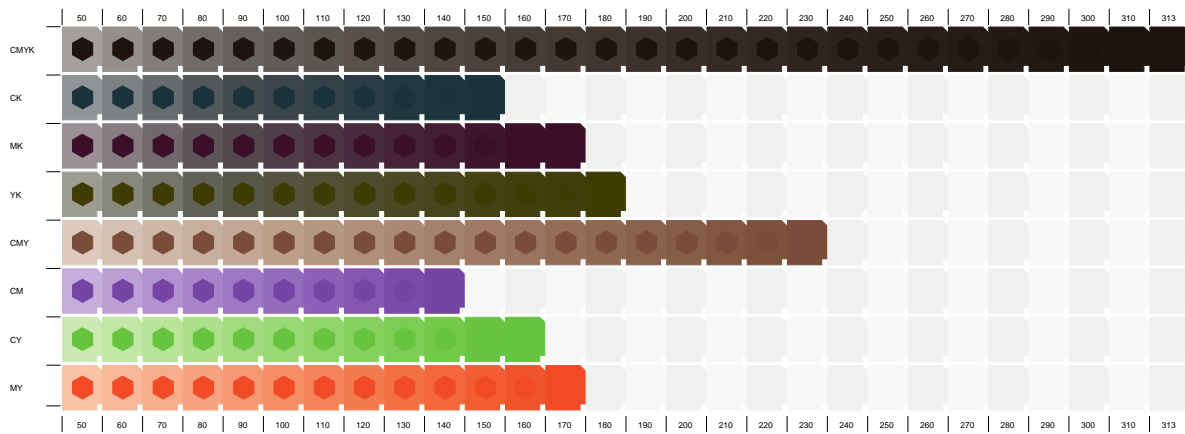
1. The chosen TIL value might limit the possible printer gamut.
 - *Sometimes it is not possible to avoid this as over-inking artifacts would occur. But the warning should alert the user to review his choice and adjust if needed.*
2. The TIL chart size exceeds the media size of the linearization device.
 - *The user can adjust the chart using the configuration to fit the chart to the page*
3. The bleeding marks are disabled but for the chosen printer it is recommended to print with bleeding marks (e.g. textile printers).
 - *The user should re-enable the bleeding marks, otherwise it might be impossible to determine the TIL value properly*

The TIL chart uses the following basic elements to help the user find a good TIL value:

- Rectangular colored patches with optional
 - hexagon shapes (centered in the background)
 - bleeding markers in the top right corner
- "Empty" patches with alternating gray levels
- Rows of colored patches and optional empty patches
- Columns of colored patches and optional empty patches
- Row headings that display the printer colorants used in each row
- Column headings that display the TIL level (absolute ink amount) of each column
- Optional horizontal spacings between adjacent rows

Note: The TIL algorithm is based on absolute ink amounts depending on the number of printer colorants. For a color mode with light inks it is possible to enter TIL values that are significantly higher than 400%. Choosing "CMYKcmyk" as the color mode the TIL value may be set to a maximum of 800%.

The image below shows a typical CMYK TIL chart:



The top edge contains the column headings, representing the TIL level of a given column. The TIL levels increase left-to-right from the "Range start" value (default: 50%) to the "Range end" value (default: maximum possible ink; e.g.: 313%) in a defined step size (e.g. 10%).

The left edge of the chart shows the row headings, which contain information about the printer colorants used within each row.

- Regular inks (norm inks) are represented by uppercase characters.
- Light inks, if used, are represented by lowercase characters.

For example:

- CMYK → row is using norm inks only: Cyan, Magenta, Yellow and Black
- CKc → row is using norm and light inks: Cyan, Black, Light-Cyan
- CMcm → row is using norm and light inks: Cyan, Magenta, Light-Cyan, Light-Magenta

The chart above shows that rows can have different lengths.

The length of a single row is given by the sum of the single ink limits per channel (either of norm ink only or norm ink plus light ink in full tone), taking the respective pre-ink-limit into account.

"Empty" patches (light gray) are placed whenever the specific ink combination of a row has reached its maximum possible ink limit, but is below the TIL level of a given column. To aid in the readability of the chart, the empty patches are displayed in alternating gray columns.

Reading the TIL chart:

Within a column, the background of each patch is filled with a combination of the printer colorants up to but not exceeding its TIL level.

Each hexagon within a row is filled with the same color combination as the right-most (= last) patch. The background and the hexagon in the last patch are made up of the same ink values, making this patch uniform.

For a printing system that does not create printing artifacts due to over-inking (typically using UV curable inks) the hexagons provide a good visual indication of TIL values.

For such a printing system, it is recommended to read the chart in this order:

1. Print the TIL chart using the default settings.
2. Review the printed chart so the surface reflection is minimized. This can be achieved by hanging the chart inside a light booth or a wall preferably at the height of the observers' eyes, looking straight on.
3. Scan all rows and select the one where the most hexagon shapes can be seen. For color modes without gamut extending inks this will typically be row 'CMYK' or 'CMY'.
4. Carefully scan the selected row from left to right and choose the first patch in which no lightness difference can be seen between the patch background and the hexagon.
 - The optimal TIL value is approximately at the TIL level of that patch.
 - For larger step sizes (e.g. 15% or 20%) it is recommended to select a value between the TIL level of this column and the TIL level of the previous column (one step size less).

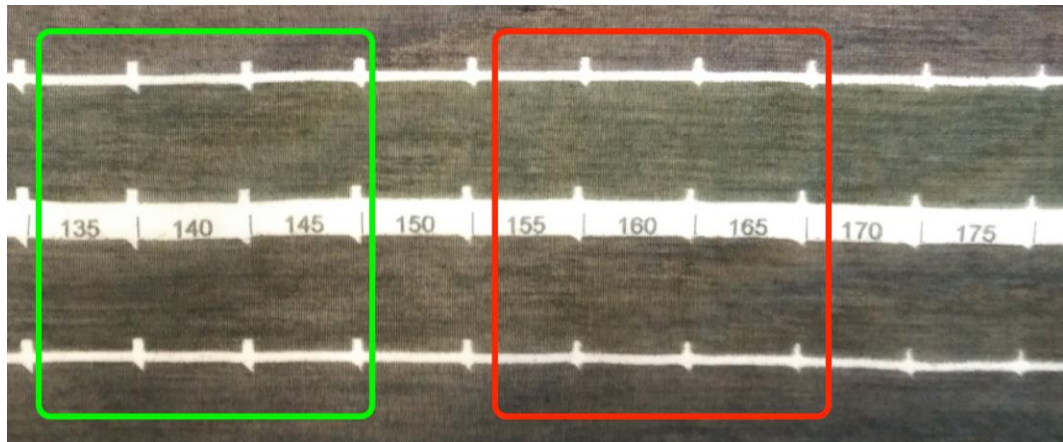
Alternatively, the TIL value can be determined in a two-step process:

1. Print the chart with a step-size of 20% and the default ranges (starting at 50%, up to the maximum possible ink).
2. Determine the range where the optimal TIL value is expected (e.g. 240% to 340%).
3. Adjust "Range start" and "Range End" values to cover this TIL range and set the TIL step size to 5%. See "TIL chart configuration" below how to adjust these options.
4. Print the chart with the adjusted settings
5. Read the chart in the recommended order (as outlined above) to find the TIL value.

For printing systems that are likely to create printing artifacts due to over-inking (typically textile printers or printers using solvent inks) the process to read the chart is different. In these situations, the entire chart needs to be scanned column-wise.

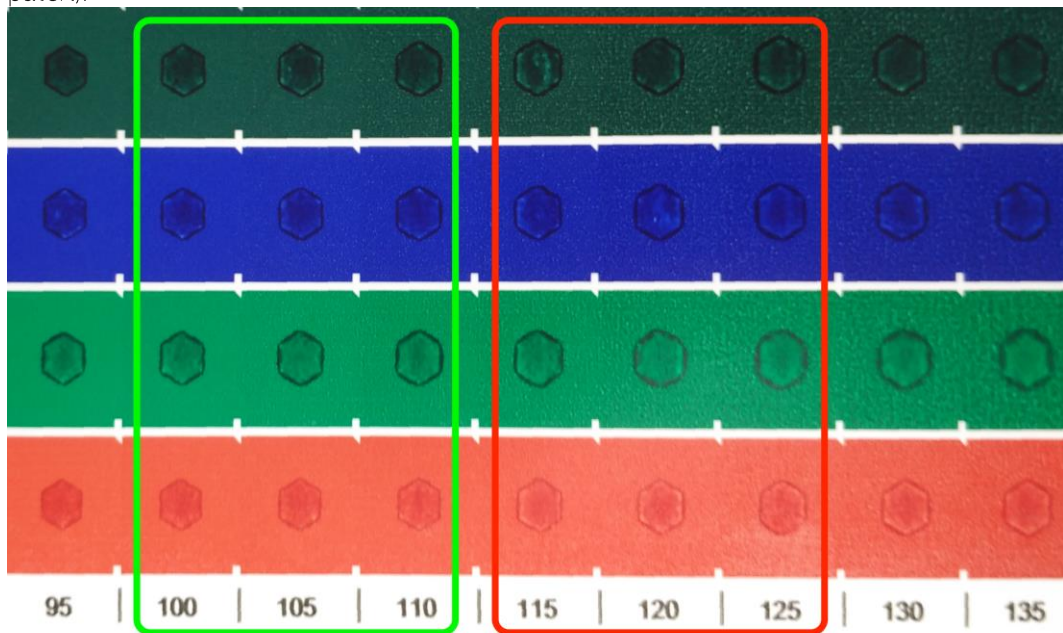
The optimal TIL value is determined by the first column that is free of any printing artifact that degrades the output quality. Different printing technologies will create different artifacts:

- **Bleeding** → the bleeding markers should show mostly sharp edges instead of fuzziness. Increase the size of the bleeding marks if needed (see "TIL chart configuration" below how to adjust this option).
The image below illustrates that for lightweight fabric (in this example) a good TIL value is between 135% or 145% because at higher TIL levels the bleeding markers become fuzzy and flooded and are not as crisp as at 145% or below.



- Fringing, intercolor bleeding, mottling, speckling** → the background of the patch should show a uniform color instead of speckles or fringes. To better determine the TIL for such applications, it can be helpful to set the hexagon to "None" (see "TIL chart configuration" below to adjust this option).
 The image below illustrates that a good TIL value is around 100% to 110% as in higher TIL levels the background of the patch (not the hexagons!) starts mottling and has a non-uniform appearance. This is most noticeably in the green row.

Note that the hexagons show fringing and intercolor bleeding artifacts due to coalescence effects of the ink droplets that do not dry fast enough. This can be ignored in this example, as their ink level is far too high and always above the desired TIL. For this printer, it would be a good choice to set the hexagon to "None" in the chart configuration to print uniform patches only (although the fringing will still appear at a certain ink amount, but not within a patch).

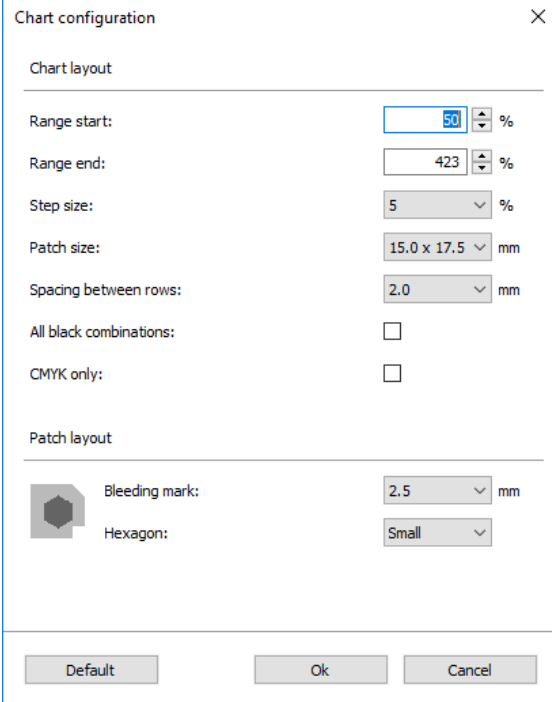


TIL chart configuration:

Clicking on the “Configuration” button in the TIL panel opens the “Chart configuration” dialog box which offers various options.

Chart layout:

- Range start [%]– sets the starting TIL level (left-most column may be offset slightly depending on other options)
- Range end [%] – sets the ending TIL level (right-most column)
- Step size [%]– sets the discrete difference in ink amount between two adjacent columns
- Patch size [mm x mm] – various patch sizes can be selected
- Spacing between rows [mm] – defines the vertical offset between two adjacent rows
- All black combinations – print all overprint combinations with Black ink
- CMYK only (only available for color modes with gamut extending inks, e.g. Orange and/or Violet) – only uses the CMYK part and ignores overprint combinations with gamut extending inks.



Patch layout:

- Bleeding mark – choose the size of the bleeding markers; select “None” to suppress.
- Hexagon – choose the relative size of the hexagon; select “None” to print uniform patches only.

Depending on the user selection, a patch preview is shown in the Patch layout section illustrating the design of a single patch printed. The size of the preview and its elements is not proportional to the actual selection of patch size, bleeding marker size and hexagon size.

TIL chart properties:

The TIL chart can be logically and visually divided into two sections with different overprint combinations:

- Upper section: overprints with Black ink
- Lower section: overprints without Black ink

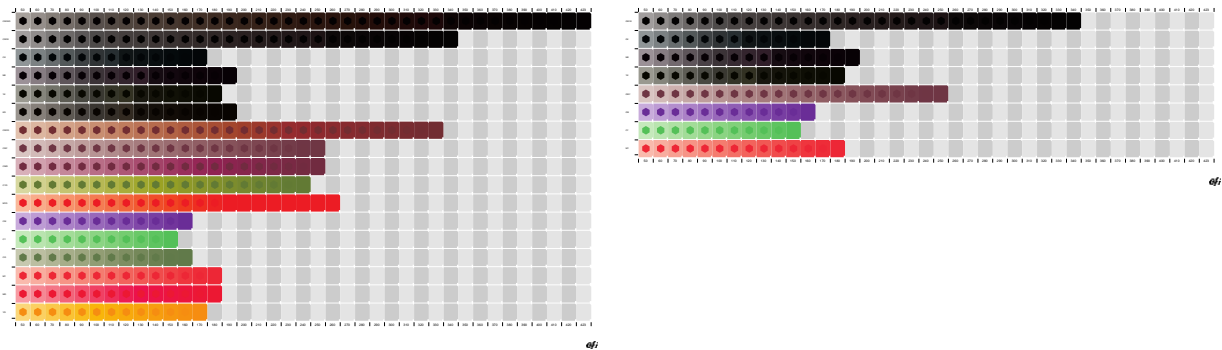
By default, the upper section has a reduced set of Black ink overprints to contain the minimum visual information needed to make a good TIL decision. Optionally the chart can be configured to enable all possible Black overprints if needed by the print application (see “TIL chart configuration” above). The lower section always contains all possible overprint combinations without Black ink.

Color modes that use gamut extending printer colorants (Orange, Red, Violet, Blue) will increase the number of overprint combinations and therefore increase the number of rows.

Light inks used by a color mode will not increase the number of rows compared to the same color mode without light inks. For example:

- CMYKcmyk, CMYKcmk, CMYKcm, CMYK all have the same number of rows (default: 8 rows)
- CMYKcmO, CMYKO, CMYKcmV, CMYKV all have the same number of rows, but more than the examples above without Orange (default: 17 rows)

For color modes with gamut extending inks the chart configuration can be optionally set to use only CMYK inks (see "TIL chart configuration" above). This option will reduce the number of rows to the same number as a regular CMYK color mode. The example charts below illustrate the use of this option for the color mode CMYKO. The left chart is the regular CMYKO chart, the right chart uses only the CMYK part of the left chart.



Setting the TIL value without printing the TIL chart:

Although typically not recommended, good results may be achieved if the printing system is well understood and uses a specific combination of

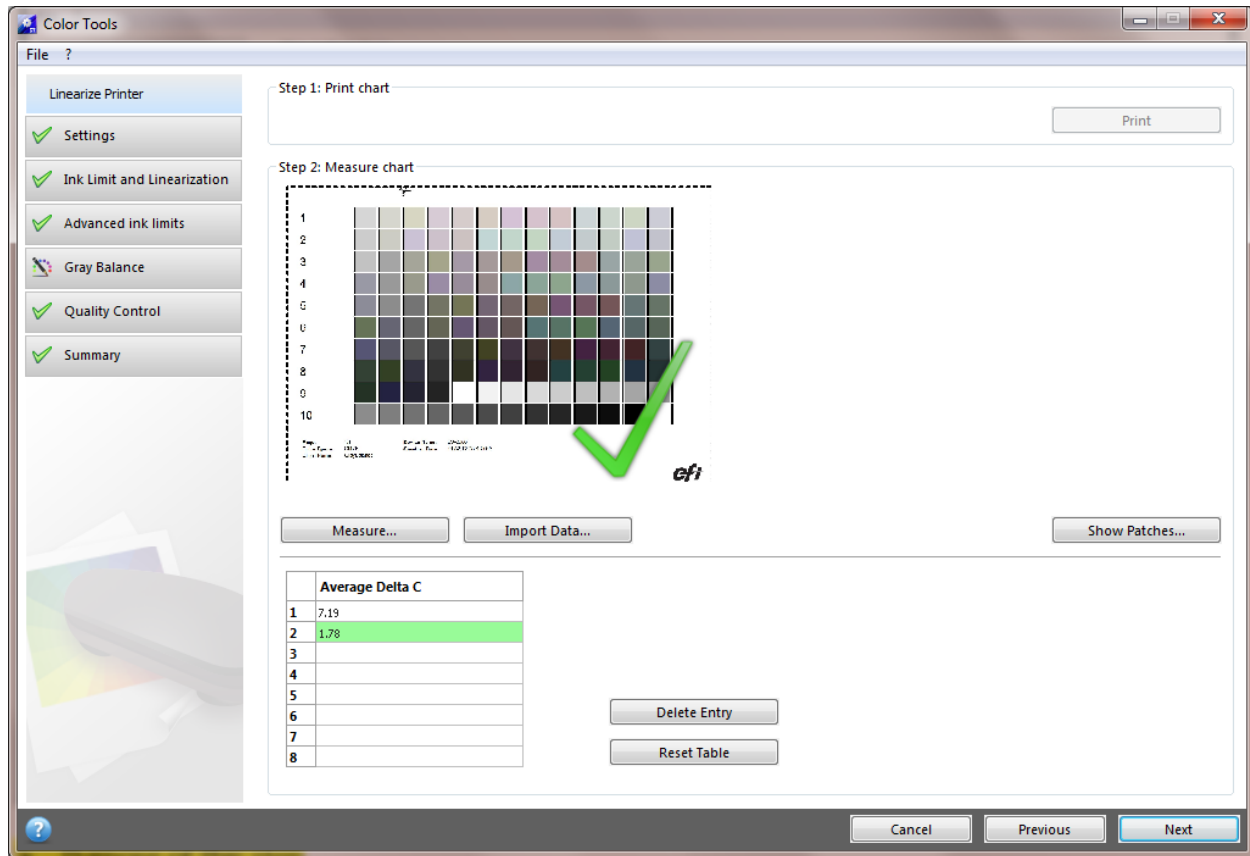
- printer,
- media,
- ink type,
- resolution,
- color mode

and when the TIL value is known from a previous Fiery XF 6.5 linearization.

In this case, you can enter the known TIL value proceed to the next step of the linearization without printing the TIL chart.

This can be particularly useful if you want to make changes to an existing EPL file, for example to adjust only the norm-ink start value or set a different target dot-gain without changing the norm ink and light-ink in full tone limits. Note that changing any of these parameters requires you to create a new media profile.

Optional step: Gray Balance



➤ Purpose of this step

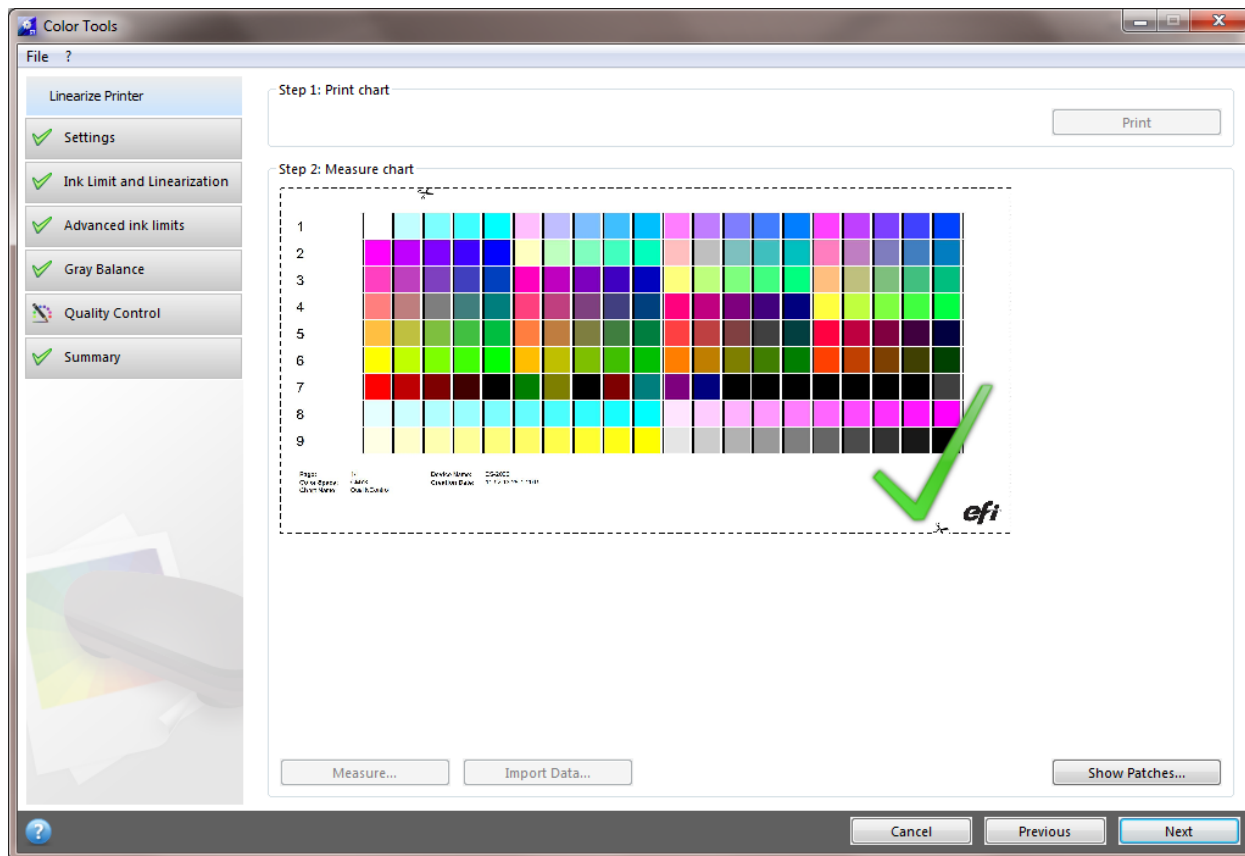
- The optional “Gray Balance” step allows you to align the C, M and Y curves to a neutral gray.
- Typically, the 3-dimensional lookup tables of the ICC profile generation will take care of the reproduction of neutral grays, but aligning C, M and Y beforehand can make the job easier for the profiler, especially when smaller charts are used.

Proceed as follows:

- Print the chart.
- Measure the chart.
- Review the resulting “Average Delta C”.
 - “Average Delta C” is a unit that describes the average chromatic difference of the gray gradation.
 - The higher the value, the stronger a color cast of gray.
 - You should target an “Average Delta C” value of “2” or less.
- If further optimizations are possible (as indicated by an arrow in the Color Tools window), repeat the process of printing and measuring until you reach a value of “2” or less.
- If the “Average Delta C” value increases in one step instead of decreasing, you can ignore that iteration step. Click on the iteration step that yields the best (lowest) result and click “Next”.

Note: You can skip this step altogether, even if you selected it in the “Settings” window, by just clicking “Next”. It is **recommended to skip** this step for EFI VUTEK, EFI Matan and EFI Reggiani printers!

Optional step: Quality Control



➤ Purpose of this step

- The optional "Quality Control" step captures the "color foundation" of your linearization by measuring representative color patches.
- Capturing this measurement data is very useful if you want to evaluate/compare gamut sizes before you proceed with profiling. However, it is not mandatory.

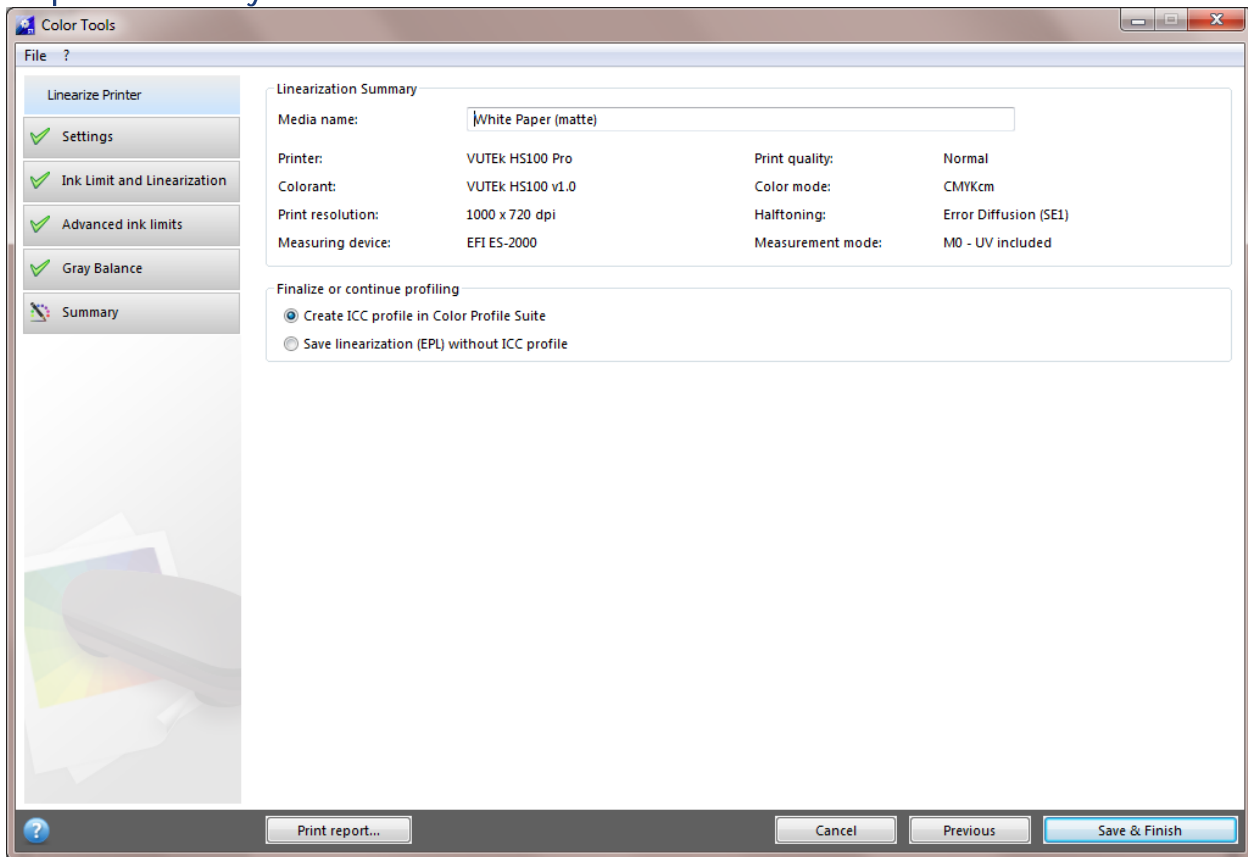
The measurement values can be used to compare the gamut achieved by the linearization in the "Summary" step and to show additional information in the linearization report.

Print and measure the "Quality Control" chart.

No further interaction is required in this step as the Quality Control chart measurement data is just used to unlock functionality in the "Summary" step.

Note: You can skip the "Quality Control" step, by returning to the "Settings" window and clearing the appropriate check box. The linearization steps you have already completed are not lost.

Step 4: Summary

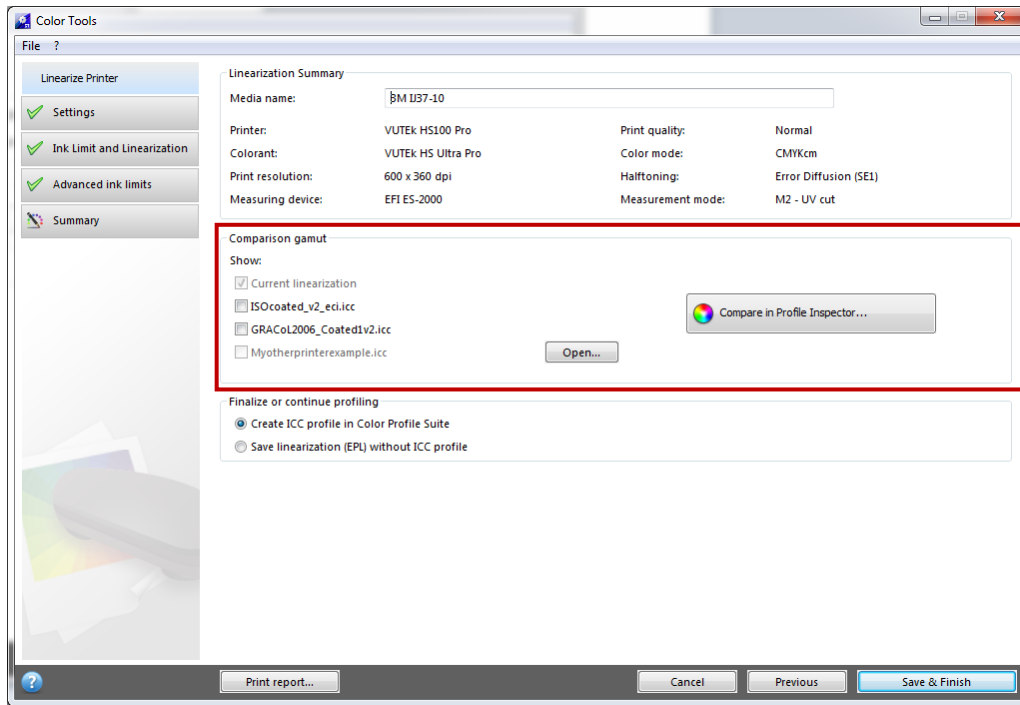


➤ Purpose of this step

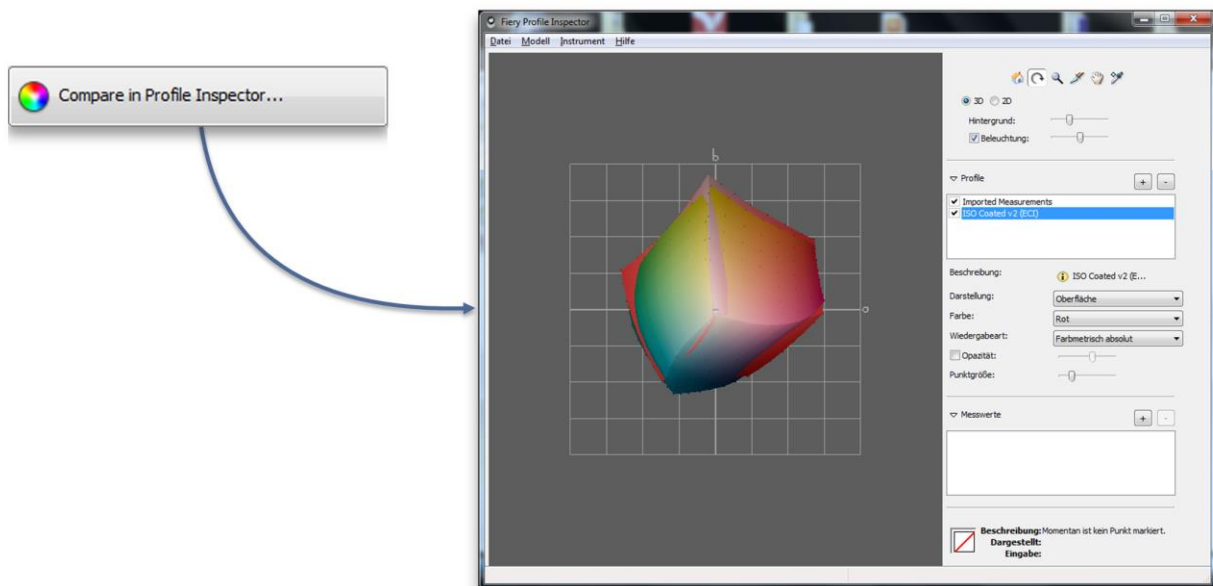
- The "Summary" step displays the most important settings of your linearization. You can also change the "Media name" in this step if you want to.

Clicking the "Print report" button at the bottom of the Color Tools window opens an HTML report in a web browser that summarizes all linearization settings and displays a gamut boundary (requires measurements of the Quality Control chart) and the linearization curves.

If you have printed and measured the “Quality Control” chart, the “Comparison gamut” section is available:



It allows you to evaluate or compare the gamut of your linearization with one of the standard reference color spaces and/or any custom ICC profile. Click “Compare in Profiler Inspector” to start Fiery Profile Inspector:



This can be useful if you want to ensure that the gamut is large enough before you proceed with profiling in Color Profiler Suite.

Linearizing white ink and handling clear ink

➤ Purpose of a “white ink linearization”

- White ink, if not linearized, shows significant dot gain when printed. This is not an issue for full tones, but the effect can be clearly seen whenever white is printed in gradations.
- Linearizing the white channel just like any other ink channel leads to smooth gradations where the input percentage is the same as the output percentage.

For printer drivers that support white ink Fiery XF 6.1+ supports two ways to create a White Linearization:

- generic
- measurement based

Note: EFI Matan printers and EFI VUTEK 3r/5r printers only support a Generic White Linearization for print modes that support white ink, for example “4C-WO”.

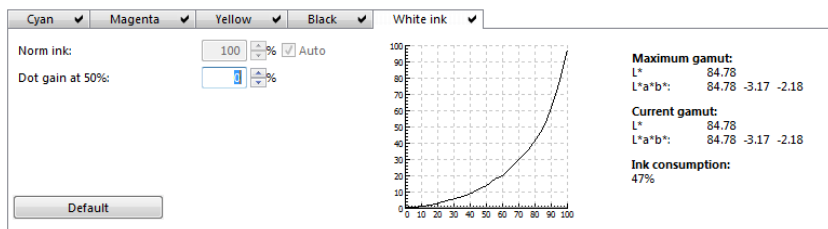
The recommended path to a white linearization

- Any linearization (EPL) created for a printer driver *without* “White” in its name automatically includes a generic white linearization for the specific combination of ink type, ink head technology, printer resolution and dot size.
- If you apply such a linearization to an EFI VUTEk printer driver *with* “White” in its name or to an EFI Matan / EFI Reggiani printer with activated white option, the generic linearization is applied to the white ink channel to ensure that you achieve smooth results.
- Based on experience, the generic white ink linearization makes it mostly unnecessary to create a custom white ink linearization. However, in some cases, a custom white linearization will lead to even smoother results.
- Note: Remove all VCC and CxF files that were created specifically for white ink from your workflow to make sure that they do not interfere with the generic white ink linearization.
- Note: If you open a linearization with a generic white ink linearization in Color Tools for a printer driver *with* “White” in its name, you cannot see the white ink curve as it is applied under the surface and is completely invisible to users.

The optional path to a white linearization

- If you create an EPL for an EFI VUTEk printer by choosing a printer driver *with* “White” in its name, the “Ink limit and linearization” step will also print a white ink chart.
- Click “Print” and open the RTLs on the VUI.
- Do the following steps if you want to print white ink on a black media:
 - Right-click each RTL file and create a multilayer job.
 - For all charts (except the file with “Ink Limit and Linearization_**W**” chart in its name):
 - Under “Colors”, clear “White” for the top layer in the image.
 - For the bottom layer, select “White Flood”.

- You can improve the ink coverage, if required, by adding a second white layer. To do so, select three layers on the Multilayer panel. Then, select “White Flood” for the middle and bottom layers.
 - For the white linearization chart (the file *with* “Ink Limit and Linearization_**W**” in its name):
 - Under “Colors”, select “White from Image” for the bottom layer.
 - Make sure that “White” is cleared for the top layer.
 - You can improve the ink coverage, if required, by adding a second white layer. To do so, select three layers on the Multilayer panel. Then, for the middle layer, click “Select Image”, and browse to the RTL file that was used to create the multi-layer job. When the image has been loaded, under “Colors”, clear all colors for the middle layer, except white.
 - In general, use the print options of each (multi-layer) job to set the smoothing level, and margins, etc. Use the interlace mode “Double strike” to increase the ink density, if needed. As this setting has a high impact on the output color, it is recommended that you include “double strike” in the name of the base linearization file. Multi-layer jobs cannot be grouped together into a layout, so you must print them separately.
- Print and measure all ink limit and linearization charts until you see a check mark on the “White” ink tab, indicating that measurement data is available.
- When it has been measured, the linearization curve for the white ink channel is calculated and displayed.
- Note that the “Norm ink” setting cannot be edited. It is automatically set to 100% as there is no need to apply ink limits to the white channel. However, you can apply a pre-ink limit to the white ink channel if you absolutely want to limit it, although this is not recommended.
- It is recommended that you leave the “Dot gain at 50%” setting on the “White ink” tab at “0%” as this results in linearization with respect to lightness. Increasing the dot gain can be used to have a white gradient fill up quicker in the highlights.



- **Important:** Custom white ink linearizations are currently not supported for transparent material. Please stick to the “recommended” path to a white linearization for transparent materials and use our generic white linearization.

Clear ink

The amount of clear ink in the full tone can be controlled in the “Ink Limit and Linearization” step by setting a pre-ink limit.

Linearizing clear ink using Color Tools is not supported.

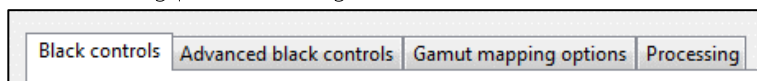
Creating a Media Profile

➤ Purpose of the "Profiling" wizard

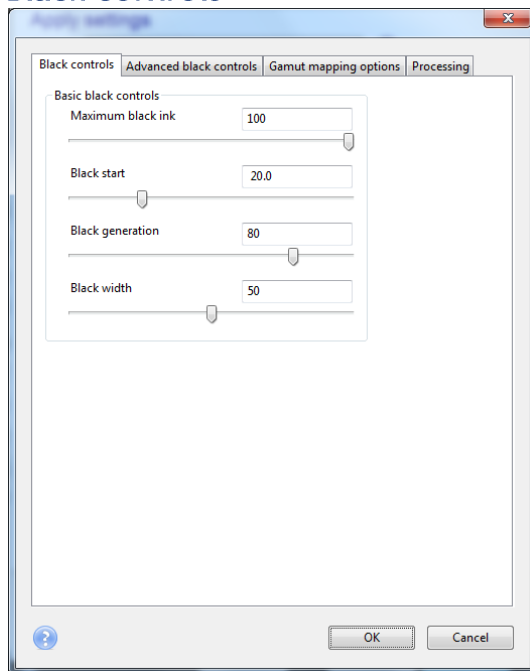
- The "Profiling" wizard guides you through the steps required to create an ICC profile for your linearization.

The 1833 patch chart is the recommended profiling chart to use. This chart is optimized for the forward model of the EFI profiler. For a standardized profiling chart, use the IT8.7/3, EFI2002 or IT8.7/4 chart. If you want to create a profile with a third-party product, it is recommended that you use the IT8.7/4 chart.

The following profiler settings are available:



Black controls



Maximum black ink:

The maximum black ink adjustment sets the targeted amount of black ink used for the profile's black point. Valid input ranges are from 0 to 100 percent. The default value is 100 percent.

Black start:

The black start slider controls when black ink is introduced on the white-to-black neutral axis (the L* axis) of the profile. A black start value of 0 indicates that black ink should be added immediately as ink is added to the white paper.

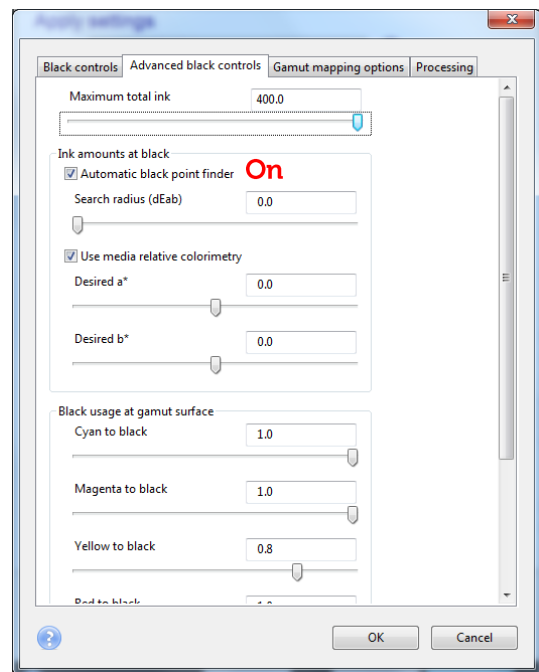
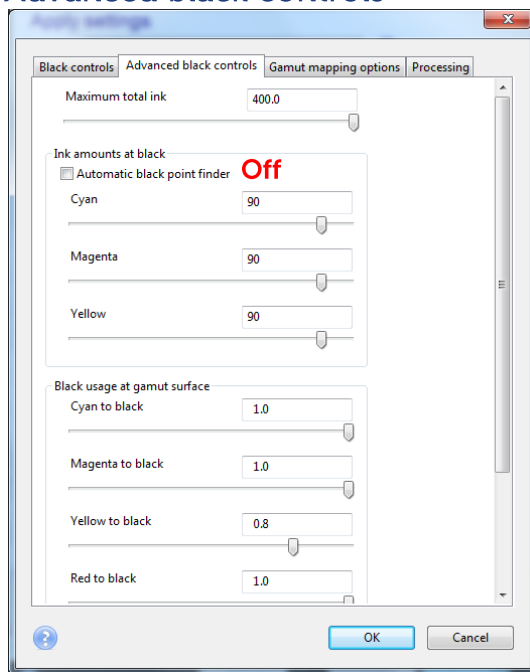
Black generation:

The black-generation adjustment controls the rate at which black ink is added along the white-to-black neutral axis. The adjustments range from 0 to 100 percent. A setting of 0 sets the black addition to its slowest rate (a gamma of 2.0). A setting of 100 sets the black addition to its fastest rate (a gamma of 1.0). As the controls is moved from 0 to 100 percent the rate of black addition increases steadily on the neutral axis.

Black width:

The black-width adjustment controls the rate at which the black ink on the neutral axis is added to increasingly chromatic (more saturated) colors. A setting of 0 percent indicates that the black ink levels on the neutral axis should fall off quickly for colors near the neutral axis. A setting of 100 percent indicates that the black amount on the neutral axis should be held close to the neutral axis level as the chromatic content colors increase. The default setting of 50 percent provides a gradual transition of the black ink amounts on the neutral axis as the chromatic content of the colors increase. Set this control to low values to limit the amount of black ink in lighter chromatic colors. Increase this control to keep the black amounts higher for lighter chromatic colors.

Advanced black controls



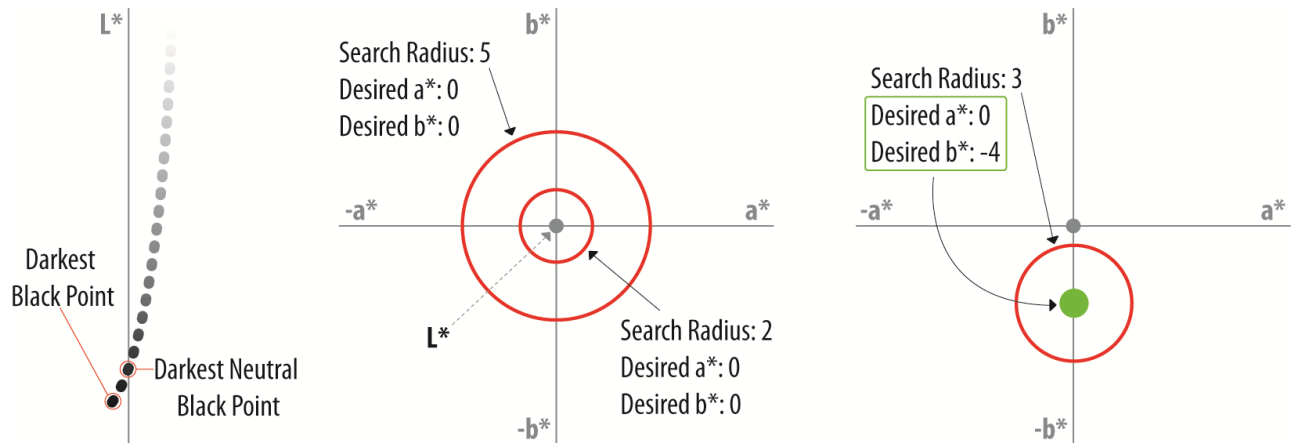
Maximum total ink:

The maximum-total-ink control affects the ink amount. In general, we should leave this slider set to the max. value, because we define the Total Ink Limit in the EPL file.

Ink amounts at black:

If Automatic black point finder is disabled, the Ink amounts at black control sets the targeted ink amounts for the cyan, magenta and yellow inks at the black point of the profile.

If Automatic black point finder is enabled, the Ink amounts at black control shows two new features to find the best black point. In the past, we only considered the darkest neutral black point. But now, we can add a range around the L^* axis or around a a^*/b^* coordinate to find a darker black point.

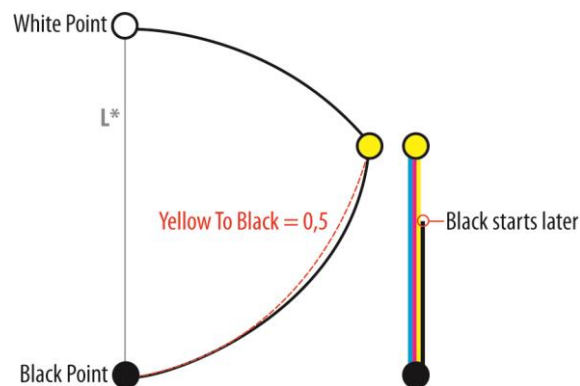


Black usage at gamut surface:

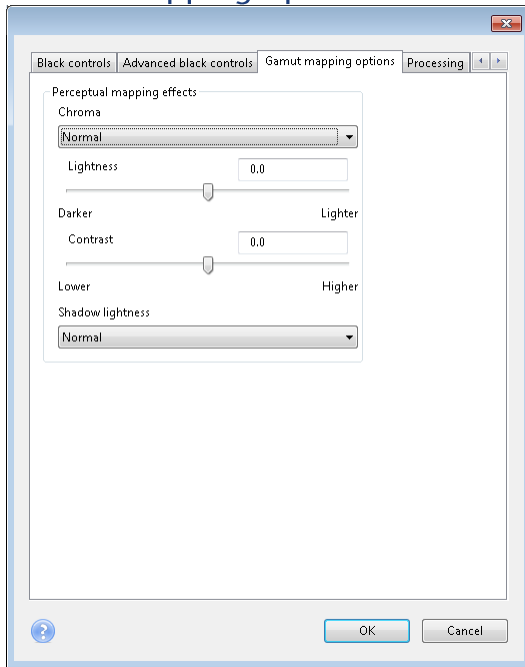
These controls set the rate at which black ink is added to chromatic colors along the gamut surface. They act similarly to the black start and black generation controls (from the black controls).

There are separate controls for the six cardinal hue regions specified by cyan, magenta, yellow, red, green, and blue regions of a hue circle. The adjustment ranges are from 0 (most delayed use of black) to 1 (start darkening with black directly). Typically setting the control to 1 will produce the maximum color gamut in a region but will introduce black ink at higher lightness colors. In some instances, such as in the yellow region, the addition of black ink produces unwanted dot visibility on light colors.

For these cases move the adjustment to lower values to delay the use of black.



Gamut mapping options



Perceptual mapping effects:

Use these controls to adjust the visual appearance of prints made using the perceptual rendering intent.

Chroma:

The chroma-adjustment controls have three levels of chroma boost for the perceptual rendering intent. The default setting is Normal which indicates that no adjustments are made to the chroma of the reproduction. The Colorful mode provides a modest boost of the in-gamut color. Select this mode to create slightly more chromatic output. The Vivid mode provides a more aggressive chroma boost to in-gamut colors. Select this mode when highly saturated colors are the goal.

Lightness:

The lightness-adjustment control globally affects the lightness of the printed colors. Adjusting the controls to larger negative values will progressively darken the reproduced colors. Adjusting the controls to larger positive values will progressively lighten the reproduced colors.

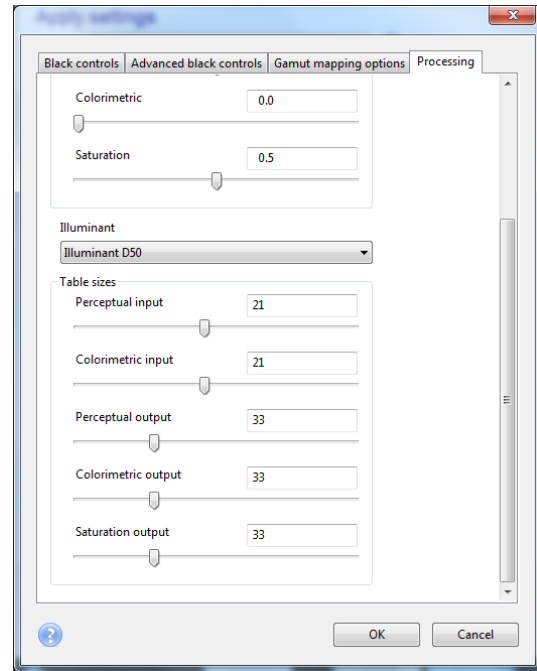
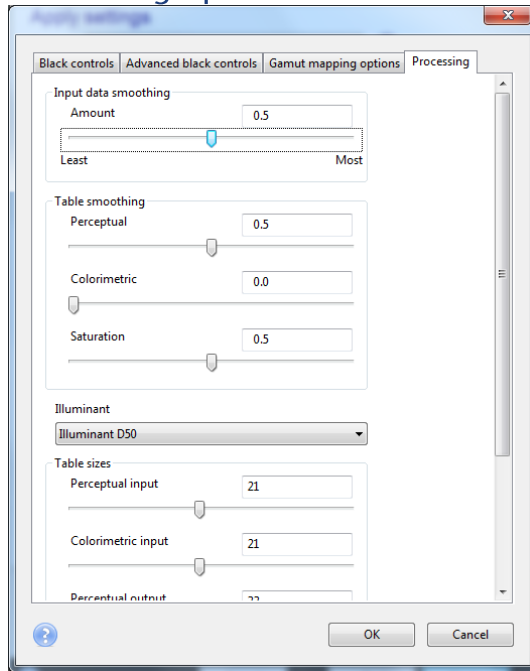
Contrast:

The contrast-adjustments control the global contrast of the printed colors. Adjusting the controls to higher values will increase the contrast of the reproduced colors. Adjusting the controls to lower values will reduce the contrast of the reproduced colors. At the midpoint (0) the original contrast is preserved.

Shadow lightness:

The shadow-lightness control can be used to selectively increase the lightness in dark colored regions while maintaining the lightness in brighter tones. There are three levels of shadow-lightness adjustment: slight, medium, and high. These settings progressively increase the brightness in the darker tone regions. Use these adjustments to enhance the detail in the darker tones. This control is useful for systems with low dynamic range where the shadow detail can be compressed.

Processing options



Input data smoothing:

The input-data-smoothing adjustment controls the amount of smoothing that is performed on the measurement data used to build the forward model of the printer. As the adjustment increases from its lowest value (0 or least) to its highest value the input colorimetric data is progressively smoothed to higher amounts.

At the lowest smoothing setting (0) the profile will most accurately fit the measured data but will be most subject to measurement/printing noise in the data.

At the highest smoothing setting (1) the profile will less accurately predict the measurement data but will be least subject to measurement/printing noise in the data.

At the default position (0.5) a nominal amount of smoothing is applied that balances data-fit accuracy and profile smoothness. Increase this control to smooth out noisy printers. Decrease this control for low-noise printing systems and/or to increase the accuracy of the profile.

Table smoothing:

The table-smoothing adjustment controls the amount of smoothing applied to the $L^*a^*b^*$ to device output tables. Adjustment control values range from 0 (no smoothing) to 1 (maximum smoothing). Values between 0 and 1 progressively increase the smoothing amounts as the value is increased. There are separate controls for the perceptual (B2A0), colorimetric (B2A1) and saturation (B2A2) rendering intent tables. Increase the smoothing amount for rendering of gradients. Decrease the smoothing for more accurate single color predictions. By default, some nominal smoothing is applied to the perceptual and saturation rendering intents.

Illuminant:

The Illuminant Adjustment provides a list of standard illuminations. If you have the same viewing conditions (e.g. D65) at all places and you want to view the results correctly under these conditions, choose D65 Illuminant.

Table sizes:

The table size adjustments determine the number of table entries in the input and output color tables. In general, larger tables produce more accurate colorimetric predictions, take longer to calculate, and result in ICC profiles that take up more disk space. For critical print-reproduction tasks increase the output table sizes. For critical proofing tasks increase the input table sizes. The defaults are intended to produce good multi-purpose ICC profiles.

Profiler setting default values

Below are the recommended settings per printer manufacturer. You do not need to enter these values manually! We have done that for you already in Fiery XF 6.5.

Matan

Black controls	Advanced black controls	Gamut mapping options	Processing	Black controls	Advanced black controls	Gamut mapping options	Processing	Black controls	Advanced black controls	Gamut mapping options	Processing	Black controls	Advanced black controls	Gamut mapping options	Processing
Basic black controls				Maximum total ink				Perceptual mapping effects				Input data smoothing			
Maximum black ink: 100				Maximum total ink: 400				Chroma: Colorful				Amount: 0.5			
Black start: 20				Ink amounts at black				Lightness: 0.1				Least: [Slider] Most			
Black generation: 80				<input checked="" type="checkbox"/> Automatic black point finder				Contrast: 0.5				Table smoothing			
Black width: 50				Search radius (dEab): 2.0				Shadow lightness: Slight				Perceptual: 0.5			
				<input checked="" type="checkbox"/> Use media relative colorimetry								Colorimetric: 0.0			
				Desired a*: 0.0								Saturation: 0.5			
				Desired b*: 0.0								Illuminant			
				Black usage at gamut surface								Illuminant D50			
				Cyan to black: 1.0								Table sizes			
				Magenta to black: 1.0								Perceptual input: 21			
				Yellow to black: 0.4								Colorimetric input: 21			
				Red to black: 1.0								Perceptual output: 33			
				Green to black: 1.0								Colorimetric output: 33			
				Blue to black: 1.0								Saturation output: 33			

Reggiani ONE/NEXT/PRO // VUTEK FabriVU

Black controls	Advanced black controls	Gamut mapping options	Processing	Black controls	Advanced black controls	Gamut mapping options	Processing	Black controls	Advanced black controls	Gamut mapping options	Processing	Black controls	Advanced black controls	Gamut mapping options	Processing
Basic black controls				Maximum total ink				Perceptual mapping effects				Input data smoothing			
Maximum black ink: 100				Maximum total ink: 400				Chroma: Colorful				Amount: 0.5			
Black start: 40				Ink amounts at black				Lightness: 0.1				Least: [Slider] Most			
Black generation: 0				<input checked="" type="checkbox"/> Automatic black point finder				Contrast: 0.5				Table smoothing			
Black width: 50				Search radius (dEab): 2.0				Shadow lightness: Slight				Perceptual: 0.5			
				<input checked="" type="checkbox"/> Use media relative colorimetry								Colorimetric: 0.0			
				Desired a*: 0.0								Saturation: 0.5			
				Desired b*: 0.0								Illuminant			
				Black usage at gamut surface								Illuminant D50			
				Cyan to black: 1.0								Table sizes			
				Magenta to black: 0.4								Perceptual input: 21			
				Yellow to black: 0.0								Colorimetric input: 21			
				Red to black: 0.4								Perceptual output: 33			
				Green to black: 1.0								Colorimetric output: 33			
				Blue to black: 1.0								Saturation output: 33			

VUTEK (CMYK)

Black controls | **Advanced black controls** | Gamut mapping options | Processing

Basic black controls

Maximum black ink

Black start

Black generation

Black width

Black controls | **Advanced black controls** | Gamut mapping options | Processing

Maximum total ink

Ink amounts at black

Automatic black point finder

Search radius (dEab)

Use media relative colorimetry

Desired a*

Desired b*

Black usage at gamut surface

Cyan to black

Magenta to black

Yellow to black

Red to black

Green to black

Blue to black

Black controls | **Advanced black controls** | Gamut mapping options | Processing

Perceptual mapping effects

Chroma

Lightness

Contrast

Shadow lightness

Black controls | **Advanced black controls** | Gamut mapping options | Processing

Input data smoothing

Amount

Least

Table smoothing

Perceptual

Colorimetric

Saturation

Illuminant

Illuminant D50

Table sizes

Perceptual input

Colorimetric input

Perceptual output

Colorimetric output

Saturation output

VUTEK (CMYKOV)

Black controls | **Advanced black controls** | Gamut mapping options | Processing

Basic black controls

Maximum black ink

Black start

Black generation

Black width

Black controls | **Advanced black controls** | Gamut mapping options | Processing

Maximum total ink

Ink amounts at black

Automatic black point finder

Search radius (dEab)

Use media relative colorimetry

Desired a*

Desired b*

Black usage at gamut surface

Cyan to black

Magenta to black

Yellow to black

Red to black

Green to black

Blue to black

Black controls | **Advanced black controls** | Gamut mapping options | Processing

Perceptual mapping effects

Chroma

Lightness

Contrast

Shadow lightness

Black controls | **Advanced black controls** | Gamut mapping options | Processing

Input data smoothing

Amount

Least

Table smoothing

Perceptual

Colorimetric

Saturation

Illuminant

Illuminant D50

Table sizes

Perceptual input

Colorimetric input

Perceptual output

Colorimetric output

Saturation output

Hints on saving ink

The following settings will help you to achieve a specific compromise between gamut size, graininess and ink saving.

Note that ink saving is very application-dependent. Saving ink at the expense of smoothness may be perfectly fine for an outdoor advertisement viewed from a typical distance of 3-5 m, but less aggressive ink saving might be more appropriate for an indoor advertisement and a viewing distance of 50 cm.

Recommended linearization tools for ink saving:

Step	Feature/setting	Ink saving potential	Risk	Recommended for ink saving?
Ink Limit and Linearization	Lower "Norm ink"	Medium	Loss of gamut	No
Ink Limit and Linearization	Lower "Norm ink start"	High	Increased graininess	Yes
Ink Limit and Linearization	Lower "Light ink in full tone"	High	Loss of gamut, increased graininess	Yes
Total Ink Limit	Lower "TIL" limit	Low	Loss of gamut, inversions	No

Recommended profiling settings for ink saving:

Step	Feature/setting	Ink saving potential	Risk	Recommended for ink saving
Black Controls	Lower "Black start"	Medium	Graininess	Yes
Black Controls	Increase "Black Generation"	High	Graininess	Yes
Black Controls	Increase "Black Width"	Medium	Graininess	Yes

Compatibility

Note that Fiery XF 6.5 EPLs cannot be used in Fiery XF 6.4 or earlier versions!