Fiery® XF/Fiery XF proServer
Advanced Calibration And Profiling Guide

Content

Fiery XF Color Tools Calibration Wizard

The Advanced Calibration and Profiling Guide is designed to give additional information about how to calibrate and profile EFI WideFormat, Super-WideFormat and EFI roll-to-roll Super-WideFormat printers like EFI VUTEk h3/h5, EFI VUTEk 32r+ or EFI VUTEk 3r+/5r+ as well as some third-party printers from Roland and Mimaki. Please refer to "Table of third-party printer using Advanced Linearization" at page 31.

To connect these devices to a Fiery XF Server, please see the related printer driver supplement available at https://help.efi.com.

Set up Fiery XF Color Tools

Purpose of this step

The Color Tools Settings allow you to define the basic parameters of your calibration, such as the resolution, color mode, dot size, and halftoning method.

1 Printer settings

Select the printer you want to calibrate, and one of the supported printer types (i.e. with additional colors such as White, Clear or Varnish) from the drop-down menu.

Note: To set up a PreInkLimit for all colors (including White, Clear or Varnish) inside of the linearization process, the related driver with White and/or Clear ink must be selected. If this is not needed and the White/Clear settings are done on the printer itself, select the printer driver without any special color for linearization.

2 Measuring device settings

Select one of the supported measurement devices from the drop-down menu. Click the Settings button to adjust the options of the chosen device. Some of the options, such as the patch size, control the layout of the chart and how many individual pages are printed and to be measured. Larger patches typically result in more accurate measurements. Please refer to "Measuring Device Recommendations" on page 33 for more information.

Other options, like the measurement mode (M0, M1, M2, M3) control how the measurement device reads the chart. It is recommended to use M1 as the default measurement mode. Please refer to "EFI recommends using M1 measurement mode" on page 32 for more information.

3 Halftoning settings

The halftone process controls how the dots are placed. Fiery XF supports three different halftone processes. Select the halftoning method that is most suitable for your application.

Halftoning methods in comparison:

Halftoning method	Comments
Contone	Some printers in Fiery XF apply the halftoning method for the printer, as defined by the device manufacturer. The halftone method is integrated into the media setting for the printer. Although the media setting takes into account all the available inks on the printer, in Fiery XF it is only possible to edit CMYK ink curves.
Error Diffusion (SE1)	To determine whether a dot will be placed or not, a special algorithm is applied which evaluates neighboring dots. If the result of the evaluation is above a certain threshold, the dot will be printed. If the result is below the threshold, the dot will not be printed. The evaluation process is complex and therefore it takes longer to calculate than SE2. However, it creates a smoother and more even appearance compared to SE2 at the same resolution.
Stochastic Screening (SE2)	For this halftoning method, the dots are arranged according to a pre-calculated random pattern to make homogenous areas appear as smooth as possible.

For information about setting up the halftoning method, see "Selecting right Halftoning method" on page 35.

4 Optional calibration steps

The calibration in Color Tools provides two optional steps:

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

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 Fiery Color Profiler Suite create ICC profiles with an optimized gray reproduction. Due to the updated calibration curve

algorithms, this step is typically not needed. As long as the jobs are processed with Color Management, it is recommended that you do not select this option to save time, ink, and media, because the ICC media profile handles the gray balance based on the calibration of the printer.

Select the "Quality Control" step if you want to evaluate and/or compare the resulting gamut of your calibration before creating a profile. You can change parameters before you print the profiling target. By selecting this step, you can evaluate the gamut and compare it to reference profiles such as e.g. GRACol, ISOcoated v2, PSO Coated v3, or any custom profile (e.g. a profile from another EFI VUTEk printer) that you load. Without printing the "Quality Control" chart, the calibration report (Summary) will not include the information about L*a*b* values of the primary and secondary color and does not include a gamut graph.

Note: *It is difficult for our EFI Support Team to troubleshoot without the L*a*b* data from the "Quality Control" step. Please ensure that the L*a*b* data is available when you file a service request for media profile or linearization issues.*

Ink Limit and Calibration

Depending on your print application (indoor/near-distance view, outdoor/far distance view), you selected a color mode with or without light inks. When light inks are used, each input channel must be split into a separate channel for light ink and norm ink. This splitting is handled by a so- called "light ink curve" and "norm ink curve." For color modes without light ink, there exists only one curve.

The primary reason to use light ink is to achieve a smooth transition in the highlights because each drop contains fewer pigments. This is important for indoor/near distance applications, where the observer may come so close to the print (below 24 inches or 60 cm) that he could see the individual norm ink drops. Printing highlights with norm ink only would cause the print to look grainy when looking at it from near distance. This can degrade the visual print quality, for example, in cosmetic advertisement or where lighter skin tones are printed.
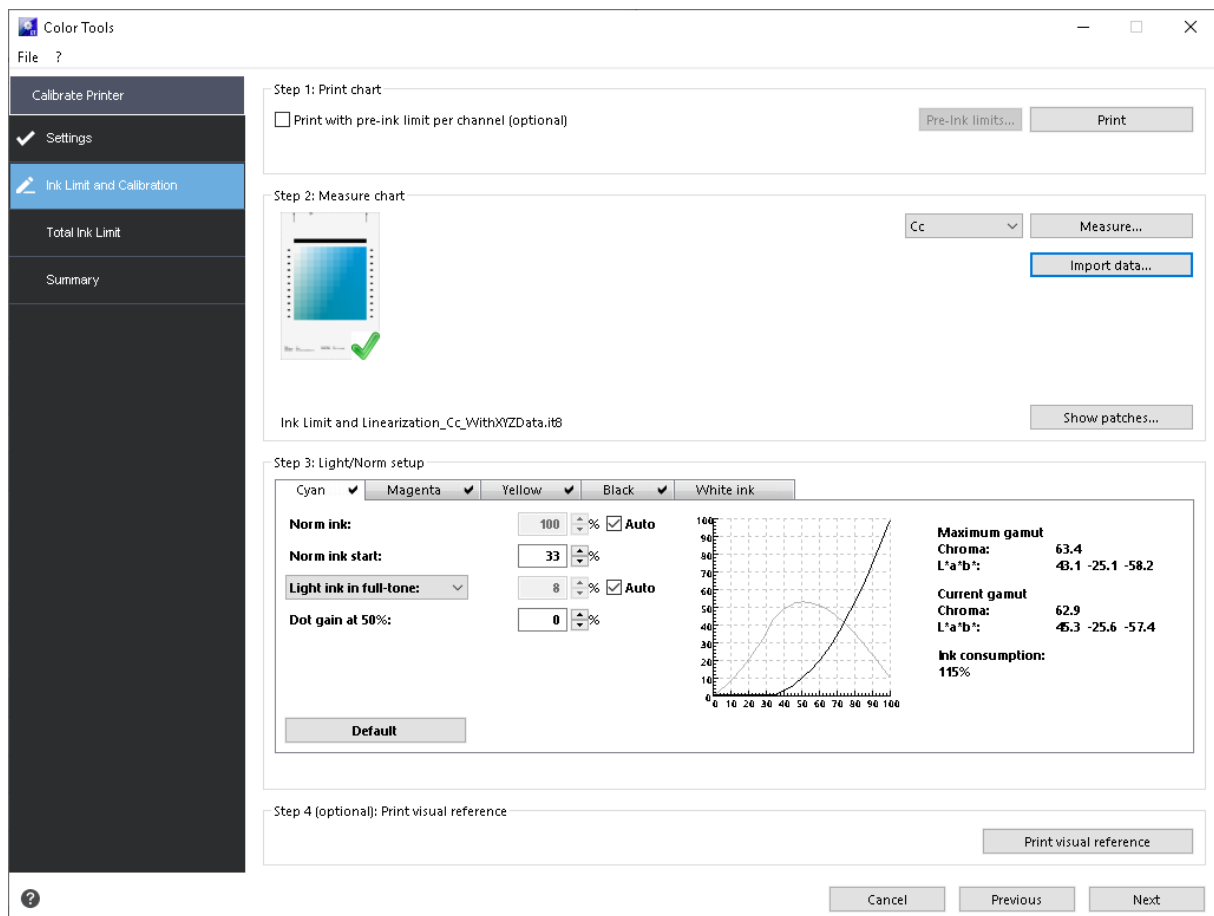
Printing highlights with light ink results in smooth transitions and improve the visual print quality.
Light ink can also support the norm ink in the higher tone values, for example to avoid graininess when printing at low resolutions.
The norm ink does not cover the media sufficiently and unprinted substrate remains between the norm ink drops. Adding light ink in the full tone can help to fill these gaps and create a smoother/less grainy appearance in the higher tone values.
Whenever your application does not require light inks, it is recommended to use a print mode with norm ink only.

Using light inks require special care in the calibration, because it increases the overall ink usage, which in turn increases the printing cost. Therefore, it is recommended to use the light ink economically that is to use only as much light ink as needed. How much light ink you need varies depending on your printer, inks, media, resolution, and press parameters (curing/drying time, number of passes, etc.).

The following section shows you the ink controls in Color Tools and how to use them. We give some recommendations wherever needed, but there is not a golden rule that always applies. By default, Color Tools automatically determines settings that result in good quality in most cases. Be prepared for some systematic trial and error before you find an optimal set of settings for your printer and application.

Purpose of this step

The "Ink limit and Calibration" 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.
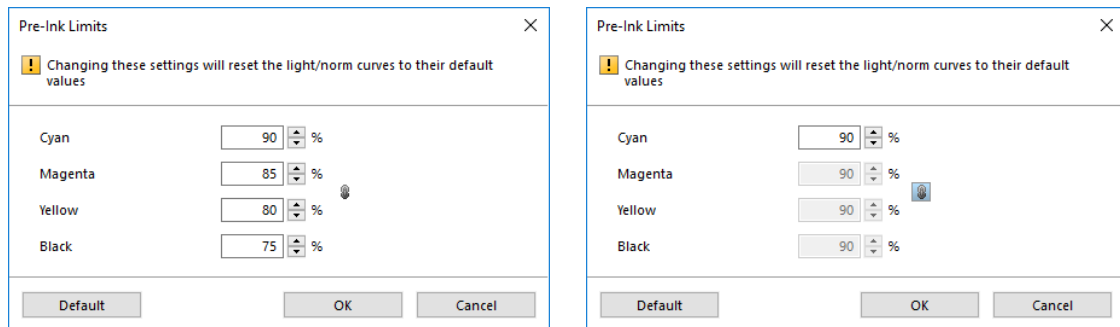
It is designed to

- o Calibrate the printer channels to create a smooth, visually linear output
- o Set norm ink limits to avoid over-inking or optimize the gamut size
- o Set norm ink start to avoid visual artifacts at the light/norm ink transition
- o Set light ink in full tone to create smoother output in higher tone values
- o Set light ink end point for additional ink-saving
- o Set the dot-gain at 50% to adjust the printer response (in special cases only)

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

1 Print Chart

Clicking the Print button creates one or more calibration jobs in Fiery Command WorkStation that needs to be printed. If you detect printing artifacts like bleeding, mottling, coalescence, ink excess, etc. for your printer/media combination, you need to change the Pre-Ink limits as follows:

- Select the "Print with pre-ink limit per channel (optional)" check box.
- Click the "Pre-Ink limits" button to open the Pre-Ink Limits panel.
- Enter pre-ink limits for each channel individually or click the small chain icon to
- set all channels to the same value. Norm and light inks are limited automatically to the same value.

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

Note: *VUTEk UV printer drivers: For some printer models, pre-ink limits are applied to all 1000 dpi resolutions. The printer gamut at 1000 dpi resolution is matched to the gamut at 600 dpi resolution. If you want to use the full gamut capabilities of the 1000 dpi mode (for example, for backlit applications), reset all pre-ink limits for the 1000 dpi resolution to 100%.*

2 Measure chart

Click the Measure button and follow the on-screen instructions on screen or click Import Data to import existing measurement data from a previous calibration that matches your printer, media, and calibration settings.

3 Light/Norm setup

A check mark appears on each tab if measurement data is available. Ink limits are automatically set to achieve the largest gamut for your printer, media, calibration settings, and pre-ink limits. If the print mode uses light ink, a maximum of 45% light ink in full tone is set automatically.

These automatic ink limits can be adjusted by the user, for example, to additionally save ink by reducing the ink limits without a significant reduction in chroma or increase in lightness.

Note: *The ink limit values in Color Tools are shown without taking the pre-ink limit into account, but internally the ink limits are applied properly.*

The displayed values for C* (chroma) and L*a*b* can be used as a guidance to select good ink limits.

- Maximum gamut values are calculated automatically and represent the largest C* (chromatic inks Cyan, Magenta, and Yellow) or the lowest L* (Black ink).
- Current gamut values are based on the ink limits currently set.

To avoid shrinking the gamut size significantly it is recommended to

- not reduce the C* value less/equal than 1.5 units for chromatic inks.
- not increase the L* value by more/equal than 2.0 units for Black ink.

Note: *You can always return to the default settings by clicking the Default button on each ink channel tab.*

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 calibration and pre-ink-limit into account.

- 100% is equivalent to an uncalibrated input channel of norm ink only.
- For light/norm: 200% is equivalent to an uncalibrated input channel (= 100% light ink uncalibrated + 100% norm ink uncalibrated).

As the calibration compensates for the printers' natural dot-gain, the ink consumption value is typically below 100% for a norm ink only channel and below 200% for a channel created with light and norm ink.

The calculated default curves can be customized by some additional controls. Please see "Customize Light/Norm Curves" on page 36 for details.
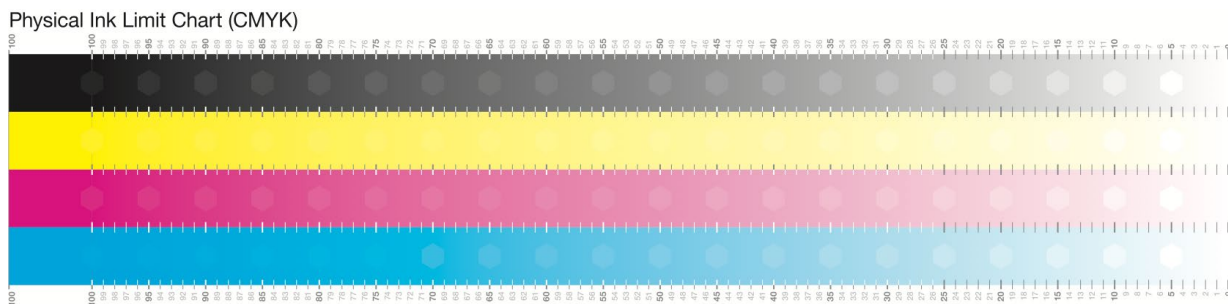
4 Print visual reference (optional)

You can review the quality of the current calibration settings by clicking the Print Visual Reference button. A new job with color gradients (as seen below) is created in Fiery Command WorkStation.

Note: *For EFI Reggiani printers, this step is not available.*

As larger prints allow a better visual inspection it is recommended, to print the job with a proportional scaling-factor greater than 100%, for example 200%, if the media width allows.
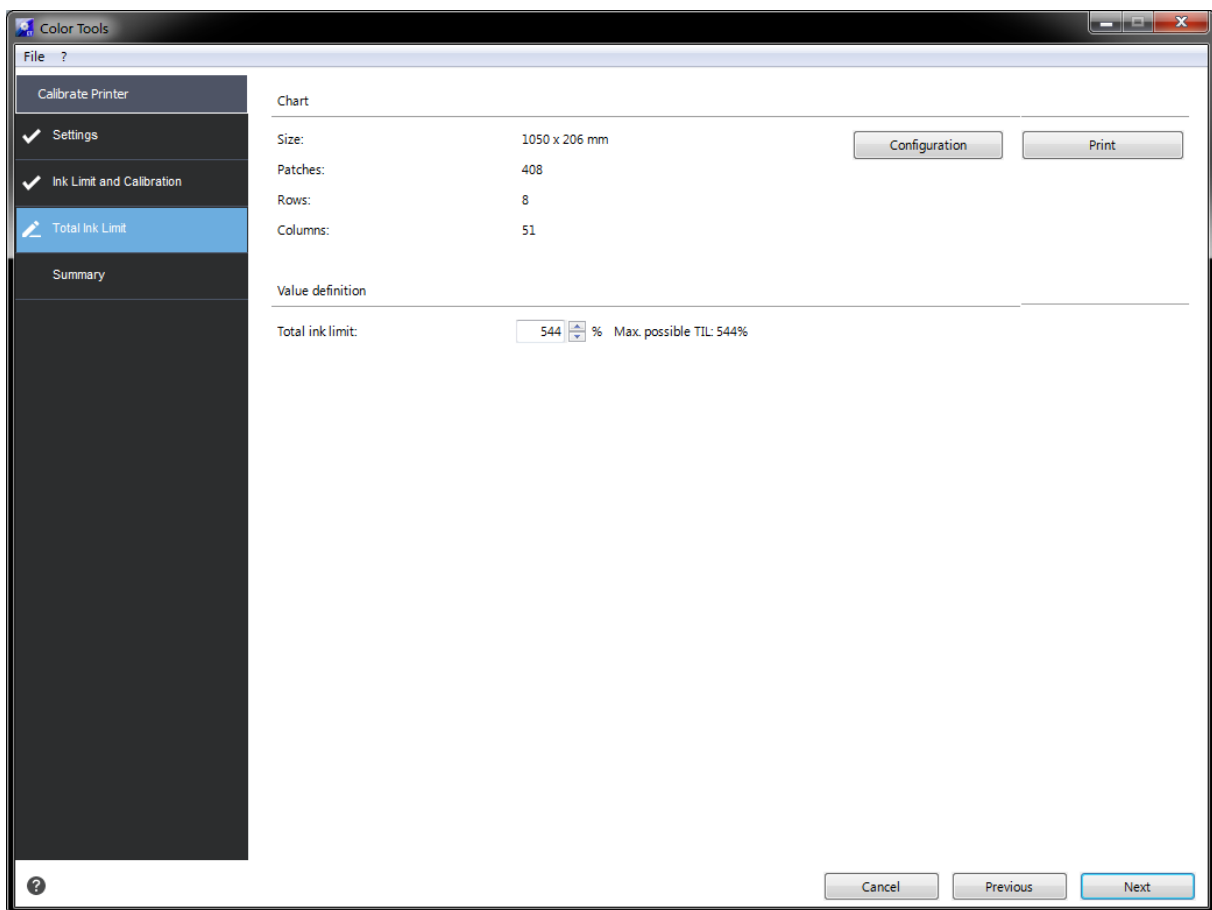

Each gradient in the print shall be inspected visually with a focus on printing artifacts in these areas:

- Norm ink start: a distinct visible step/band or grainy appearance of the norm ink drops
- Light ink end point (if selected): a distinct visible step/band
- Highlights to mid-tones: visible steps/bands
- Check all gradients for graininess and adjust the Norm ink start to a higher value if needed
- Check all gradients for gloss banding and adjust the Light ink in full tone for an improved result
- Use an asymmetric scaling value creating portrait formatted patches to get a better visualization of the passes.

Note: If you see gloss banding, it is very likely that this cannot be resolved completely by adjusting the calibration settings. Contact the EFI Technical Support to check if your printer operates within its specification.

Note: If you see banding in general, a reduction of light ink in full tone, even a light ink end point lower than 100% could help.

Total Ink Limit

Purpose of this step

The "Total Ink Limit" step allows you to set a total ink limit (TIL) in percent.
TIL acts as a global ink restriction with the following goals in mind:
- 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. For more information, see "Setting TIL without printing" on page 49.

The Total Ink Limit window contains basic information about the chart, and uses 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 the Print button.

To customize the chart layout, click the Configuration button to open the Chart configuration window. For more information, see. "TIL Chart Configuration" at page 48 for details.

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 the full tone ink limits (norm and light inks) set in the previous step (Ink Limit and Calibration). The pre-ink-limit for each channel is taken into account.

Note: 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%.

Note: A too high total ink limit can increase a banding effect.

Below the TIL value definition, the following warning messages can appear as a result of your settings:

1. The chosen TIL value might limit the possible printer gamut.

Sometimes it is not possible to avoid this message as over-inking artifacts would occur otherwise. But the warning should alert the user to review his choice and adjust if needed.

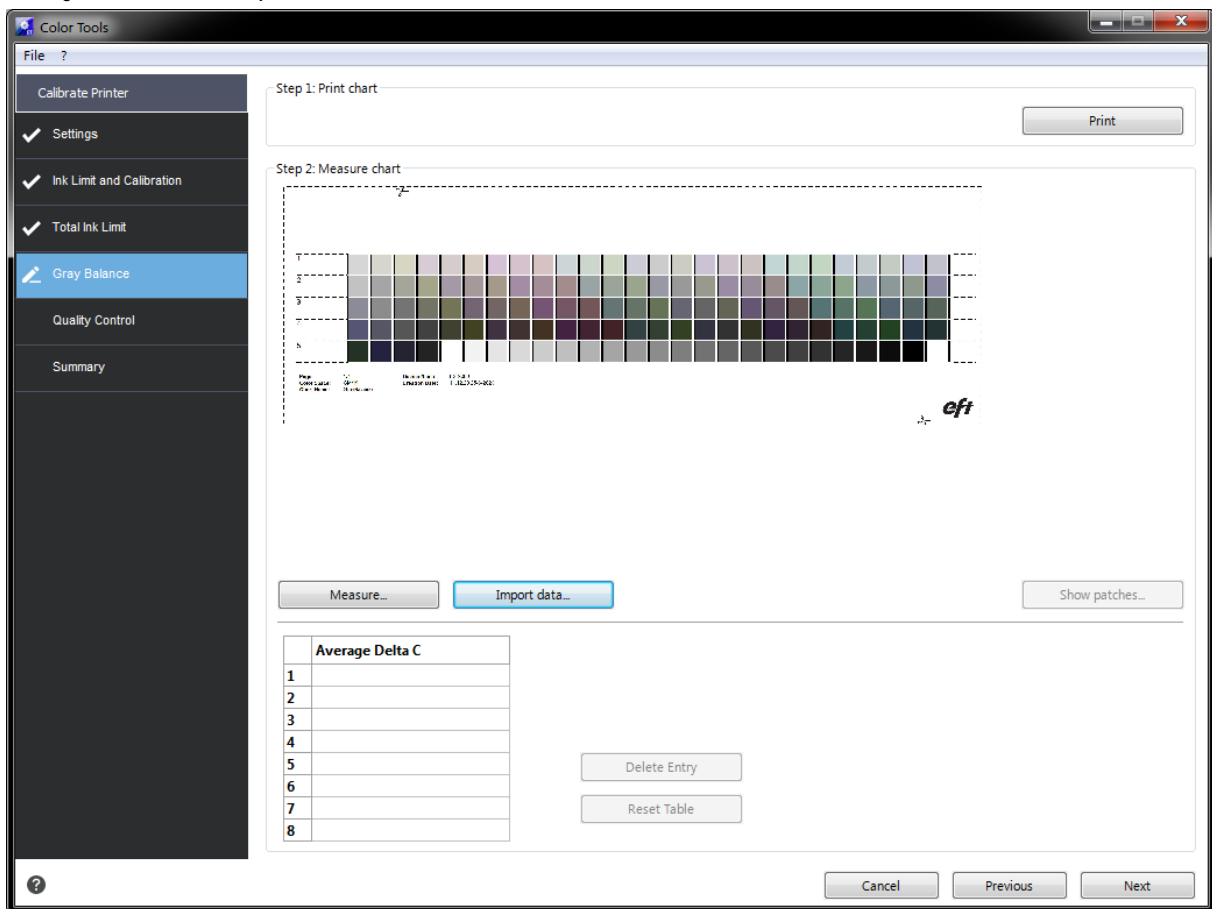2. The TIL chart size exceeds the media size of the calibration device.

The user can adjust the chart settings 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

For information about reading and interpreting a TIL chart to find a suitable total ink limit, see "Reading the TIL chart" at page 45

Gray Balance (optional)

Purpose of this step

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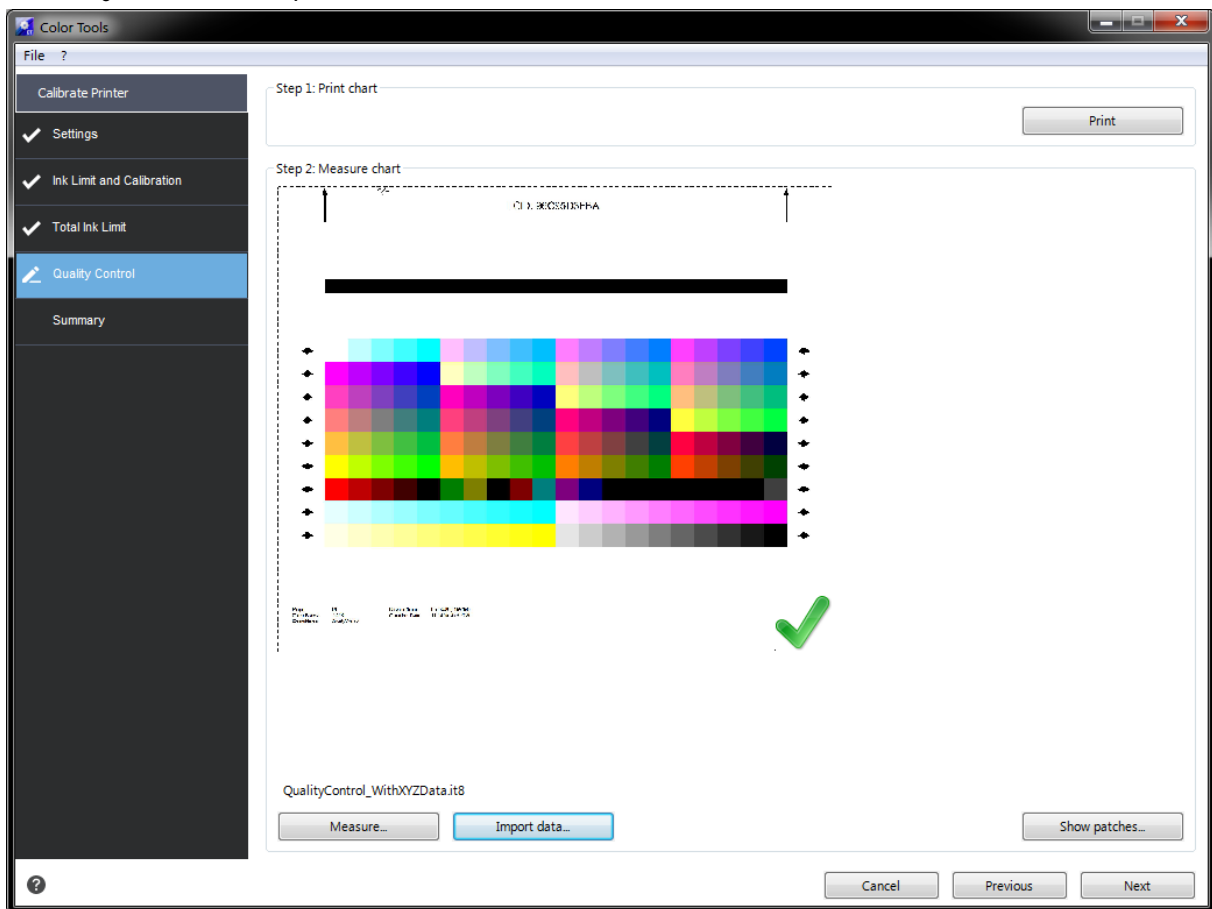
Typically, the 3-dimensional lookup tables of the ICC profile generation will take care of the reproduction of neutral grays. If you align C, M, and Y beforehand, it can make the job easier for the profiler, especially when smaller charts are used.

Proceed as follows:

- Print the chart.
- Measure the chart.
- Review the resulting "Average Delta C".
  - The "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 clicking Next. It is recommended to skip this step for EFI VUTEk, EFI Matan, and EFI Reggiani printers!

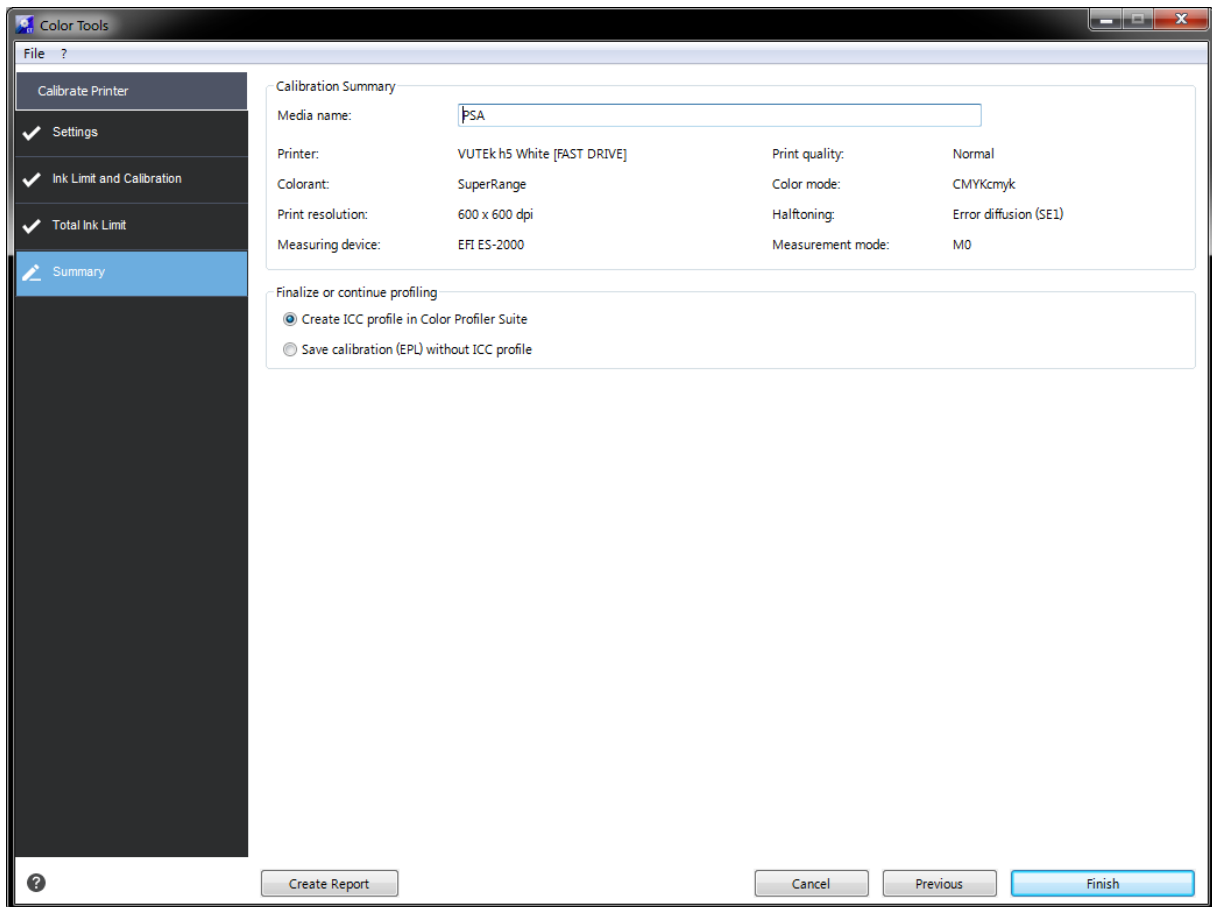## Quality Control (optional)

Purpose of this step

The "Quality Control" step captures the color foundation of your calibration by measuring representative color patches. Capturing this measurement data is very useful if you want to evaluate or 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 calibration in the "Summary" step and to show additional information in the calibration report.

Print and measure the Quality Control chart to unlock gamut comparison 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 calibration steps you have already completed are not lost.
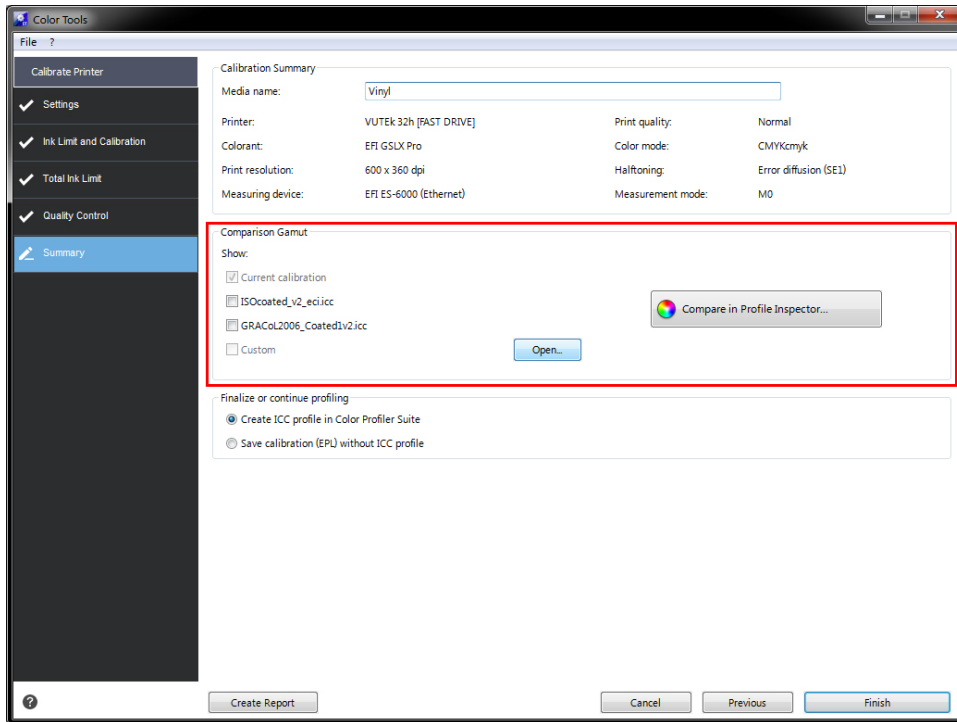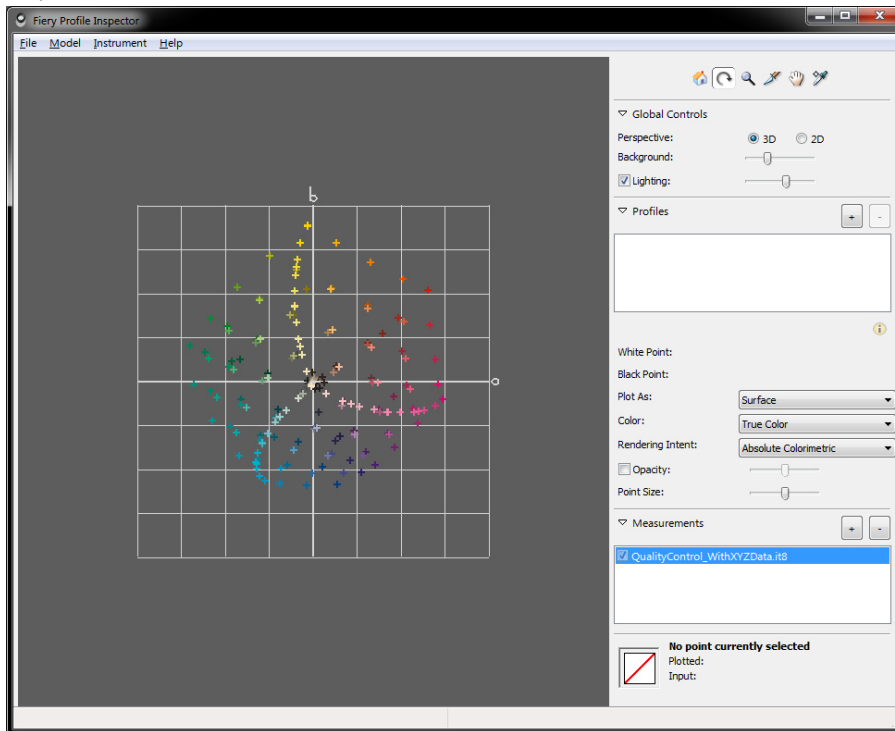
Summary

Purpose of this step:

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

Click the Create Report button at the bottom of the Color Tools window to open an HTML report in a web browser that summarizes all calibration settings, displays a gamut boundary (requires measurements of the Quality Control chart), and the calibration curves.

In the case that the optional Quality Control step was used, and a chart is measured, the "Summary" step allows you to do a gamut comparison.

You can evaluate or compare the gamut of your calibration with one of the standard reference color spaces and/or any custom ICC profile. Click the Compare in Profiler Inspector button to start the Fiery Profile Inspector.

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

Note: *Starting with Fiery Color Profiler Suite v5.3.0, there is no longer a profile been rendered when Fiery Profile Inspector is started. Therefore, you will not see a 3D-corpus.*

Fiery Printer Profiler

Finalizing the calibration of a printer using Fiery XF Color Tools can use the Fiery Printer Profiler directly to create a media profile. Therefore, when you select the "Create ICC profile in Color Profiler Suite" option and click the Finish button, you will be asked to save the calibration in an EPL and to start the Fiery Printer Profiler from Fiery Color Profiler Suite.

On the other hand, the calibration of a printer with Fiery XF Color Tools can be completed by using the "Save calibration (EPL) without ICC profile" option. In that case, you are redirected back to the start screen of Fiery XF Color Tools and can start to create a media profile.

Creating a Media Profile

To create a media profile with Fiery XF, you can use Fiery XF Color Tools to start the Fiery Printer Profiler. In the start screen of Color Tools, you will find the "Create Media Profile" and "Create Profile from Measurement" options.
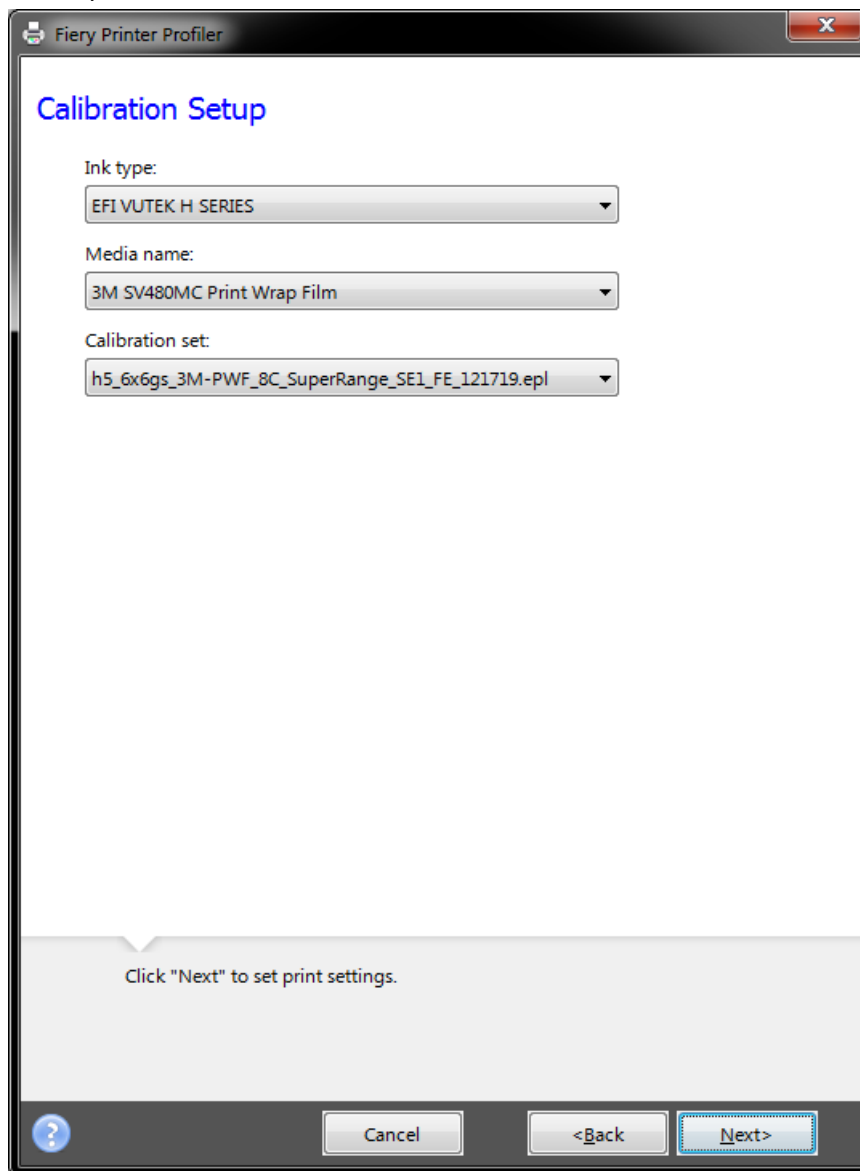
Set up Fiery Printer Profiler to create a Media Profile

Purpose of this step

When using the "Create Media Profile" option, you can create a printer-related media profile by connecting to a Fiery XF server.

After adding a valid profile name, you need to choose a Fiery XF server by typing the server name or IP address. If the connection is successful, you can select the printer type and model for profiling.

Click the Next button. In the Calibration Setup window, you can choose printer-related ink type, media name, and calibration set (EPL).
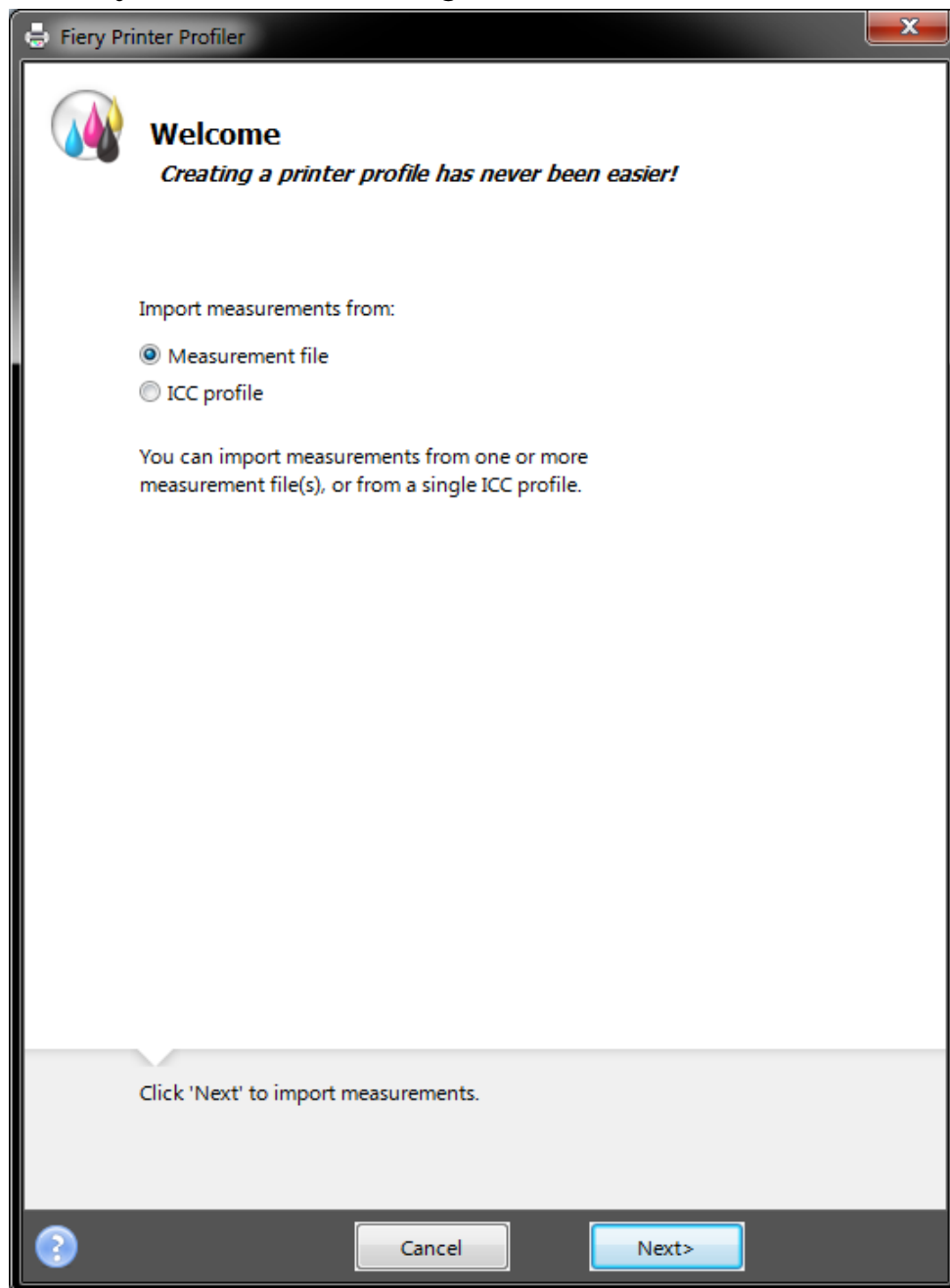
Calibration Setup

Purpose of this step

Depending on the printer model selected in the "Calibration setup" step, you can choose the ink type, media name, and calibration set for profiling. Based on these settings, the profiling chart is printed based on the measurement device, patch layout, and chart size selected in the <u>"Profile print settings"</u> step on page 17.

Set up the Fiery Printer Profiler using a measurement file

Purpose of this step

The Create Profile from Measurement option in ColorTools allows you to start profiling by importing measurement data from either a file or an ICC profile. This step allows you to make a selection according to either an ICC profile or measurement data when you click the Next button.

Note: The 1847 patch chart is the recommended profiling chart to use. This chart is optimized for the forward model of the Fiery Printer Profiler. Use the IT8.7/3, EFI2002, or IT8.7/4 chart for a standardized profiling chart. If you want to create a profile with a third-party product, it is recommended that you use the IT8.7/4 chart.
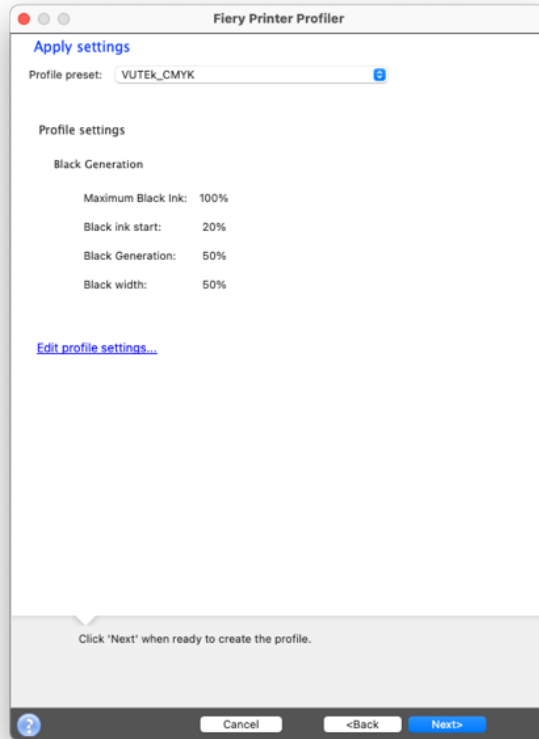
Fiery Printer Profiler Settings

A summary window is prompted, as shown below, whether the measurement data is coming from measuring a target or importing data. If the measured data contains redundant patches, average and maximum ΔE00 values are shown for these patches as an indicator of measurement data quality.
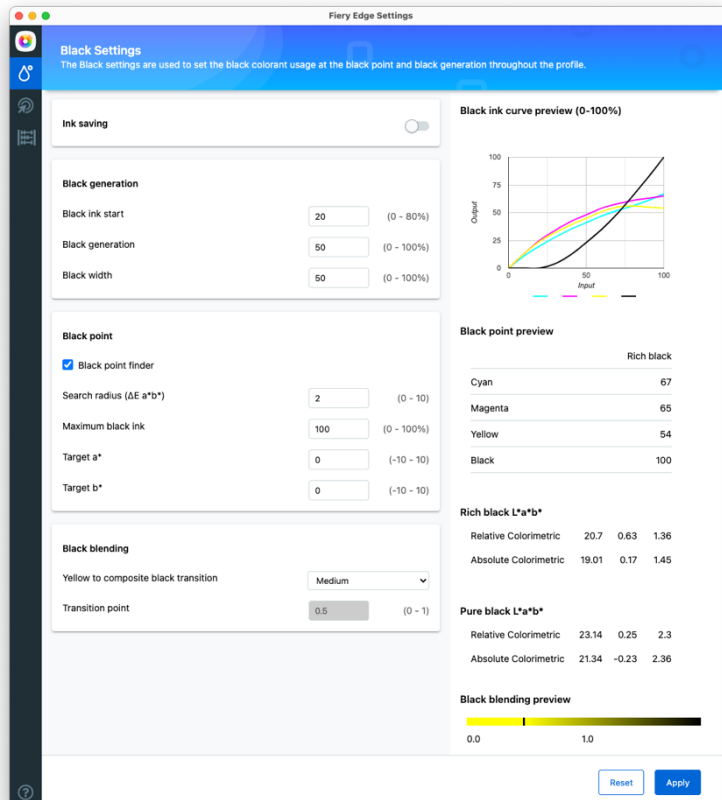

Click Next. In the next window, you can do the following:

- Select a Profiling preset.

- View a summary of the most relevant profile settings, such Black Generation.

- Customize the settings by clicking the "Edit profile settings" option and configuring the preferred parameters.

Fiery Color Profiler Suite version 5.4 implements a new profiling engine, named "Fiery Edge," and a revised user interface consisting of three tabs: "Black settings," "Gamut mapping," and "Processing," as shown in the following screenshots.

Black settings

The Black settings are used to set the black colorant usage at the black point and black generation throughout the profile.

Ink saving

Ink saving is a unique feature of the Fiery Color Profiler Suite. The pane is active or not, depending on the user license. Please contact your Fiery XF reseller for an Ink Saving License for EFI or non-EFI printers, depending on your hardware. The Ink saving feature requires Fiery XF server v7.2 or later. The Ink saving technology (based on ΔE00 tolerances) will reduce the ink amount on top of the general GCR settings. Three different amounts of ink savings are possible: "Low," "Medium," and "High." The ink saving setting will visually affect the relevant black generation parameters and set them to values that are inline with the ink saving strategy. If you change any of the black settings manually after selecting an ink saving setting, the current ink saving setting may change from low, medium, or high. These levels combine stronger GCR values with so-called Smart Ink Saving values to achieve different amounts of ink savings. For more information, see the "Ink saving" chapter.

Black generation

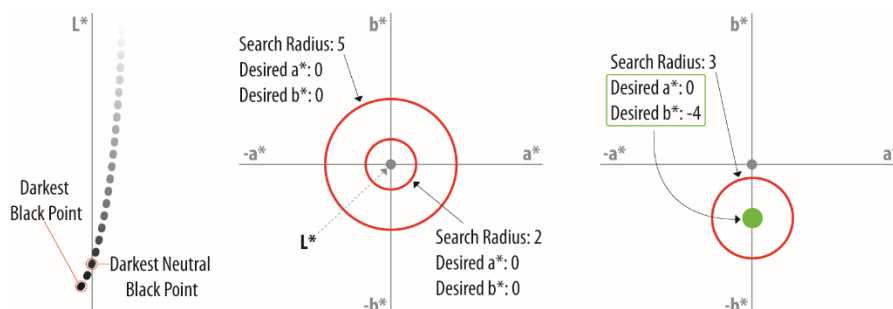The Black generation settings mostly affect the profile characteristics.

- The "Black ink start" setting 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 media white. You might adjust this value to adjust the stability of the gray balance or to reduce graininess in highlights when the black screen is grainy.

- The "Black generation" setting controls the rate at which black ink is added along the white-to-black neutral axis. The adjustments range from 0% to 100%. 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 setting is modified from 0 to 100 percent, the rate of black addition increases steadily on the neutral axis.

- The "Black width" setting controls the rate at which the black ink on the neutral axis is added to increasingly chromatic (more saturated) colors. A setting of 0% indicates that the black ink levels on the neutral axis should fall off quickly for colors near the neutral axis. A setting of 100% indicates that the black amount on the neutral axis should be held close to the neutral axis level as the chromatic content colors increases. The default setting of 50% 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.

Black point

The Black point controls are specified in Relative Colorimetric values. The Black point pane sets the black point of the profile and shows different settings depending on whether the (automatic) "Black point finder" is active or not. When the "Black point finder" is active, the Fiery Edge Profiler will automatically identify a black point, honoring the chosen constraints:

- The "Maximum black ink" value sets the targeted amount of black ink (K) used for the black point. Valid input ranges are from 0% to 100% (default value). A value lower than 100% is unusual and should be used carefully.

- The target (a*, b*) axis; default is almost always (a*, b*)=(0, 0) (aim for a neutral black point).

- The "Search radius" around the chosen (a*, b*) axis.

The previous settings mean that the profiler aims for the darkest ink combination inside a cylinder centered in (a*, b*) having a radius defined by the "Search radius." As an example, having (a*, b*) = (0, 0) and "Search radius" higher than 0 allows the profiler to choose a non-neutral black point, if this point is darker than a neutral one. The descriptions above are graphically summarized below.
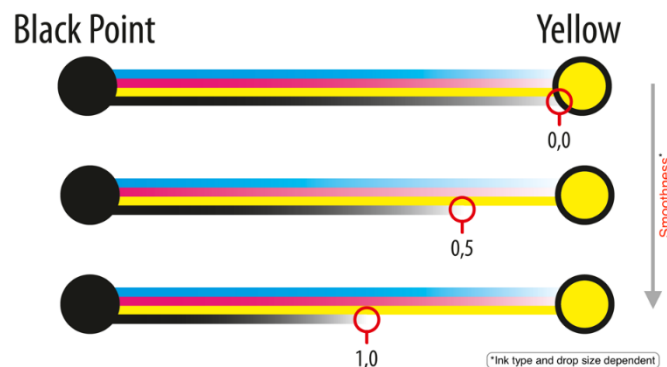
When the "Black point finder" is not active, youcan enter the desired ink combination at the black point.

Black point		
☐ Black point finder		
Maximum black ink	100	(0 - 100%)
Cyan	67	(0 - 100%)
Magenta	65	(0 - 100%)
Yellow	54	(0 - 100%)

Only CMYK inks contribute to the black point. Additional inks, like Orange, Violet, Red and Blue do not contribute even in HT driver mode. Anyway, it is generally discouraged to choose an arbitrary ink for the black point; this could lead to sub-optimal transitions to the black point and artifacts in prints. Please always check the preview pane to get relevant information about the current choices.

Black blending

The Black blending control sets the rate at which black ink is added to the yellow along the gamut surface. It acts similarly to the black start and black generation controls (from the Black settings controls). The adjustment ranges are 0 (start darkening with black ink directly) to 1 (most delayed use of black ink). Setting the control to 0 will produce the maximum color gamut in a region but will introduce black ink at higher lightness colors. In the yellow region, the addition of black ink produces unwanted dot visibility on light colors. For these cases, move the adjustment to higher values to delay the use of black.

Preview

The Preview pane shows an interactive and auto-updating preview of the following items:

- "Black ink curve preview (0-100%)" - Shows the relationship between the input value and the actual output colorant value as a percentage. It shows the composition of the neutral grays (gray line), from media white (0%) to the black point (100%).

- "Black point preview" - Shows the L*a*b* values for CMYK and the inking of the black point.

- "Rich black" - The Rich black values are set according to the values defined in the Black point controls. Both Relative Colorimetric and Absolute Colorimetric values are shown for comparison purposes.

- "Pure black" - Pure black represents the colorimetry of black ink only. Both Relative Colorimetric and Absolute Colorimetric values are shown for comparison purposes.

- "Black blending preview" - Shows the color shift from solid yellow to composite black. Solid yellow is 100% Y.

Gamut mapping

The Gamut mapping controls adjust the visual appearance of prints made using the perceptual and saturation rendering intent.

Perceptual gamut mapping

The Perceptual gamut mapping options allow you to adjust related mapping effects. Use the following controls to change the visual appearance of prints made using the perceptual rendering intent.

- The "Chroma" controls have three levels of chroma boost for the perceptual rendering intent. The default setting is the Normal mode, which indicates that adjustments are not 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.

- The "Brightness" 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.

- The "Contrast" control globally affects 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.

- the "Brightness in shadow area" control can be used to selectively increase the lightness in dark colored regions while maintaining the lightness in brighter tones. There are four levels of Brightness in shadow area adjustment: Normal, Lighten shadows (low), Lighten shadows (medium), and Lighten shadows (high). These settings progressively increase the brightness in the darker tone regions 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.

Saturation gamut mapping (Fiery Intensify)

The combination of all settings in this pane is the so-called "EFI Fiery® Intensify," an innovative rendering intent technology that boosts color, saturation, and intensity without compromising gray balance and keeping natural-looking skin tones. Compared to the perceptual mapping options, the saturation mapping effects deliver brighter and more saturated colors
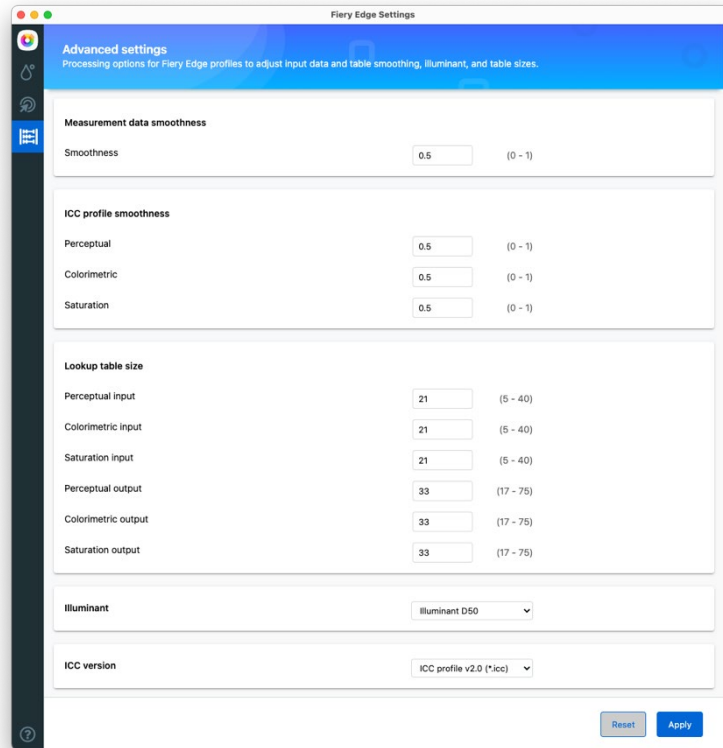
- The "Chroma" option has four levels of chroma boost for the saturation rendering intent. The "Normal" mode, the default setting, indicates that adjustments are not made to the chroma of the reproduction. The "Low" mode provides a modest boost of the in-gamut color. Select this mode to create slightly more chromatic output. The "Medium" and "High" modes provide a more aggressive chroma boost to in-gamut colors. Select the High mode when highly saturated colors are the goal.

- The "Brightness" 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.

- The "Contrast" globally affects 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.

- The "Brightness in shadow areas" control can be used to selectively increase the lightness in dark colored regions while maintaining the lightness in brighter tones. There are four levels of Brightness in shadow area adjustment: Normal, Lighten shadows (low), Lighten shadows (medium), and Lighten shadows (high). These settings progressively increase the brightness in the darker tone regions 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.

- The "Reference for Fiery Intensify rendering" option defines how the colors in your image are processed based on the reference RGB profile. Set the reference RGB profile for using Fiery Intensify output profiles to either sRGB(PC) or Adobe RGB (1998) to produce vivid and highly colored prints. It makes the best use of the gamut of your printer. It is recommended to use Adobe RGB for display graphics, soft signage, and textile, and to use sRGB for Fiery cutsheet printers.

The differences between EFI Fiery Intensify and other standard rendering intent options are shown in next figure.

Perceptual (Standard)   Fiery Intensify   Perceptual (Vivid)

Advanced settings

The Advanced settings tab shows the processing options for Fiery Edge profiles to adjust input data and table smoothing, illuminant, and table sizes.

Measurement data smoothness

The "Measurement data smoothness" 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 more subject to noise present in the measurement data. This noise could originate from the printing process itself or in the measurement process. At the highest smoothing setting (1), the profile will predict the measurement data less accurately, but will be least subject to measurement or 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 amount for low-noise printing systems and/or to increase the accuracy of the profile.

ICC profile smoothness

The "ICC profile smoothness" values control the amount of smoothing is 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 the 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.

Lookup table size

The "Lookup table size" options 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.

Illuminant

The "Illuminant" option provides a list of standard illuminations; common choices are D50 and D65. If you have the same viewing conditions (e.g., D65) at all places and you want to view the results correctly under these conditions, you should choose D65 illuminant.

ICC version

The "ICC version" option creates profiles compliant with ICC v4.0 specifications. Default selection provides compatibility with ICC v2.0 specifications. Use the default setting unless the v4.0 specification is strictly required.

Printers using Advanced Linearization

The list of printers using the "Advanced linearization" can be found here:
https://www.efi.com/library/efi/documents/1595/efi_fiery_xf_supportedprinters_or_en_us.pdf

EFI recommends using M1 measurement mode

The M1 measurement mode picks up the idea of "measure how you see" in an ISO 3664:2009 compliant environment with D50 illumination. This means that the illuminating light source contains a specific amount of UV radiation that excites the optical brighteners found in typical printing papers, self-adhesive and non-self-adhesive vinyl and most soft-signage fabrics.

Measuring in M1 excites the optical brighteners in a similar way as the D50 light source does, which better correlates the measurement data with our visual perception. As a result, your ICC profile will have a visually pleasing neutral balance when your prints are viewed under D50 illumination.

In the past few years many new reference profiles, such as CGATS21_CRPC, GRACoL 2013, SWOP 2013, PSOcoated v3, PSOuncoated v3 FOGRA52, etc. are also based on M1 measurement data for the same reason. By choosing M1 for your device (if it is supported), you get the best colorimetric match to those reference profiles.

It is important to understand that "M0" means that the measuring device uses an <u>undefined</u> amount of UV radiation during the measurement; it could range from zero UV light up to very strong UV light. M0 is not well suited for a predictable colorimetric match in an environment with measuring devices of different make and model, or when you receive data from your customers that are targeting at M0 conditions.

"M2" on the other hand excludes the impact of UV radiation by the measuring device, although optical brighteners are present in our media. This is suitable if the prints are not viewed in an environment where UV radiation is present, otherwise the M2 measurement data does not correlate well with our visual perception. As a result, a certain color cast, mostly visible in the neutrals, can be observed, which degrades the output quality. If the printing substrate contains little to none amounts of optical brighteners, M1 and M2 will both result in almost identical measurements, so you can safely keep M1.

Some measurement devices support the use of a polarization filter, also known as "M3" mode. M3 suppresses most of the surface reflections and typically results in smoother measurements for heavily textured substrates like canvas or fabrics with an inhomogeneous surface. M3 typically results in darker and more chromatic measurements and similarly exclude UV radiation as M2 does. Due to its M2-like nature, M3 is suitable for textured substrates that contain very little to none optical brighteners or if the viewing environment does not contain UV radiation. Since our eyes do not look through a polarization filter, M3 measurement data does not correlate well with our visual impression. It is recommended that you use M3 only for very special applications or heavily textured media that do require it.

Although you can use any of the supported measuring devices, it is recommended to not mix measurement data from devices of a different make and model or at least that you check the measurement consistency on your media with your devices upfront to prevent unwanted side effects.

Measuring Device Recommendations

To minimize measurement variation, large patches typically result in more precise measurements for small aperture devices than small patches. It is recommended to use the large patch size option if available.

Keep in mind that you should use the same physical measurement device for
- Calibration
- Re-Calibration

- ICC-Profiling
- Quality Control
- Validation

If it is not possible, you should try to use a measurement device of the same make and model. This reduces the measurement variation to the inter-instrument agreement of the device manufacturer.

If this is also not possible, you should at least try to use measurement devices of the same manufacturer. Although the measurement variation will likely be increased in this scenario, it ensures that all devices refer to the vendor's common calibration standard.

You should use measurement devices from different manufacturers only if there is not another option. Keep in mind the following:

- One or more of your printers use an inline measuring device (ILS).
- For special applications, such as backlit, that require transmission measurements.
- You work for or with others that require you to use a special kind of measurement device to better match their measuring environment.

Measurement data for publicly available references from Fogra, GRACoL or other institutes are supposed to be device independent or generic unless stated otherwise by the publisher (typically to be found within the documentation or release notes of the measurement data). Thus, it is not needed to use the same device when working with such data.

For consistency reasons, you should keep the same measurement mode between calibration, profiling, and quality control for a specific media. EFI recommends M1 for measurements unless your media or application requires otherwise.

Check your measurement device periodically to ensure that it operates properly within its specification. Most device manufacturers offer special diagnosis programs for this purpose on their websites.

It is recommended to replace worn-out or damaged parts on a regular basis. The aperture on the measurement device should be checked carefully for dirt or dust. The calibration standard ("White tile") must be clean and not damaged. Some measurement devices allow you to clean the aperture and/or the calibration standard while others do not recommend it. Read the manual of your measurement device before trying to clean it yourself to prevent damage to the device that may result in a loss of its warranty.

It is important that you re-certify your measurement device on a regular basis. A measurement device is exposed to environmental conditions and degeneration that can have a negative impact on its reliability. Over time, due to dust and/or mechanical wear, the device may drift away from its original state and the readings can become unreliable. Device manufacturers offer their customers the option to send-in and re-certify their measurement devices for a small cost. You should take advantage of this service as this keeps your measuring workflow stable over time. Contact the device manufacturer for additional information about their re-certification program.

Notes for Barbieri Spectro LFP devices:

- It is recommended to use the largest aperture supported by your device.
- EFI recommends using "Up/Down" measuring type as it results in more precise measurements than "Fast", but it also increases the measurement time. Using "Contactless" is not recommended.
- For frontlit ("Reflected light"), increasing the number of measurements per patch can help to obtain more reliable results, although it also increases the overall measurement time.

- For backlit applications ("Transmitted light"), it is recommended to use one measurement per patch otherwise measurements may become unstable.
- For backlit applications and a chart with multiple pages, it is recommended to cut out the "Reference area" of all pages in the beginning. When measuring the individual pages, replace the reference area with the one from the first page, so that every page has the same reference area in common. Take care not to damage or contaminate the common reference area during chart measurement.

Selecting the correct Halftoning method

There are several pros and cons using either SE1 or SE2 halftoning method.

		Pro	Con
SE1		• Sharper edges, important for small fonts on printers with big ink jet droplets. • Smoother output than SE2 at the same resolution.	• Processing and calculation time. SE1 is implemented for CPUs only, whereas a related GPU acceleration is missing.
SE2		• Very fast and good for high production volume and processing speed. Beginning with Fiery XF 7.0 server, a GPU based acceleration is available through the FAST DRIVE printer drivers. • Minimize ink interaction. This is a better prediction for color profiling, which depends on the ink system itself.	• Less sharp edges than SE1 for printers with big ink jet droplets and low resolutions. • Less smooth output than SE1 at the same resolution.

When it is acceptable for the print quality requirements, SE2 shall be used. SE1, on the other hand, is better for the near distance view print application on printers with less than 400-600 dpi print resolution. The following matrix helps to make a suitable decision on SE1 vs. SE2. Use the following formula to generate the effective resolution:

$$\text{Effective Resolution } dpi_{eff} = \sqrt{dpi_{hor} \times dpi_{ver}}$$

Viewing Distance (m) / Effective Resolution (dpi$_{eff}$)	Near Distance View (≤ 1m)	Distance View (>1m – <2m)	Large Distance View (≥ 2m)
1200	SE2	SE2	SE2
1000	SE1/SE2(*)	SE2	SE2
800	SE1/SE2(*)	SE2	SE2
600	SE1/SE2(*)	SE2	SE2
400	SE1	SE1/SE2	SE2
200	SE1	SE1/SE2	SE2

*In the case of print heads with fixed droplets, SE1 is recommended up to 1000 dpi$_{eff}$, and in case of print heads with variable droplets, SE2 is recommended up to 600 dpi$_{eff}$.
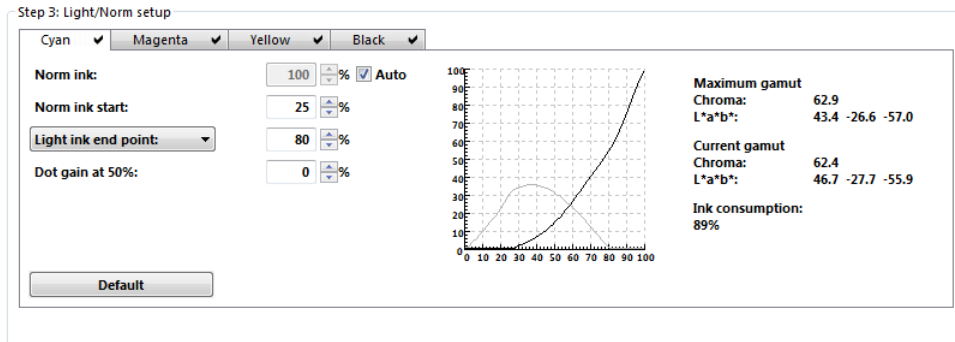
Customize Light/Norm Curves

To customize measured Light/Norm curves, the following controls are available in Color Tools:

- **Norm ink – sets the ink limit of norm ink for an input value of 100%.**
  - When the Auto check box is selected (this is the default), Color Tools determines automatically the amount of norm ink use to achieve the largest gamut (maximum C* or minimum L*).
  - Deselect the Auto check box to set a custom ink limit.
  - Evaluate the dark colored curve in the graph to see how much norm ink is used.

- **Norm ink start – sets the input value in % at which norm ink is printed**
  - The main intention of light ink is to print the highlights to quartertones of vignettes and gradients smoothly. From the Norm ink start, the light ink is reduced gradually while the norm ink starts smoothly to maintain linearity.
  - The Norm ink start is determined automatically by the calibration and can be adjusted as follows:
    - 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.

- **Light ink in full tone – sets the amount of light ink for an input value of 100%.**
  - If the Auto check box is selected, the calibration determines automatically 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.
  - Deselect the Auto check box to allow 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.
  - You can force the calibration to not use light ink in the full tone by entering 0%.
  - **Recommendations:**
    - Set similar (not necessarily identical) light ink in full tone values across all chromatic channels (Cyan, Magenta, Yellow) where light ink is used.
    - Avoid extreme differences like 0% light ink for Cyan, and 45% light ink for Magenta.
    - Do not use excessive light ink in full tone as this does not significantly increase your gamut size but significantly increases your ink consumption.
      Using more light ink also forces the Total Ink Limit to work more aggressively and leaves less room for the norm ink. Using up to 45% light ink in full tone (maximum by default) is reasonable.
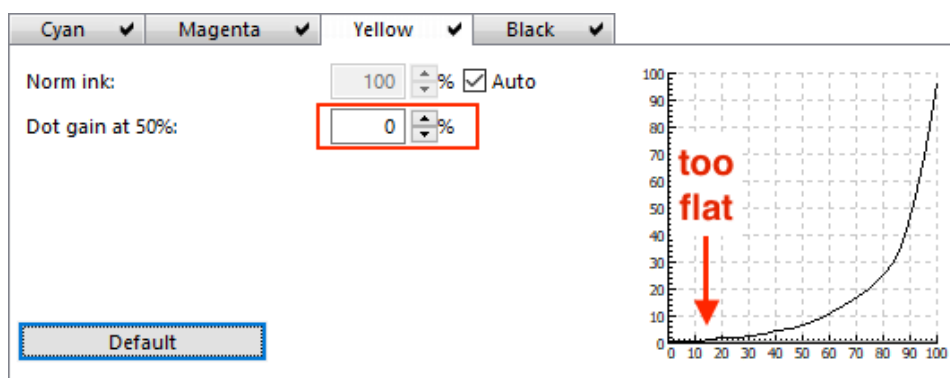
- **Light ink end point – sets the input value in % at which no more light ink is printed**
  - This option needs to be selected by you for each channel separately and can be useful to additionally save ink.
  - The light ink end point effectively disables the usage of light ink and only norm ink gets printed for higher input values.
  - You must be careful to not reduce the light ink end point too far. It is recommended to prevent values where the norm ink curve shows a noticeable kink at the light ink end point.
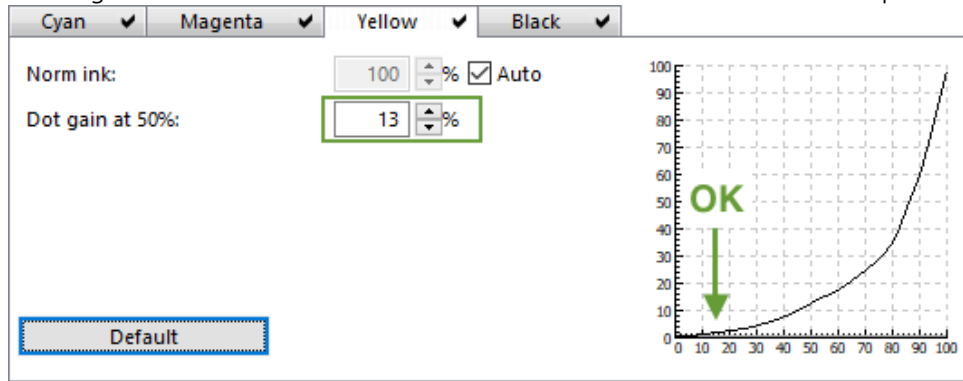
- o The light ink end point will always have a minimum distance of 35% to the norm ink start. This will prevent kinks in the norm ink curve in most cases.
    - o Shifting the Norm ink start to a higher value may also shift the Light ink end point to maintain the minimum distance of 35%.
    - o It is recommended to not mix Light ink end point and Light ink in full tone for chromatic inks (Cyan, Magenta, Yellow).

- **Dot gain at 50% - adjusts the calibration curves mainly in the mid-tones**
    - o The dot gain can be adjusted within a range of -30% to +30%.
    - o It is recommended to use the default dot gain setting (0%) unless needed.
    - o 0% dot gain is the default value for most supported printers.

At dot gain 13% the Yellow calibration curve starts with a reasonable slope.

Note: When the dot gain is increased, it may increase the light ink usage and overall ink consumption significantly. Also note that the dot gain value of 13% is used an example and is <u>not</u> a suggested value for the dot gain in general.

Calibrate White Ink

If an application requires White ink printing with tints or smooth gradients, it is recommended to calibrate White ink.

The White ink calibration compensates the visually non-linear response of the uncalibrated White ink and creates a visually linear relation between the input tone values (0% to 100%) and the dynamic range in lightness (L^*) of the printed White ink ($L^*_{max} - L^*_{min}$).

Calibrated White ink makes it easier for designers to achieve the desired "White effect" and the print shop does not need to apply a custom curve to adjust the White ink response.

Before starting the calibration process some application-specific options need to be considered:

- **Measuring mode (depends on the application)**
  - Reflection – light is reflected from the ink layer and/or substrate
  - Transmission – light transmits through the substrate and/or ink layer

- **White ink layer order**
  - W (White only)
    - White ink is printed on top of the substrate.
    - Suitable for colored opaque substrates in reflection mode as well as for transparent substrates in transmission mode.

  - WO (White over)
    - White ink is printed on top of colored ink layer.
    - Typically used for transparent substrates and transmission measuring mode.
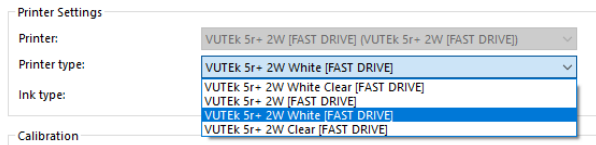
  - WU (White under)
    - Colored ink is printed on top of white ink layer.
    - Typically used for colored opaque substrates and reflection measuring mode.

  - CWC (Color-White-Color)
    - White ink is printed between two color layers, and typically acts as a light diffusor.
    - This mode requires transparent substrate and transmission measuring mode.

  - CWBWC (Color-White-Black-White-Color)
    - Transparent substrate is used and a layer of black ink is used as a light-block-out layer in the middle of two white ink layers.
    - The white ink layers are typically a flood fill to create a white, opaque backing for the color layers (like a regular white substrate).
    - This mode requires reflection measuring mode.

Steps to calibrate White ink:

1. When you create a new calibration, select your printer driver in Printer Settings.
2. Choose the Printer type that contains "White" in its name, such as "VUTEk 5r+ 2W White [FAST DRIVE]". For any other printer type, the White ink channel will not be part of the calibration process and White ink remains uncalibrated.
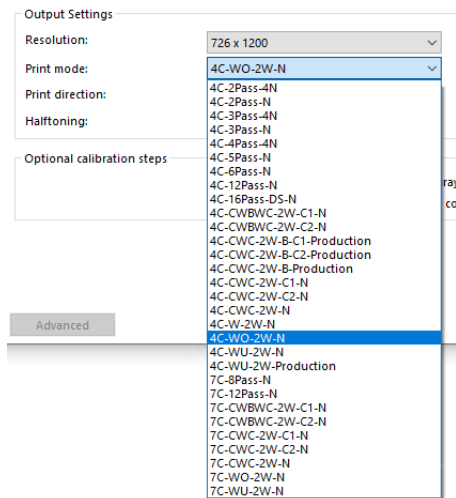
Note: Some printer drivers contain a generic White linearization which becomes active instead of an uncalibrated White channel.

3. Choose your measurement device and measuring mode (reflection or transmission) that is suitable for your application. The White ink chart will be different depending on the measuring mode, so you cannot use a chart for reflection measurement in transmission mode and vice versa.

   Note: Transmission measurement mode is currently supported only by the Barbieri Spectro LFP, Barbieri Spectro LFP qb, and Barbieri Spectro Swing devices.

4. Set up the White ink layer order:

   - For some EFI printers, the White ink layer order must be set at the printer controller (VUI/Vutek User Interface) before printing by creating a "multilayer" job. For information about how to set up multilayer jobs, see the manual that accompanies your printer or follow this link.

   - For other EFI printers, the White ink layer order must be selected in the Output Settings/Print mode section in Color Tools. The screenshot shows the available print modes of the VUTEk 5r+ 2W White [FAST DRIVE] printer of which some also support White ink.
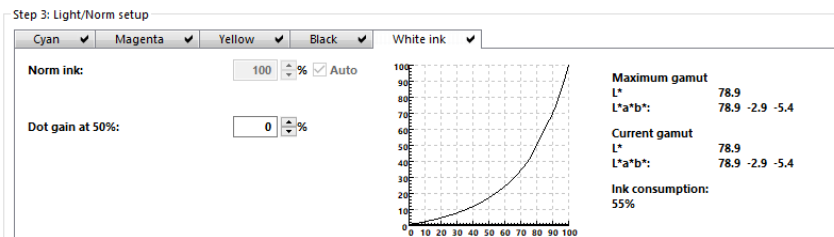

   Note: White ink will always be part of the calibration process when a printer type with "White" in its name was chosen, even when a print mode without a white ink layer was selected. It is not required to print and measure the White ink chart to continue with the calibration process; if the White ink measurement is being skipped the White ink channel remains uncalibrated.

5. Click the Next button to proceed to the "Ink Limit and Calibration" step. A White ink tab appears in the Light/Norm setup section, indicating that White ink is part of the calibration process.

8. If the White ink calibration curve is monotonically increasing and overall smooth, similar to the example screenshot above, the calibration was successful.

9. If the calibration curve is not monotonic, not smooth or shows severe distortions something went wrong. In this case, do the following:

    - Inspect the measured chart for defects (dirty or damaged patches, and missing nozzles).
      Resolve the issue(s), then re-print and re-measure the White ink chart.
    - Inspect your measurement device for errors or malfunction during the measurement. After the issue is resolved, re-measure the White ink chart.
    - Re-measure the White ink chart with another measurement device of the same model.
    - Check your printer for technical issues. After the issue is resolved, re-print and re-measure the White ink chart.

General recommendations for calibration curves

Here are some general recommendations for suitable calibration curves

- **Watch the full tones**
  - An extremely steep norm ink curve between 95% and 100% input is an indication of too much ink. In this scenario, reduce the Norm ink value but keep an eye on the Chroma and L*a*b* values so you do not limit too much.
    - 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.
    - The Black full tone may be reduced significantly as well without sacrificing too much of the dynamic range of the printer, where 0.5 to 2.0 L* lighter than the minimum L* may be reasonable.
      Keep in mind that the black point of the printer is controlled not only by the darkness of the Black channel, but also by the Total Ink Limit as well as the Black Point Settings in EFI Printer Profiler. If in doubt, use to the default values for Norm Black and Light Black in full tone.

  - Avoid excessive usage of Light ink in full tone. As mentioned, up to 45% light ink in full tone is reasonable. Although at first glance more light ink seems to increase the gamut, it increases the overall ink consumption and printing cost disproportionately.
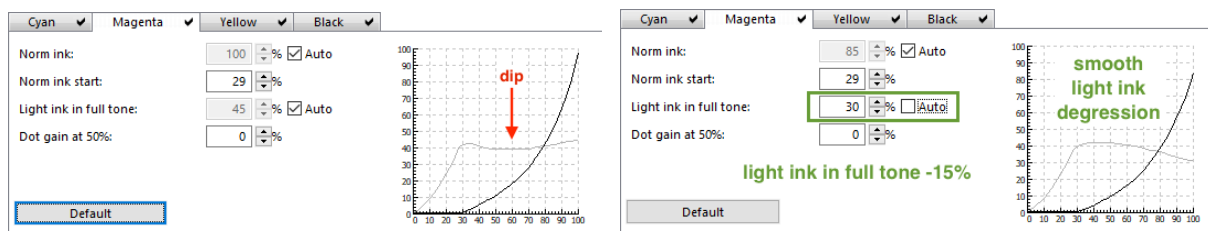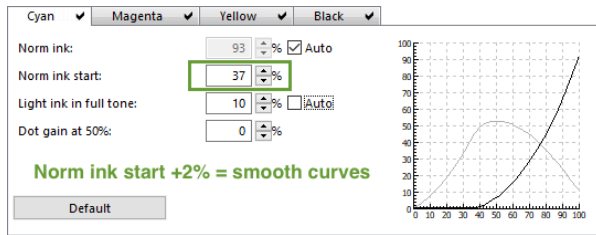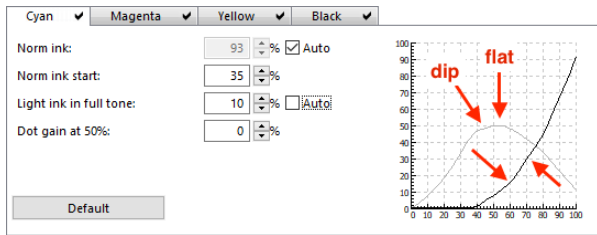
- **Smooth curves**
  - The Norm and Light ink curves are determined with respect to the linearity of their composite print, based on the measurement data of the calibration chart, and the (default) settings of the controls discussed earlier.

Under certain conditions, mainly the Light ink curve can show some odd characteristics or is not smooth. In the examples shown below, you can see a dip in the Magenta Light ink curve beyond the Norm ink start and a dip or flat spot in the Cyan Light ink curve and bumps in the Cyan Norm ink curve. Although not critical for both examples, you should avoid curves like this.

The smoothness of the Norm and Light ink curves sometimes can be improved by slight adjustments of the Norm ink start and/or dot gain at 50%. The two examples below show Light/Norm curves that can be improved. Although not critical, you should adjust the controls until an improvement is achieved.

Example 1 (Light-Magenta dip):

If improvement cannot be made regardless of the settings used, re-print and re-measure the calibration charts and/or check the performance of your measurement device.
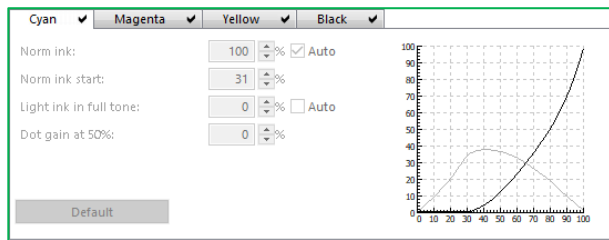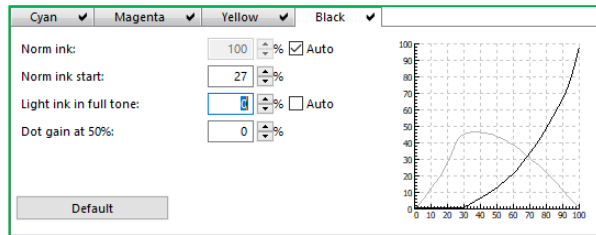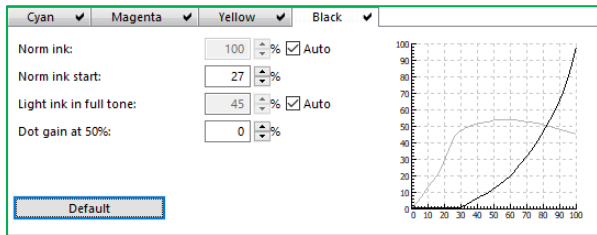
The following screenshots show examples of:

    a) Recommended light/norm curves
    b) Valid but <u>not recommended</u> light/norm curves
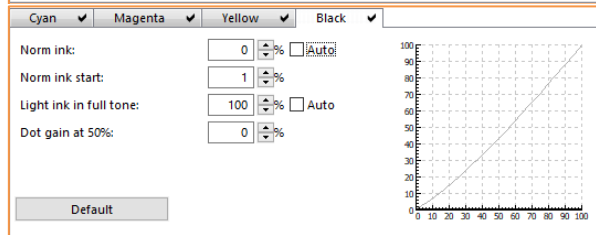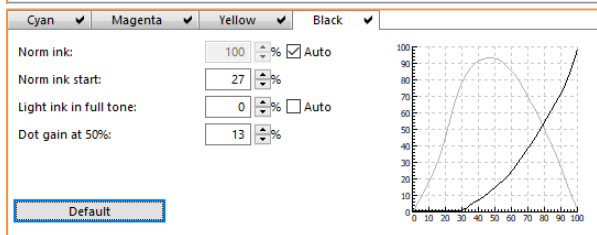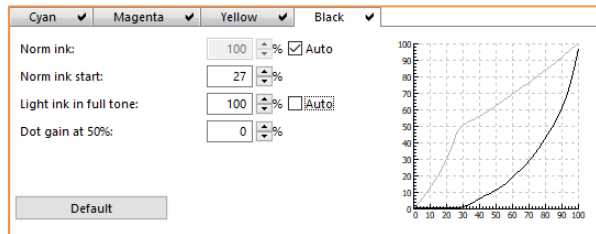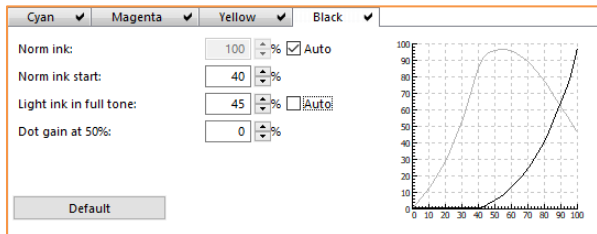   c) Light/Norm curves <u>not recommended</u>

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

Note: *Your Light/Norm curves will not match these examples as the curves depend on the measurement data of your specific combination of printer, ink, and media.*
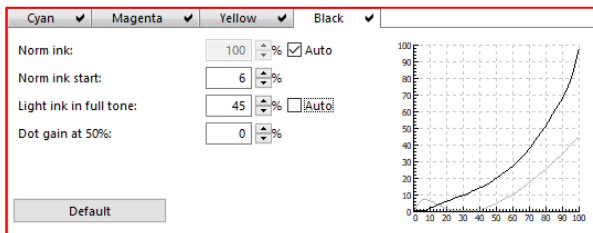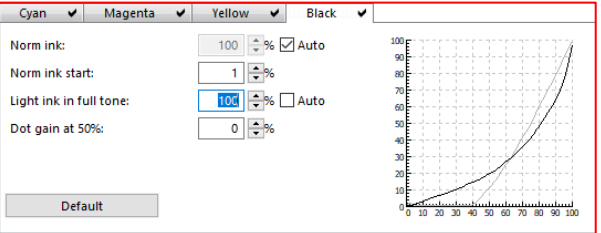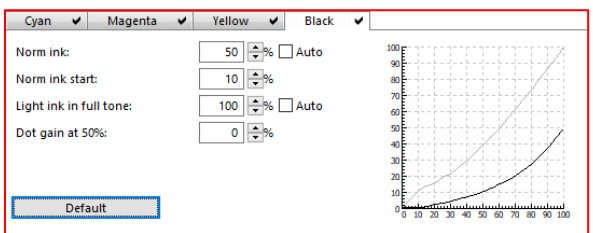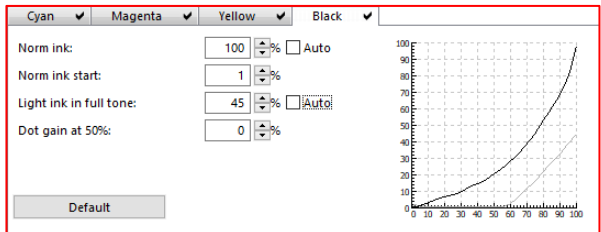
Recommended:

Valid, but not recommended:

Not recommended:

Reading the Total Ink Limit chart

The Total Ink Limit (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
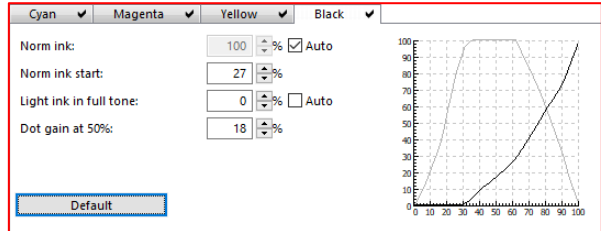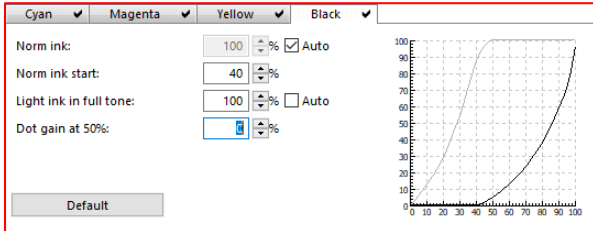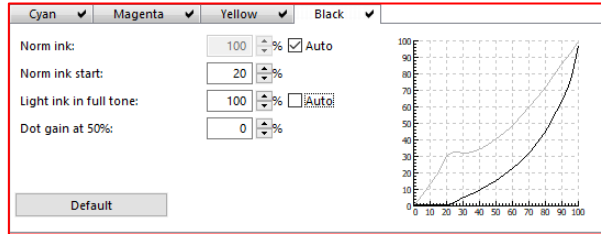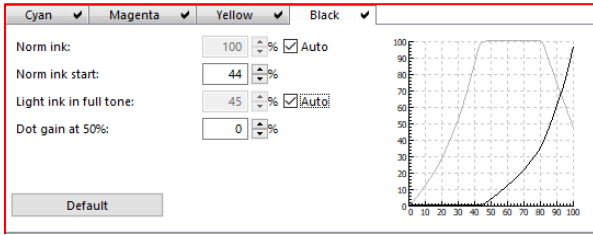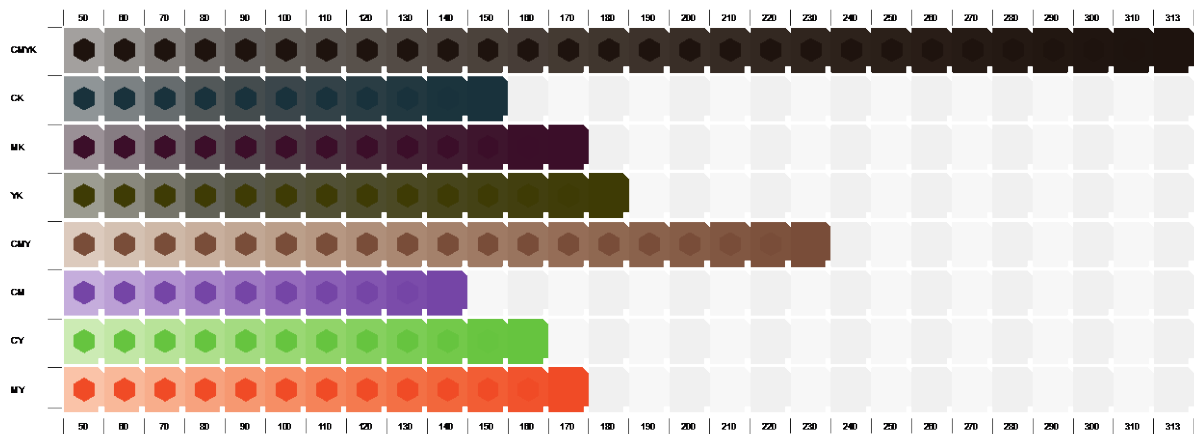- Column headings that display the TIL level (absolute ink amount) of each column
- Optional horizontal spacings between adjacent rows

Note: *The TIL algorithm is based on <u>absolute ink amounts</u> 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; for example, 313%) in a defined step size (for example, 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 Night inks: Cyan, Black, and Light-Cyan
- CMcm -> row is using Norm and Night 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 the readability of the chart, empty patches are displayed in alternating gray columns.

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 as stated in the column header.

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 to appear 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 on 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 CMYK or CMY row.
4. Carefully scan the selected row from left to right, and choose the first patch in which lightness difference cannot 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 (for example, 15% or 20%), it is recommended to select a value between the TIL level of the current column and the TIL level of the previous column (one step size less).
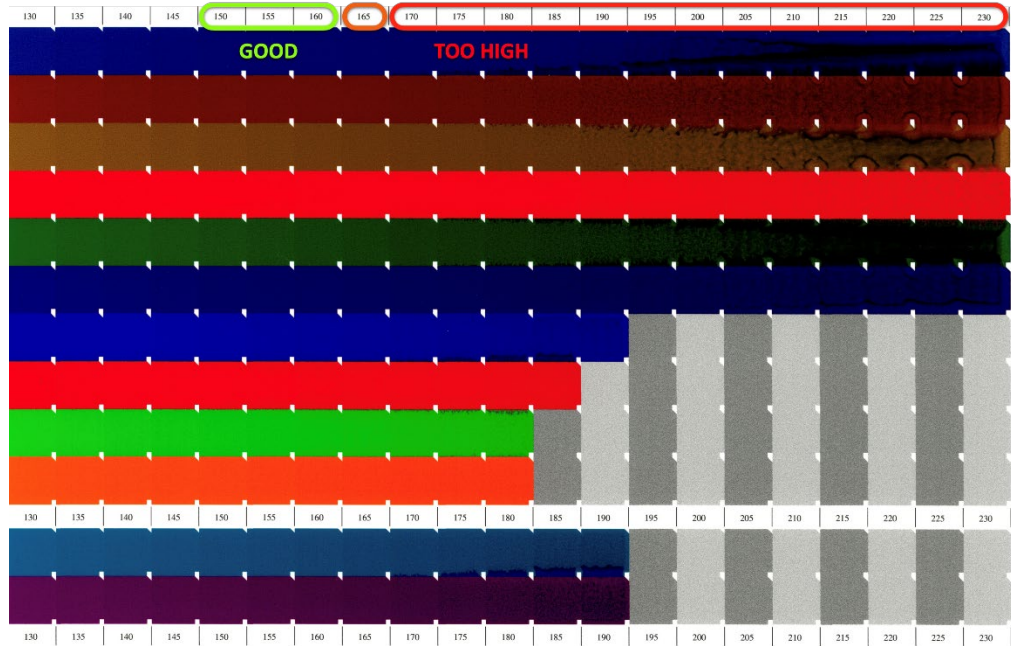
Alternatively, the TIL value can be determined in a two-step process:
1. Print the chart with a step-size of 20% and the default ranges (starting at 50%, up to the maximum possible ink).
2. Determine the range where the optimal TIL value is expected (for example, 240% to 340%).
3. Adjust "Range start" and "Range End" values to cover the 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. For information on how to adjust the size of the bleeding marks, see "TIL Chart Configuration" at page 48.
  The image below illustrates that for lightweight fabric (in this example), a good TIL value is between 135% or 145%. At higher TIL levels, the bleeding markers become fuzzy and flooded and are not as crisp as at 145% or below.

- **Fringing, inter-color bleeding, mottling, speckling** - The background of the patch should not show speckles or fringes, which are indicators for over-inking. To better determine the TIL for such applications, it can be helpful to print the chart without the hexagons (See "TIL Chart Configuration" at page 48).
  The image below illustrates that a good TIL value is around 180% to 190%. In higher TIL levels, the background of the patch (not the hexagons) starts mottling and has a non-even appearance. This is clearly visible in the red ink row.

  Note: The hexagons may always show fringing and inter-color 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 print the chart without the hexagons as it makes it easier to read the chart.

To avoid ink contamination of your printer due to ink run-down, it is recommended to limit the TIL chart to a reasonable "Range end" value (see "TIL Chart Configuration"

below). A good value varies for each printing system, ink type, and printing resolution. If you do not know your printing system well and how to set a good value, it is recommended to constantly monitor the printer while printing the TIL chart and abort the printing process immediately when ink run-down becomes first visible. Then re-print the chart with a lower "Range end" value.

Total Ink Limit chart configuration

When you click the Configuration button in the TIL panel, the Chart configuration window opens and offers various options to change the chart and patch layout.

Chart layout

- Range start – sets the starting TIL level as a percentage

- Range end – sets the ending TIL level as a percentage

- Step size – sets the discrete difference in ink amount between two adjacent columns as a percentage

- Patch size – various patch sizes can be selected (mm x mm)

- Spacing between rows – defines the vertical offset between two adjacent rows in mm

- All black combinations – prints all overprint combinations with black ink

- CMYK only – only uses the CMYK part and ignores overprint combinations with gamut extending inks. This is available for color modes with gamut extending inks, for example Orange and/or Violet

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 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 is 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 Total Ink Limit decision. Optionally, the chart can be configured to turn on all possible black overprints if needed by the print application (see "TIL chart configuration"
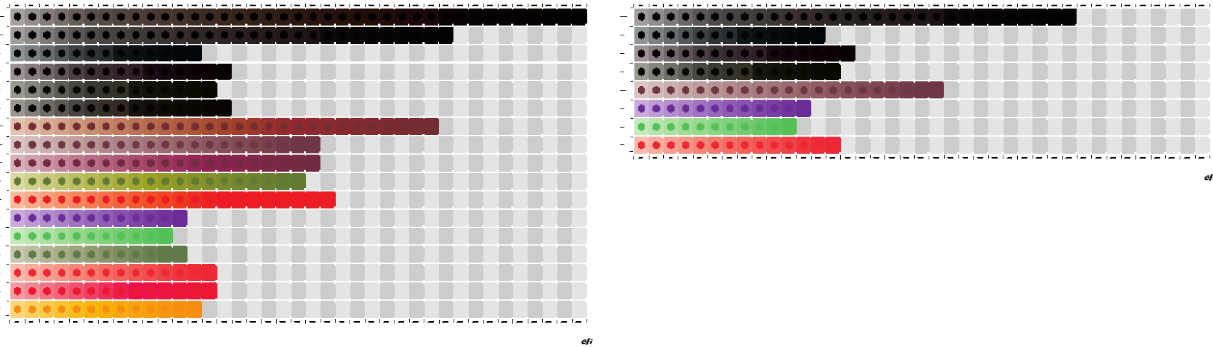
on page 48). The lower section always contains all possible overprint combinations without black ink.

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, and CMYK all have the same number of rows (default: 8 rows)
- CMYKcmO, CMYKO, CMYKcmV, and 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" on page 48). 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, and the right chart uses only the CMYK part of the left chart.

Setting TIL without printing

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

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

for which the TIL value is known from a previous Fiery XF calibration made with Fiery XF 6.5 or later.

In this scenario, you can enter the known TIL value and proceed to the next step of the calibration 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, Light ink end point, or set a different dot-gain without changing the Norm ink and Light-ink in full tone limits. If you change the Norm ink and Light ink in full tone, you are required to create a new media profile.

Ink Saving

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

Note: *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 meters, but less aggressive ink saving might be more appropriate for an indoor advertisement and a viewing distance of 50 cm.*

For higher ink savings, you need to activate the EFI Ink Saving option and use the Ink Saving settings or presets "Low, Medium or High".

Recommended <u>calibration</u> tools settings for ink saving:

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

Recommended <u>profiling</u> 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

Document change history

Version/ Revisions	Page	Item	Description	Date
Initial version	All	-	-	July 3rd 2018
Rev. A	All	All	Reworked complete document	May 10th 2021
Rev. B	6 8 24 32 36	Changed 22in to 24in Deleted 'Individual' Modified graphic Replaced appearance with perception Replaced ink with kink	Corrected some wordings and phrases	May 28th 2021
Rev. C	-	Updated Profiling section for CPS 5.4		Dec 2021
Rev. D	17 – 30 31	Corrections Added link to printers supporting Advanced Lin	Corrected some wordings and phrases Removed table and included link	Feb 2022