

Curve Pilot 14.1 – What's New

Version 1.1 – Peter Morisse

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New Gray Balance control implementation in Curve Pilot

Methods used for calculating compensation towards neutral colors

The G7 calibration method is based on adjusting curves towards perceived neutral gray scales. The measured data used by this method is mainly colorimetric. Unfortunately there is no exact relation between color changes observed in neutral scales and the required dot gain adjustments of the primary colors. So when the color of a CMY patch composed as neutral (made of equal percentages of CMY) deviates from the desired neutral color, how much should I change the individual C, M, and Y components to bring the color back to neutral?

Curve Pilot 14.1 has two different methods for obtaining curves that compensate towards gray balance.

Method 1: Linear method

The linear method assumes a linear relationship between changes in $L^*a^*b^*$ and changes in C,M,Y components. The coefficients for this relationship are derived from the a^*,b^* values measured for the ink solids.

This method takes measurements from CMY patches composed as neutral. The measured $L^*a^*b^*$ values are compared to the $L^*a^*b^*$ values that give neutral perceived scales. Compensation is calculated from the difference, using a linear relationship: $\Delta C, \Delta M, \Delta Y = kx\Delta L^*, lx\Delta a^*, mx\Delta b^*$

The option to select this method can be found in the 'Gray Balance Control Options' panel.

The linear method is used if no gray finder patches are available (the 'Use gray finder' option is disabled), or when a user has deselected the 'Use gray finder' option.

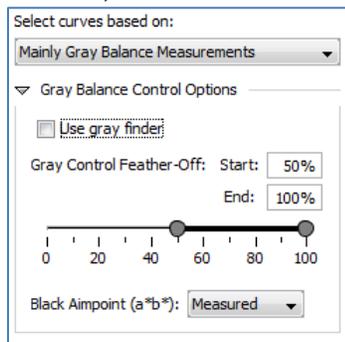


Figure 1: Gray Balance Control Options - linear model: 'Use gray finder' option deselected

Important:

This method estimates a relationship between a^*,b^* changes and C, M and Y changes.

If the measured a^*, b^* values are too far away from a neutral tone, the calculated curves may not immediately result in neutral scales, and different print iterations may be required.

This method is not suited for printing conditions that use inks with non-linear ink profiles (the a^*b^* values that don't scale linearly with tone).

Method 2: Gray finder method

A more accurate method is to determine the relationship between the L*a*b* and CMY composition changes from measurements: by printing patches around the patches composed as neutral, and measuring the L*, a*, b* variations for the different CMY compositions.

Adjustment is then obtained by making a CMY to L*a*b* lookup table, and finding a CMY correction by looking up the desired a*b* values.

Since Curve Pilot 14.1 this method is also implemented, and called the 'gray finder' method.

The P2P25 G7 calibration target created by the IDEAlliance group is especially suited for this method: it contains several G7 gray patches composed as neutral, and patches around them (see Figure 3: P2P25 chart with gray finder patches for 49.8% gray highlighted.).

This method can also be used when profiles are used as measurement. The L*a*b* values of gray finder patches are then extracted from the profile by interpolation.

The option to select this method can be found in the 'Gray Balance Control Options' panel.

The gray finder method is used if the 'Use gray finder' option is enabled and selected.

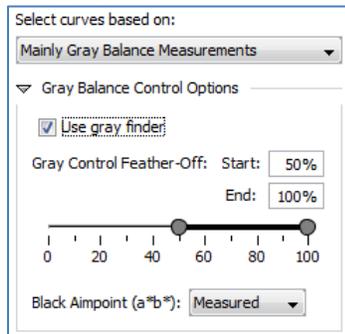


Figure 2: Gray Balance Control Options - gray finder model used.

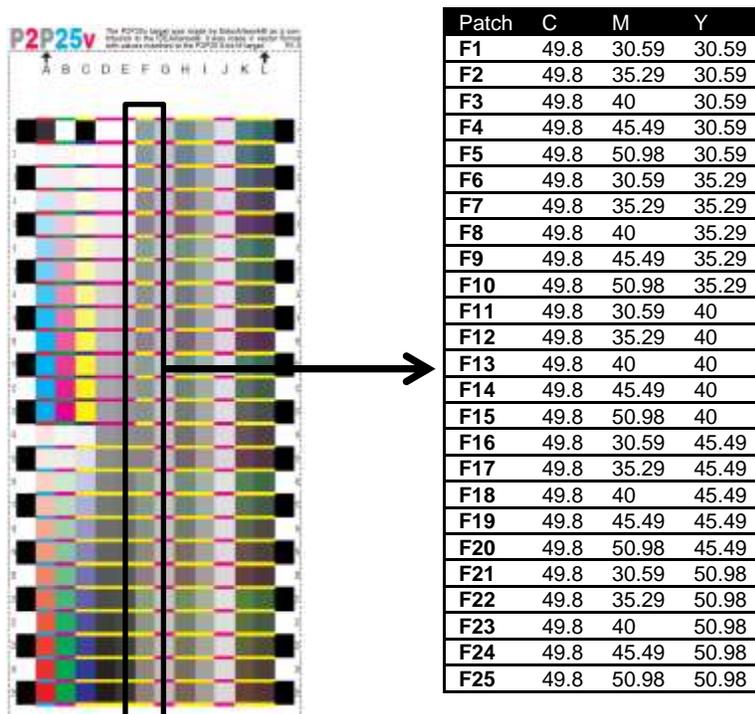


Figure 3: P2P25 chart with gray finder patches for 49.8% gray highlighted.

L relative

G7 documentation specifies that a^* , b^* values should scale from paper to 0,0 at 100 CMY, using the 'relative Lightness' as linear scale factor.

The relative lightness of a gray tint is defined as the lightness relative to paper and 100 CMY:

$$L_{rel} = (L - L_{paper}) / (L_{100CMY} - L_{paper}).$$

In previous versions of Curve Pilot, the a^* , b^* aim values were linearly scaled with the 'cyan' ink component of gray patches (the Cyan component of G7 gray patches composed as neutral indicates the Gray tint - e.g. 50% gray is composed out of 50C, 40M, 40Y).

From Curve Pilot 14.1 onwards, L relative is used as scale factor.

The difference is very small but noticeable in the Gray Balance Measurements graph: the a^* , b^* aim lines in that graph are now slightly curved, whereas in previous versions they were straight lines. The difference is bigger when using paper with more color (higher a^* or b^*).

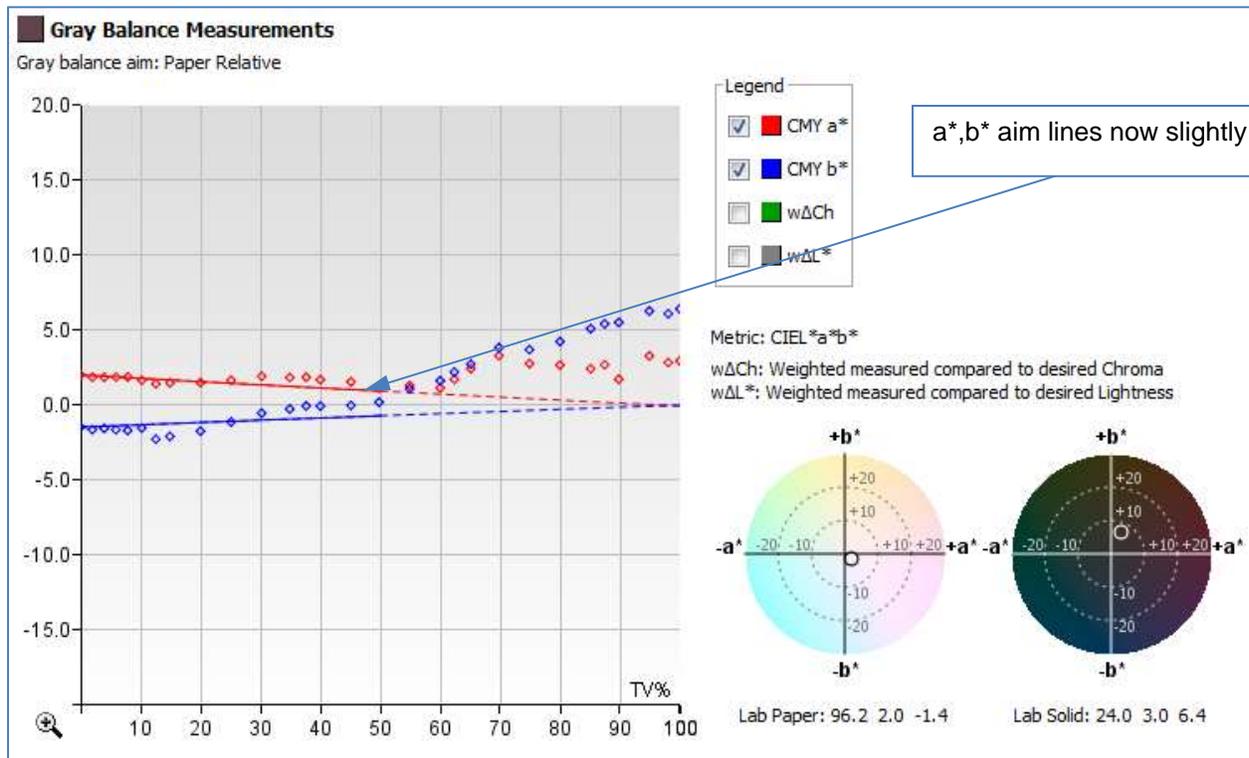


Figure 4: Gray balance graph using L relative for calculating a^*b^* aims

Gray compensation fade-out

On most real printing conditions 100% CMY is not perfectly achromatic ($a^*, b^* \neq 0, 0$). To compensate for that, one or more of the C, M, Y components of the 100 CMY patch would need to be screened, and this is mostly not wanted (we don't want screened solids).

The G7 method specifies that color of neutral scales should go from paper to perfectly achromatic ($a^*=b^*=0$ at 100 CMY). But because we don't want to correct 100 CMY, and because we want a smooth transition towards slightly colored 100 CMY, we will gradually fade out gray balance correction.

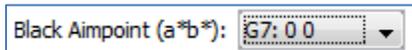
This fading out can be obtained by gradually reducing the required CMY shifts, or by scaling aim values.

In Curve Pilot 14.1 both methods can be used.

Method 1: Fade out gray correction

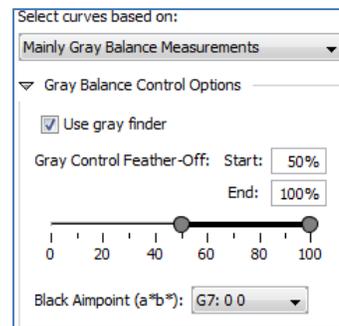
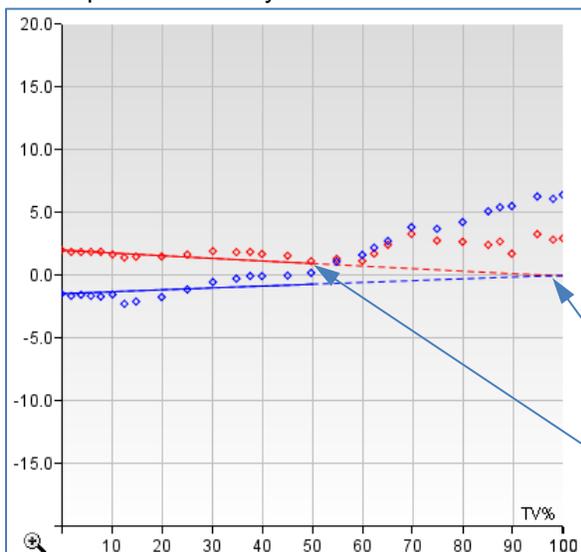
This method keeps the a^*, b^* aims over the whole tonal range as specified from the G7 method, but from a certain gray tint onwards (feather-off start), correction calculated towards these aims will gradually diminish. By default this feather-off start is set at 50%, this can be changed by the user.

This method is selected by changing the 'Black Aimpoint (a^*, b^*)' option in the 'Gray Balance Control Options' to 'G7:0 0'



The curves obtained with this method will fully correct gray balance in the highlights and mid tones, but in the shadows gray tints will gradually follow the natural overprint behavior of the inks.

On the gray balance chart you will notice that the a^*, b^* aim lines will change into dashed lines at the tone value specified in 'Gray Control Feather-Off Start'.



Feather-off end: a^*, b^* aim lines end.

Feather-off start: a^*, b^* aim lines change into dashed lines.

When Curve Pilot calculates compensation for the measured points, it splits the compensation calculated towards tone (neutral density) and the compensation calculated towards gray balance (neutral color). This can be made visible in the 'Calculated Curves' graphs in Curve Pilot, by selecting the 'Show tone and gray compensation points' option - see the graph below.

On this graph you can see that the final adjustment curve first fits the gray compensation points, and after the feather-off tone it gradually fits to the tone compensation points.

You can also see that the final curve for Yellow is PressSync curve B52. This curve first follows the gray points and above 50% it gradually bends to the blue points.

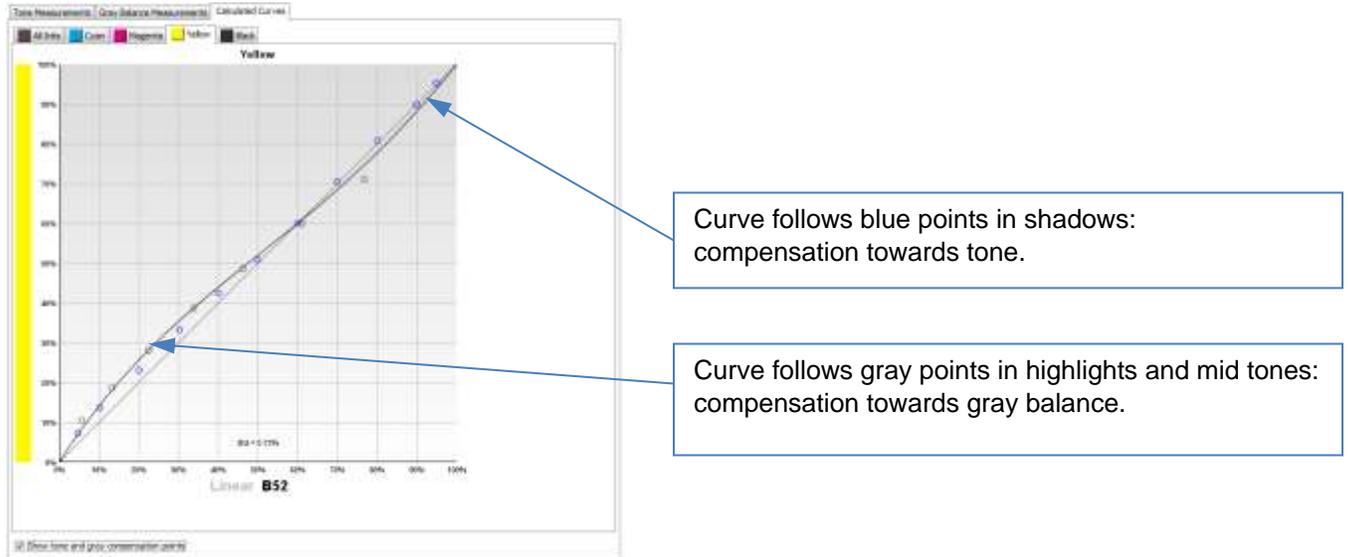


Figure 5: Gray correction faded out

The effect of using curves obtained from this fade-out method is illustrated below, by synchronizing a profile with the curves. For tones below 50% you can see that the measured a^* b^* points nicely follow the a^* b^* aim lines. Above 50% the a^* b^* points gradually deviate from the aim lines in a non-linear way, following the natural overprint behavior of the inks.

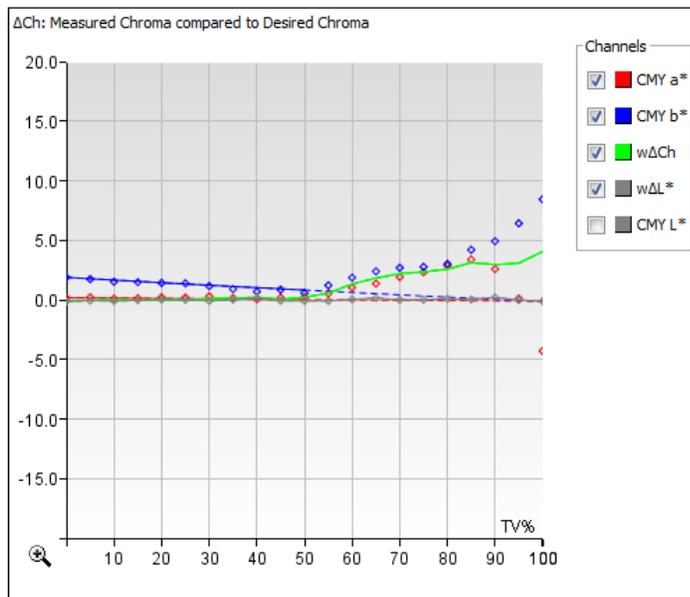
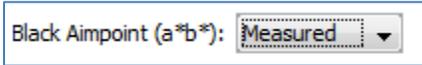


Figure 6: Simulated press run using curves calculated from method 1

Method 2: Scale aim towards 100 CMY

For this method fading-out is obtained by scaling the a^* , b^* aim values: After the feather-off tone the a^* , b^* aim values are linearly scaled towards a^* , b^* values measured for the 100 CMY patch.

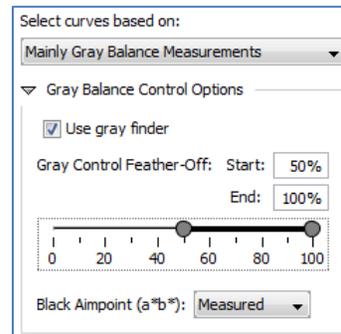
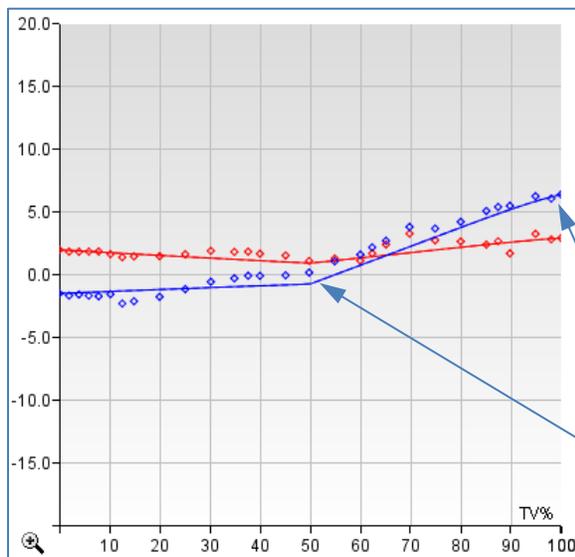
This method is selected by changing the 'Black Aimpoint (a^* , b^*)' option in the 'Gray Balance Control Options' panel to 'Measured'



The correction is now controlled over the whole tonal range.

The curves obtained from this method will result in neutral color scales for highlights and mid tones, and in colors linearly shifting towards 100 CMY from the feather-off tone onwards.

On the gray balance chart you will notice that the a^* , b^* aim lines are kept solid, but the direction of the lines will change towards the a^* , b^* values of 100 CMY at the tone value specified in 'Gray Control Feather-Off Start'.



Feather-off end: a^* , b^* aim lines will start to be dashed.

Feather-off start: a^* , b^* aim lines bend towards a^* , b^* measured for 100 CMY.

When looking to the adjustment curve calculated from this method, you will notice that the curve now fits the gray points (the compensation points towards gray balance) over the whole tonal range. You will also notice that past 50%, these gray points gradually become linear ($X=Y$). That is because the aim values gradually go towards measured 100 CMY and so required compensation gradually diminishes.

In the graph below the final curve for Yellow is PressSync curve C54, fitting all the gray points best.

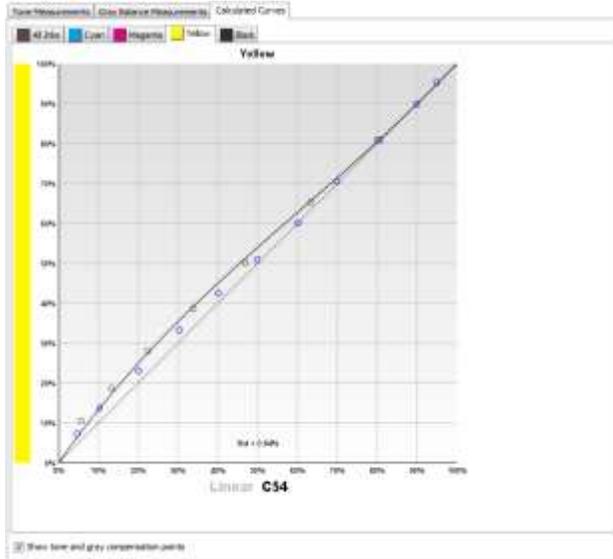


Figure 7: Gray correction calculated towards 100 CMY

The effect of using curves obtained from this method is also illustrated below. You can see that the measured a^* b^* points follow the aim lines perfectly over the whole tonal range. With this method the color of neutral scales above 50% is also under control: The color linearly shifts from neutral to the color of an uncompensated 100 CMY patch.

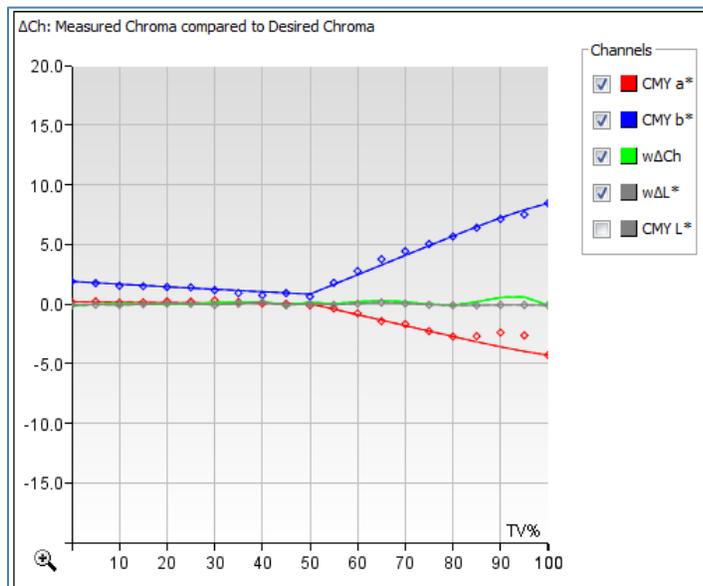


Figure 8: simulated press run using curves calculated from method 2

Usage of gray balance control on curve sets with CMYK logic

Curve sets with 3ck logic are dedicated to the G7 method: The curves are calculated from composed CMY and K patches only, towards neutral color scales. Curve sets with CMYK logic have reference tone scales (TVI curves) for each process ink. Curves are calculated so that tone scales for each ink match these reference tone scales. However, such curve sets can also be used to calculate curves towards gray balance, or with these curve sets one can verify how far the neutral scales deviate from the G7 specifications.

The algorithm for calculating compensation towards gray balance in the case of CMYK curve sets is different compared to 3ck curve sets:

For 3ck curve sets, density or L is used to calculate the 'tone compensation points' (from G7 NPDC curves), while $a^* b^*$ is used for calculating the 'gray balance compensation points'.

For CMYK logic, 'tone compensation points' are calculated based on desired TVI curves, while 'gray balance compensation points' are calculated from a^*, b^* but also from L^* .

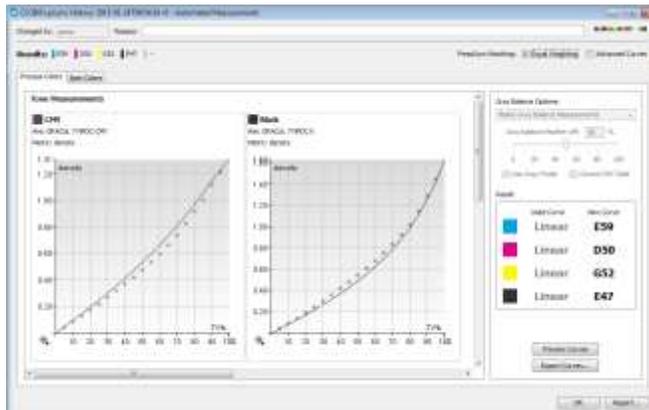
The desired L^* values for these points are derived by converting the G7 NPDC curves to L^* values. So for CMYK curve sets selecting full gray compensation is equal to calibrating towards G7 method: towards neutral density and color.

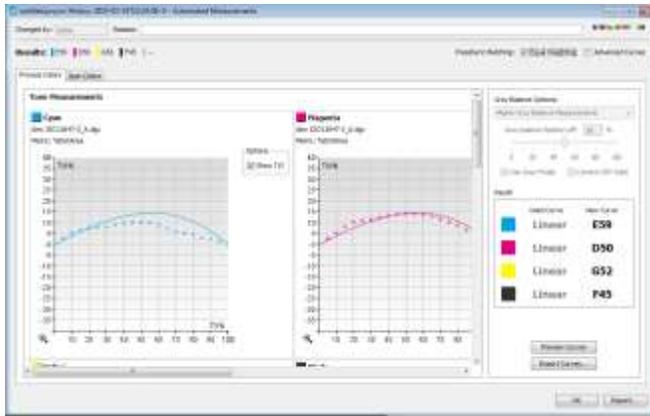
Advantage of using CMYK curve sets for G7 calibration method is that the tone scales of the individual colors are also measured and registered: The press is calibrated towards neutral scales and TVI of each individual color to obtain these neutral scales is known.

As an example, you can see below the result panels that shows curve calculations from a P2P25 measurement.

The top panel is from a curve set with 3ck logic. The bottom panel is from a curve set with CMYK logic.

As you can see, the resulting PressSync curves are the same, although the tone or density aims for both are different.





Another possibility is that with CMYK curve sets the TVI and G7 method can be mixed. For example, a press can be calibrated towards neutral color scales (relative to paper) for highlights and gradually follow TVI curves for mid tones and shadows.

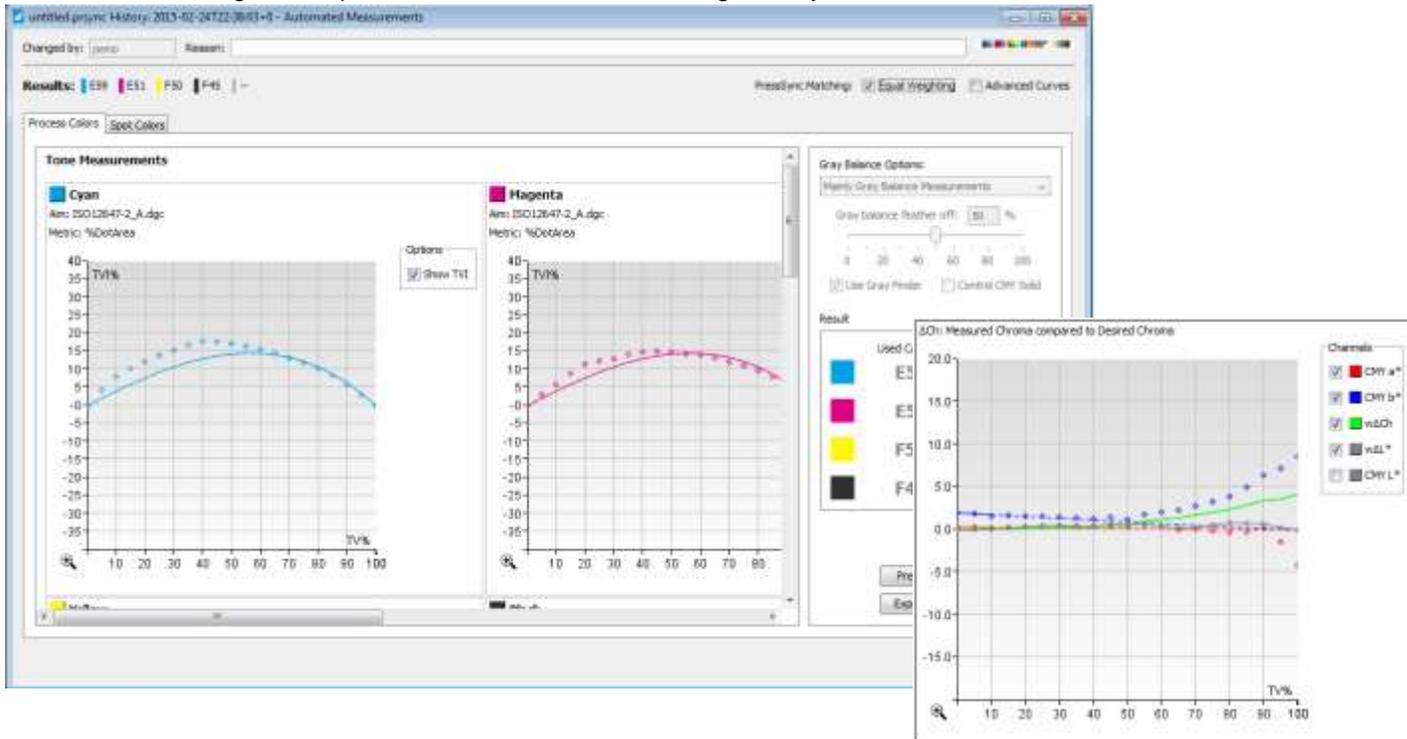
CMYK curve set for calibrating towards G7 method, TVI method in shadows

For this CMYK curve set, curves are set to be based on 'Mainly gray balance measurements'.

When the black aim-point is set to 'measured' (see [Method 2: Scale aim towards 100 CMY](#)), the gray is fully controlled until '**Feather-off end**' tone. After that tone, the correction will gradually move towards the desired TVI curves.

When the black aim-point is set to 'G7:0,0' (see [Method 1: Fade out gray correction](#)), the gray control starts to fade out at '**Feather-off start**' tone. After that tone, the correction will gradually move towards the desired TVI curves.

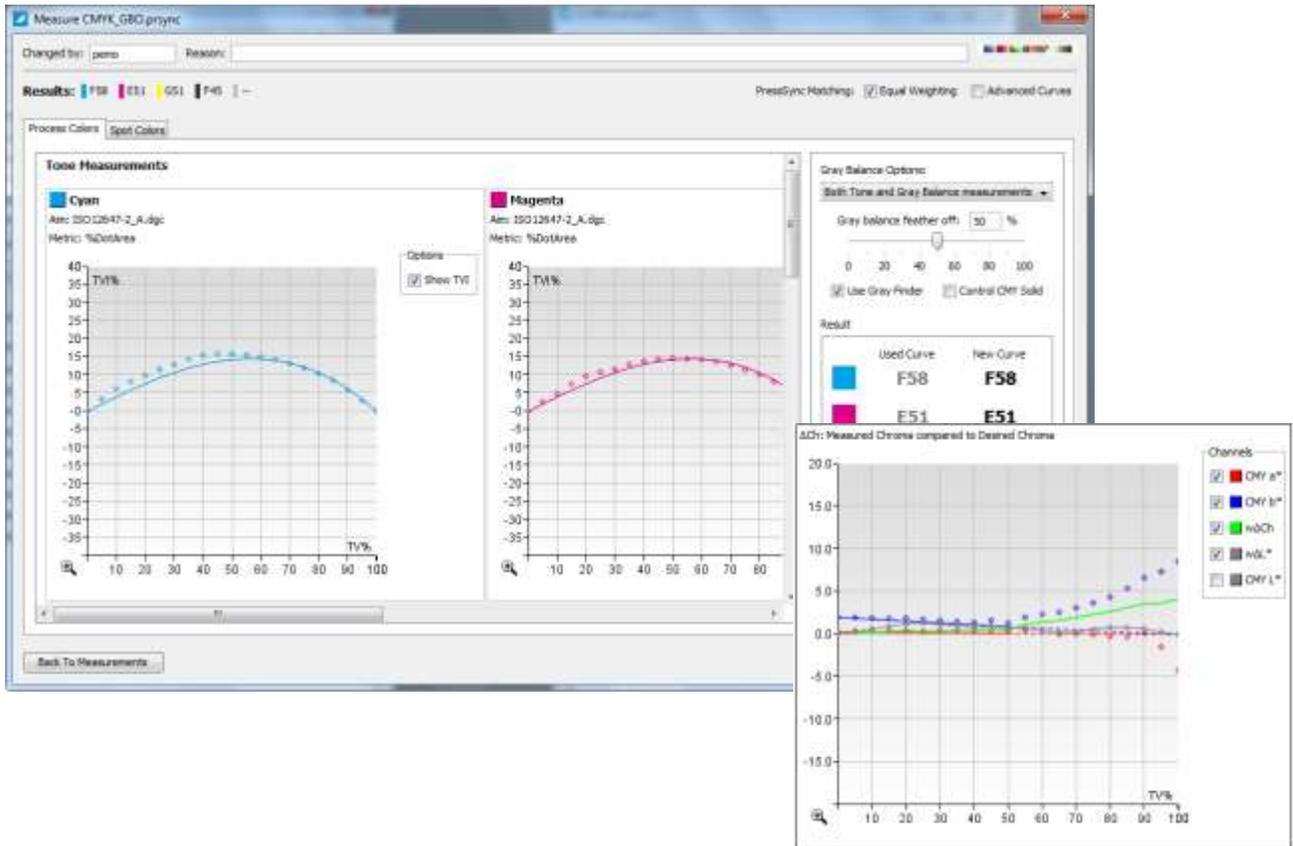
Below a simulated press run from curves set to full gray balance, and gray correction feathering off (method 1). You can see that the tones below 50% deviate from the desired TVI curves, but that gray balance is according to G7 specifications. Above 50% tones gradually follow the desired TVI curves.



CMYK curve set mixing TVI and gray balance correction

Another way to combine the TVI method and the G7 method is using the option: 'Match curves using both tone and gray balance'. In that case, the correction towards TVI curves and G7 gray balance will be averaged evenly over the complete tonal range.

Below you can see a simulated press run, in which both TVI and gray balance are close to the aims, over the complete tonal range.



PressSync Curve fit option

A user can influence the way a PressSync curve is matched to (calculated) adjustment points. There are two options provided for this: 'Robust fit' and 'Standard fit'.

Robust fit

When 'robust fit' is selected, a PressSync curve is selected so that the sum of absolute deviations between y values of points and y values on the curve is minimal:

Mean Deviation (MD) = minimal $\Sigma |Y_{data} - Y_{curve}|$

The result of this fit is that adjustment points following a normal trend relative to a PressSync curve will fit the curve very well, while other points that deviate from this trend will be left aside.

- ⇒ The PressSync curve will tend to follow common points and ignore outliers.
- ⇒ For some set of points multiple solutions are possible. E.g. if two groups of points trend to two different curves. This can result in unstable curve fitting.

When to use this:

Robust fit is suitable in cases where there are enough measured points (e.g. calibration charts). It is robust against measurement errors (it ignores outliers).

This fit is less suitable for cases where only a few points are known (e.g. control strips), or where all points are of equal importance and should fit the curve equally well.

Standard fit

When 'standard fit' is selected, a PressSync curve is selected so that the sum of squared deviations between y values of points and y values on the curve is minimal:

Minimal Standard Deviation (SD) = minimal $\Sigma (Y_{data} - Y_{curve})^2$

The result of this fit is that a curve is selected where ALL of the points fit equally close to the curve. There is no distinction between points that fit well relative to a PressSync curve and other points that don't.

- ⇒ The PressSync curve will tend to follow all points (equally weighted).
Points that don't follow the average behavior of other points will have a big impact on the shape of the curve. This type of fitting is not robust against outliers.
- ⇒ There is only one solution/optimal curve for a given group of points, so fitting is stable.

When to use:

Standard fit is suitable in cases where all the adjustment points are considered equally important: each measured point has the same importance and the curve must follow each of them as closely as possible (e.g. control strips that typically only have a few points).

This fit is not suitable when more points are available and not all points are correctly measured (e.g. calibration charts).

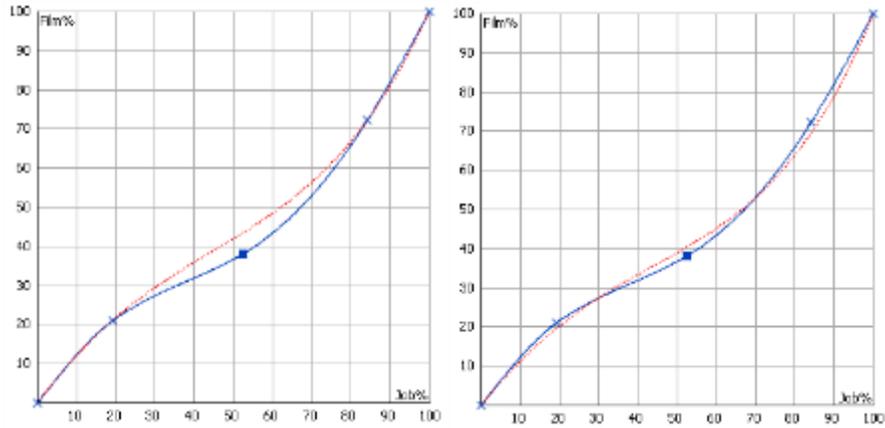


Figure 9: Robust fit versus standard fit - 5 points

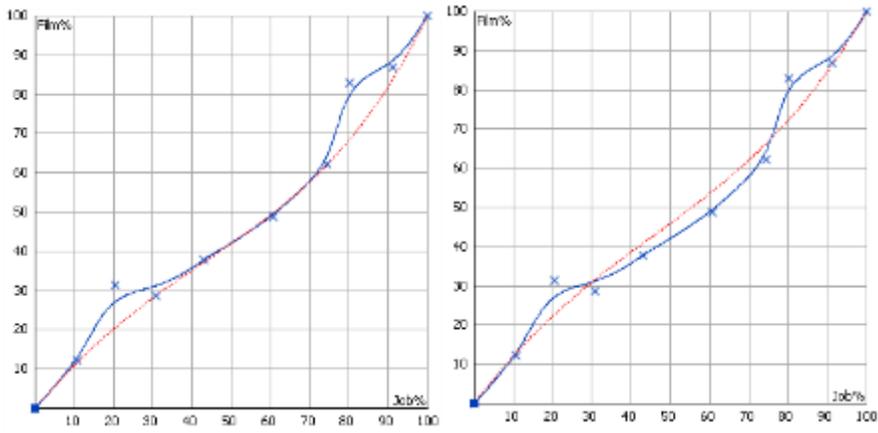


Figure 10: Robust fit versus standard fit - 10 points

Measured Ink Solid panel

Before curves are created or refined from printed charts or control strips it is important to know if printing was done with a compatible printing condition: Paper and inks match the specs, aim values and curves are valid for the printing condition used.

The printing condition can be verified by measuring the color of the paper and of the ink solids.

In Curve Pilot 14.1 an extra panel is shown after collecting measurements, that displays these measured values.

The measured paper and ink solids are compared with the reference profile that was set as 'Desired Printing Condition' for a curve set.

If color differences (using $\Delta E76$) or density differences exceed certain limits, the values will be colored red and the panel will have an exclamation mark.

$\Delta E76$ or Δ Density limits can be specified in the Curve Pilot Preferences.

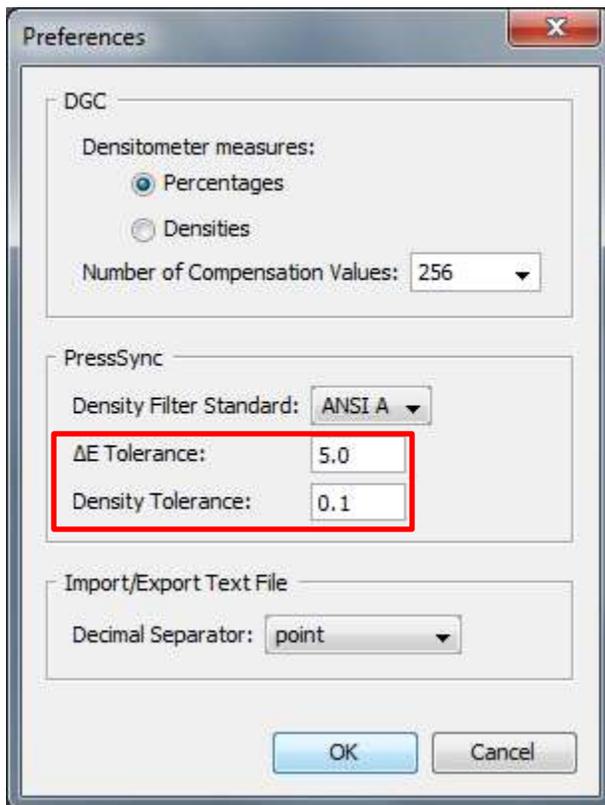


Figure 11: Curve Pilot preferences

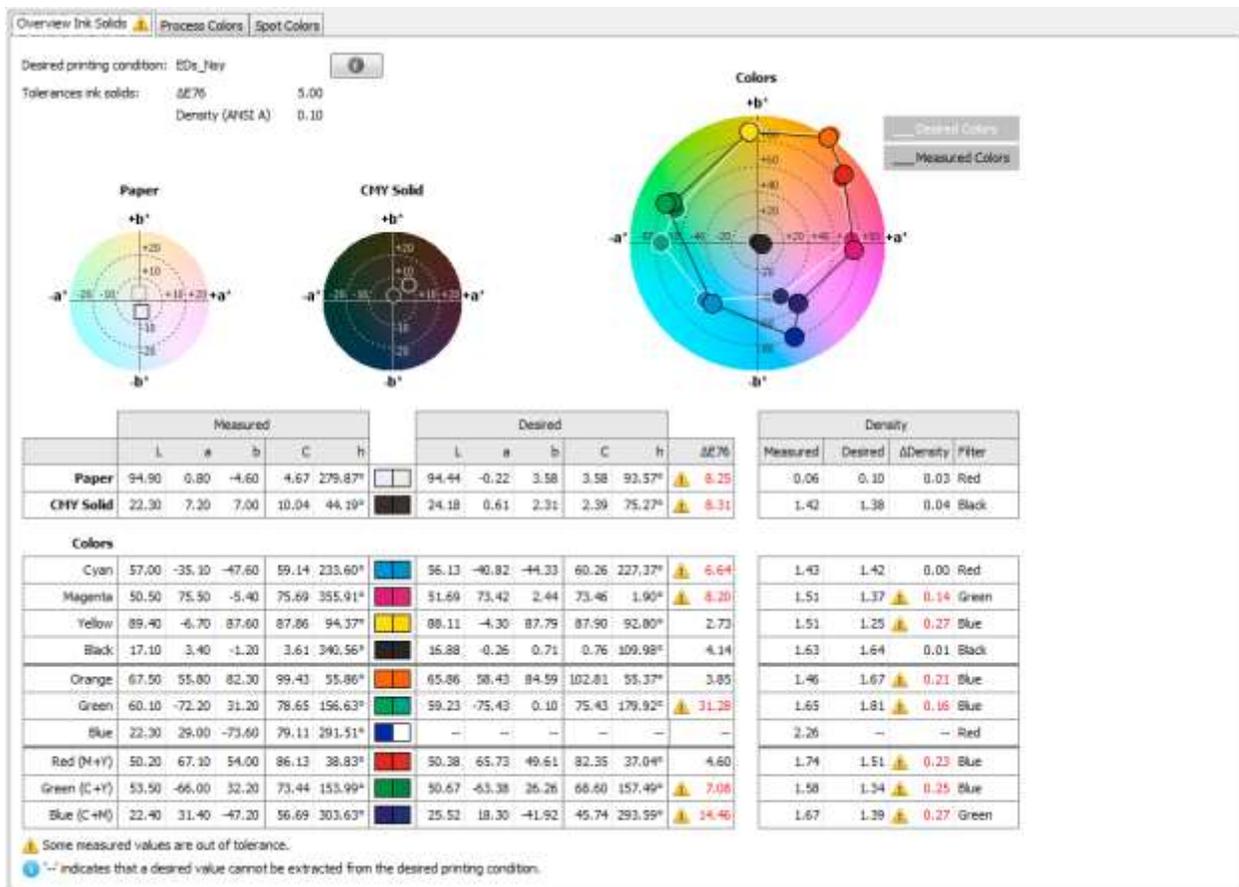


Figure 12: Ink Solids panel

Notes:

- Make sure that solid patches for all inks are available on the printed chart or control strip. If an ink has no solid patch, it will not be verified.
- Only inks that are available in the desired printing condition profile will be evaluated. E.g. when the desired printing condition profile is a CMYK profile, OGB ink solids will not be verified.
- Density values will only be evaluated if both the measurement and the desired printing condition profile have spectral data, or if neither of them have spectral data.
- When working with spectral data, the density will be extracted from the spectral data using a Red, Green, Blue or Black filter, dependent on which filter returned the largest value. The filter used is indicated in the 'Filter' column.
- When working with non-spectral data, the density is extracted from X, Y or Z tri-stimuli values. In that case the 'Filter' column will indicate X, Y or Z depending on which gave the largest value.
- The 'Overview Ink Solids' panel is also included in the report.
- The 'Overview Ink Solids' panel will also show when loading a measurement from history.

New Control Strips

With Curve Pilot 14.1 new control strips are added to support Equinox printing conditions.

When starting an automatic measurement, the new control strip layouts can be selected from the 'Layout' drop down box.

The PDF files for these control strips can be found in the following folder:

\\Esko\bg_prog_intellicurve_v141\dat\doc\

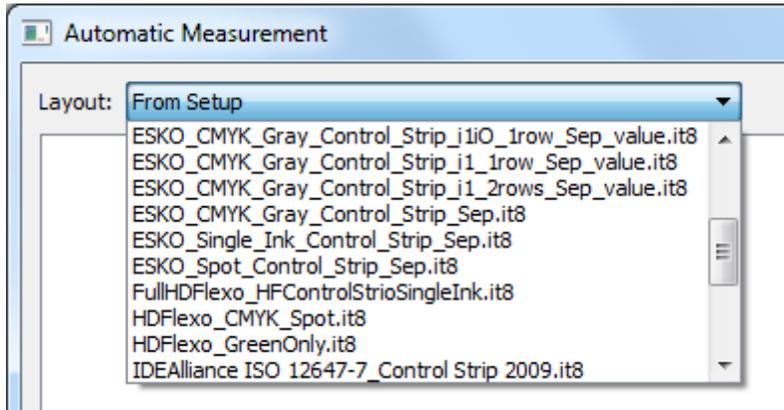


Figure 13: Layout drop down with new 'ESKO_' control strips

ESKO_CMYK_Gray_Control_Strip_i1iO_1row_Sep_value

Layout:

ESKO_CMYK_Gray_Control_Strip_i1iO_1row_Sep_value.it8

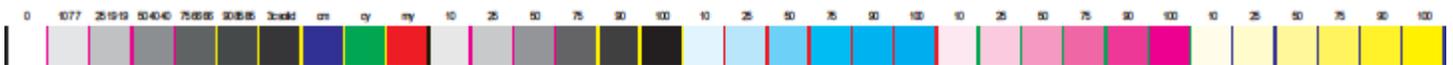
PDF:

ESKO_CMYK_Gray_Control_Strip_i1iO_1row_Sep_value.PDF

This control strip is suitable for the i1iO measurement device.

The strip has only one row of patches.

Patches included are C,M,Y,K tones and ink solids, G7 composed CMY gray patches and CMY solid, Red (M+Y), Green (C+Y), Blue (C+M).



ESKO_CMYK_Gray_Control_Strip_i1_1row_Sep_value

Layout:

ESKO_CMYK_Gray_Control_Strip_i1_1row_Sep_value.it8

PDF:

ESKO_CMYK_Gray_Control_Strip_i1_1row_Sep_value.PDF

This control strip is suitable for the i1 measurement device.

This 1-row control strip is similar to the i1iO version strip, but with some patches removed. That is because for the i1 device the number of patches in 1 row is limited to 33.

Patches included are C, M, Y, K tones and ink solids, G7 composed CMY gray patches and CMY solid. (Red, Green and Blue patches are not included)



ESKO_CMYK_Gray_Control_Strip_i1_2rows_Sep_value

Layout:

ESKO_CMYK_Gray_Control_Strip_i1_2rows_Sep_value.it8

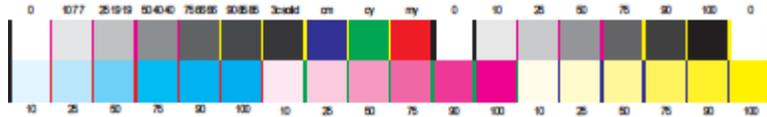
PDF:

ESKO_CMYK_Gray_Control_Strip_i1_2rows_Sep_value.PDF

This control strip is suitable for the i1 and i1iO measurement device.

The strip contains all patches that are included in the i1iO single-row control strip, but with a layout over two rows so it is also suitable for the i1 device.

Patches included are C, M, Y, K tones and ink solids, G7 composed CMY gray patches and CMY solid, Red (M+Y), Green (C+Y), Blue (C+M).



ESKO_Single_Ink_Control_Strip_Sep

Layout:

ESKO_Single_Ink_Control_Strip_Sep.it8

PDF:

ESKO_Single_Ink_Control_Strip_Orange_Sep_value.PDF,

ESKO_Single_Ink_Control_Strip_Green_Sep_value.PDF,

ESKO_Single_Ink_Control_Strip_Blue_Sep_value.PDF

This control strip has patches for only one ink.

There are PDF files available for O, G, B but the control strip can also be used to print other inks.

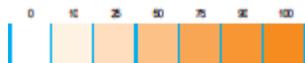
This strip can be measured in combination with Esko_CMYK strips, to derive curves for CMYK and one or more Equinox colors (O, G, V, B...)

Curve Pilot will detect the ink automatically from the ink solid patch on the strip.

However, this ink must be one of the inks available in the ClassicColors CMS ink book.

When a spot color from another ink book (e.g. Pantone colors) is used, a dedicated control strip layout needs to be used (see [ESKO_Spot_Control_Strip_Sep](#)).

Patches included are different tints and solid patch for one ink.



ESKO_Spot_Control_Strip_Sep

Layout:

ESKO_Spot_Control_Strip_Sep.it8

PDF:

ESKO_Spot_Control_Strip_Sep_value.PDF

This control strip has patches for only one ink.

The spot color that is going to be used for the control strip must be specified in the layout file. So the layout file (.it8) needs to be modified.

Procedure:

1. Open the Curve Pilot data folder `\Esko\bg_data_intellicurve_v141`

2. In that folder make a copy of **ESKO_Spot_Control_Strip_Sep.it8**
Change the name of the copy so it refers to the spot color.
E.g. '**ESKO_Control_Strip_Spot7452C.it8**'
3. Edit this file with a standard text editor, and change the value of the field PROCESSCOLOR_ID which defines the spot color used.
PROCESSCOLOR_ID "pms1000c/7452"
4. Save the file, and use it with Curve Pilot.

Patches included are different tints and solid patch for one ink.

