Chapter 2

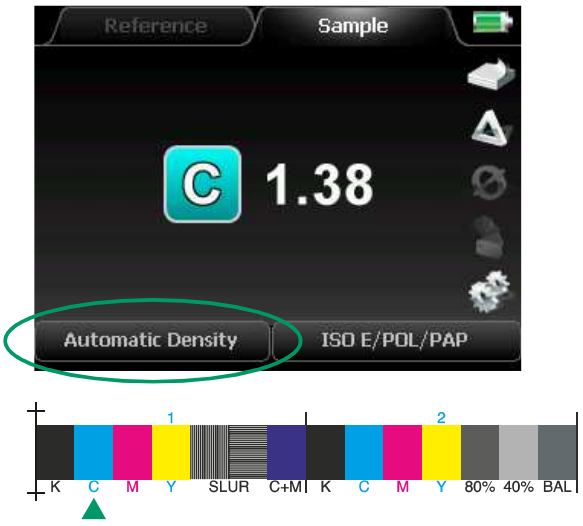
Description of the measurement functions

2.1 Measurement functions of SpectroDens Basic

Automatic Density

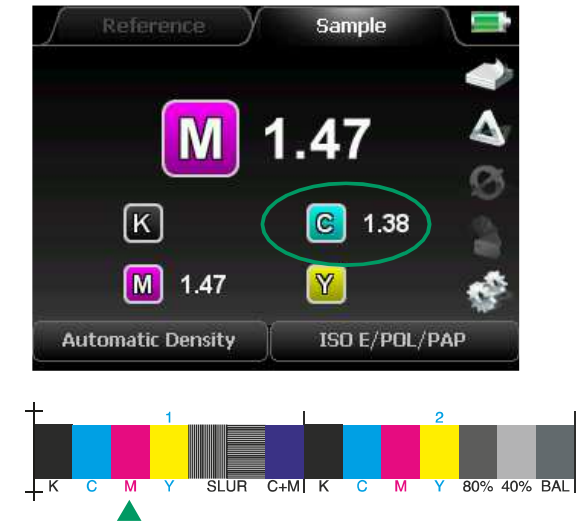
SpectroDens Basic comprises all functions related to density measurement. A very practical feature is the **Automatic Density** mode. By a push of the green measurement button the relevant measurement values are displayed. Depending on the type of measurement patch this can be:

- Solid density D
- Dot area in %
- Gray balance

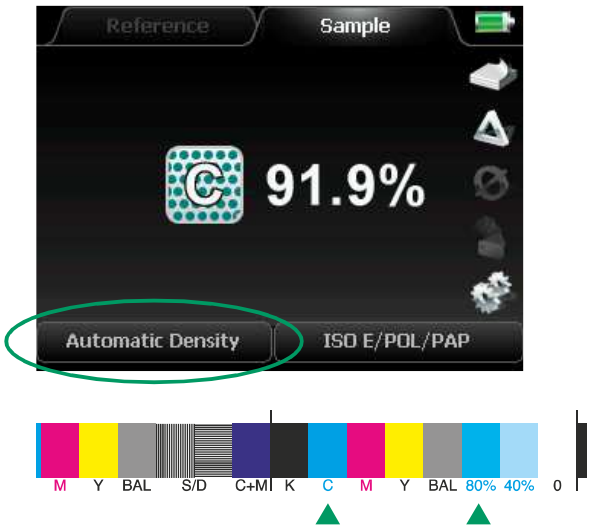


In this example the measurement has been taken on a Cyan patch. SpectroDens recognizes the type of process color and displays the **solid density** value of Cyan, which is displayed with the "C" symbol. Values for Cyan (C), Magenta (M), Yellow (Y) and Black (K = key color) can be shown.

The density value is a value without a unit. It corresponds to the amount of ink applied on the paper surface. The higher the density value the higher the thickness of the ink layer. The correct density value is dependent on the printing parameters (paper, ink, printing process). Usually, density values are between 1.00 and 2.00.



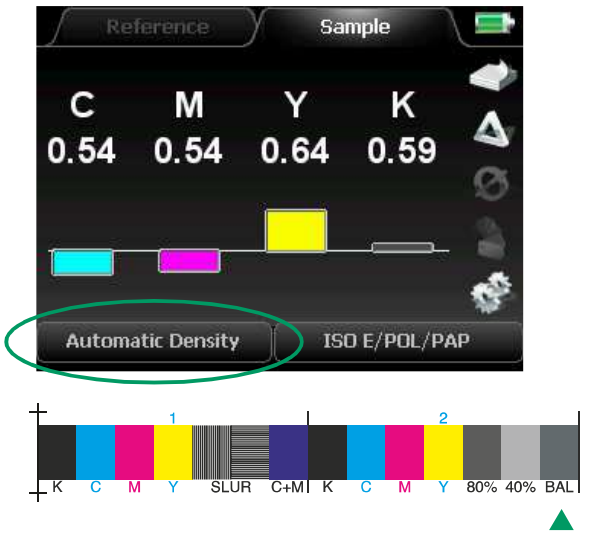
The second measurement has been taken on a Magenta patch. The former Cyan measurement still gets displayed. Measurements of a specific process color will be overwritten as soon as a new measurement of this specific color will be made.



For the display of **dot area** (or dot percentage) in %, two measurements have to be made: First the solid density patch and then the %-patch, which is in this example a 80 %-patch. The resulting dot percentage is in this case 91.9 %; the referring **dot gain** is 11.9 %:

91.9 % - 80 % = 11.9 %

Should a solid density value be displayed instead of the desired dot percentage value, then the density measured first was significantly higher than the second one. In this case we recommend to delete the displayed value by pressing the red escape button and to measure again.



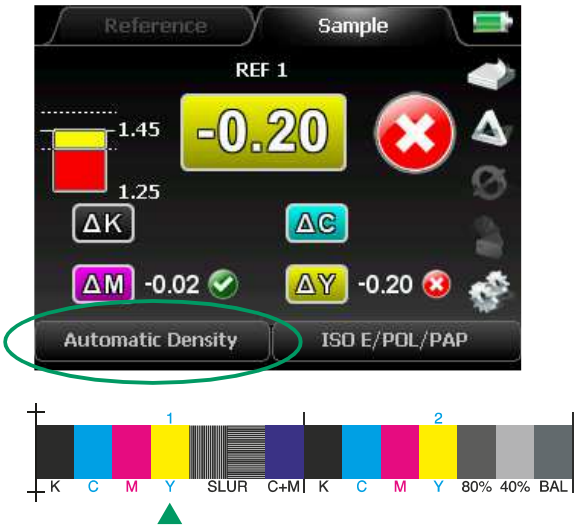
A gray balance patch is composed of different portions of Cyan, Magenta and Yellow. It does not include black ink.

When making a measurement on a **gray balance** patch, the referring density values for all four process colors are shown in a bar graph. The values for Cyan, Magenta and Yellow should be in close range to each other to ensure a neutral gray balance without a color hue.

It is important that the gray balance patch, on which the measurement is taken, comprises the right %-values to achieve a neutral gray when printed correctly. The process standard ISO 12647 for offset print defines the values as:
C = 50 %,
M = 40 % and
Y = 40 %.

The value for Black indicates how dark the gray color is. The higher the value for Black (= K) the darker the sample.

In **DELTA Mode** (= comparison mode) the measured values are compared to reference values. The mode is activated by navigating to the "soft key" with the triangle symbol and selecting it.



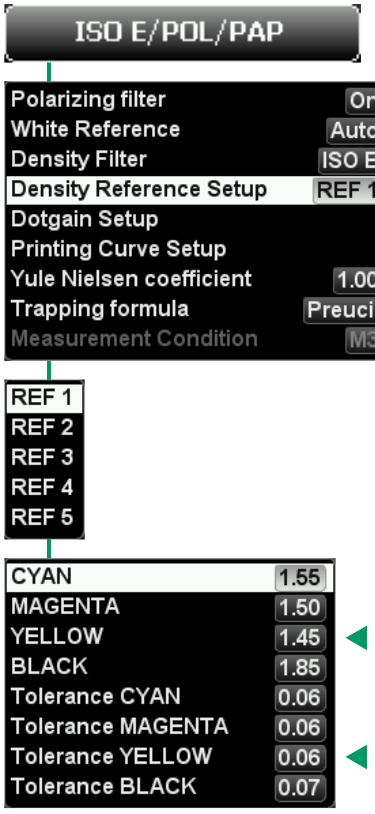
In the example on the left side a Yellow patch was measured.

The measured solid density is:

Y = 1.25

This is 0.20 less than the set reference (= target) density of Y = 1.45.
The measured value is outside the limits of the set tolerance of ± 0.06. Therefore it is marked with a cross symbol in the round icon.

A checkmark symbol would be shown in case of a measurement within the tolerance limits.



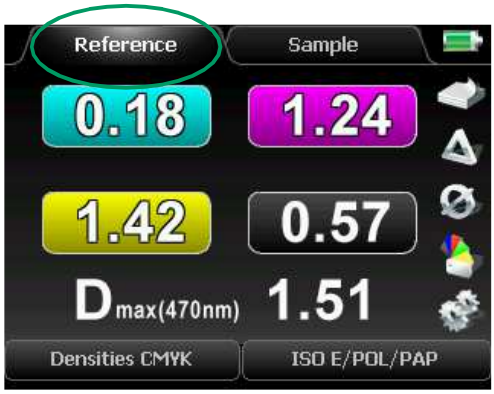
The setting of **reference values** and **tolerances** is done in the menu under the item measurement conditions.

In the **Density Reference Setup** up to five data sets (REF 1 – 5) for reference (= target) densities can be edited. Reference densities recommended for the five defined paper classes are already pre-set.

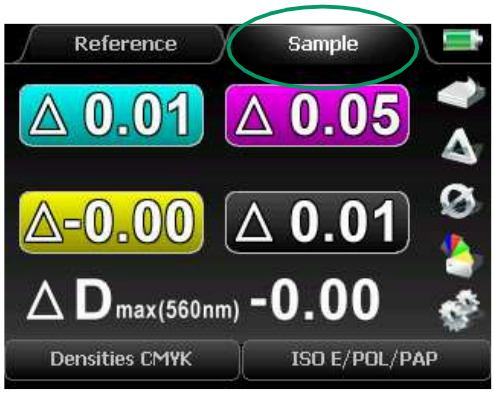
The tolerances define the lower and upper limits around the reference values. In this example for Yellow:
1.45 + 0.06 = 1.51
1.45 - 0.06 = 1.39

Densities CMYK

In the measurement function **Densities CMYK** all four partial densities for Cyan, Magenta, Yellow and Black are displayed.



Patch for reference measurement



Patch for sample measurement

In this example, a solid Magenta patch was measured. The solid density is:

M = 1.47

But why are densities for the other colors shown as well ? Shouldn't they have a value of 0 ? No. These are the so-called **partial densities**. No printing ink is 100 % spectrally pure. There will always be partial colors besides the actual main color.

This function also makes comparison between measurements and reference values. In this example the reference value was not taken from the reference memory but was measured just before by putting the "soft key" to **Reference**:

1. First select via "soft key" **Reference** and make a measurement on a patch which will be the future reference patch.

2. Now activate via "soft key" **Sample** and make a measurement on a sample patch. A triangle symbol in front of the measurement value indicates that delta values (difference between reference and sample) are shown. Future sample measurements will be compared to the once measured reference values as well.

3. Now activate the **DELTA Mode** by selecting the triangle symbol.

The function **Densities CMYK** is especially suitable for the measurement of multicolored composed CMYK colors, e.g. in logos, to find out the reason for possible color shifts.

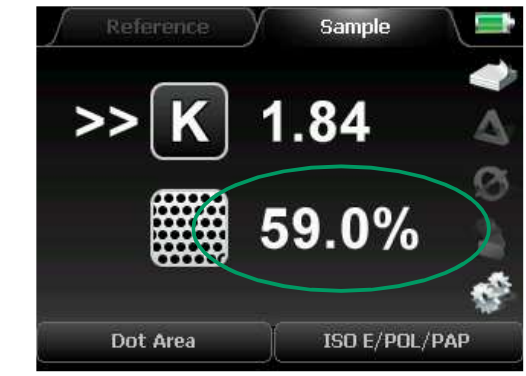
For information about the ΔDmax-function see page 45.

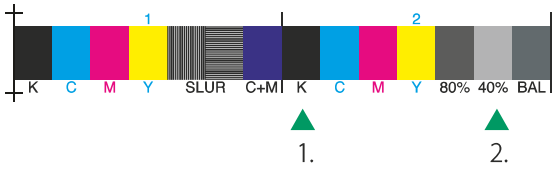
Dot Area

For the function **Dot Area** (= dot percentage) two measurements have to be carried out. First a measurement on a solid patch and then a measurement on a %-patch (= screen patch). The dot area value is calculated with the Murray-Davies formula.

1. First place the measurement head above a solid patch and start the measurement by pressing the green button. The solid density value will be displayed.

2. Now make a second measurement on a %-patch and the **dot area** in % will be shown.



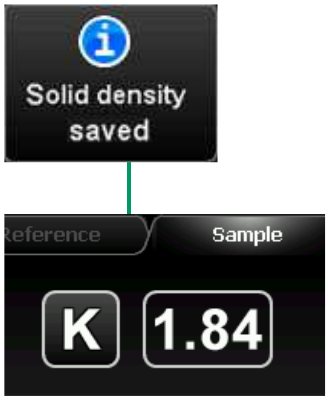


In this case a measurement has been taken on a 40 %-patch.

The resulting dot gain can be easily calculated:
59 % - 40 % = 19 %

The dot gain value gives the information to what degree a point is enlarged (or decreased) during each process step of the reproduction process chain.

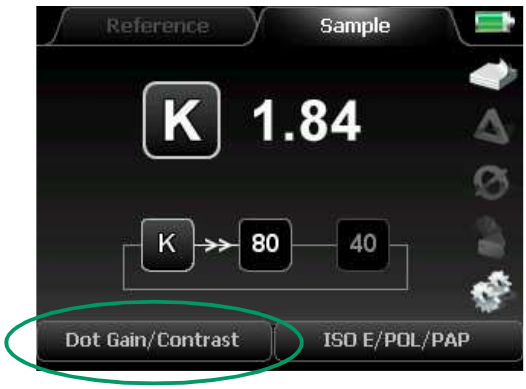
The double arrow on the left side of the device display indicates which measurement has to be done next.



Should several dot area values refer to the same solid density, this value has to be measured only once and can be saved for consecutive %-measurements. After a solid density measurement, just keep the enter button pushed for approximately 3 seconds until the density value is framed. Now an unlimited number of %-measurements can be made. Deactivating is done by keeping the enter button pressed again.

Dot Gain / Contrast

The function **Dot Gain / Contrast** is closely related to the previously described function of dot area. Here also, first a solid density measurement is carried out and then %-measurements follow.



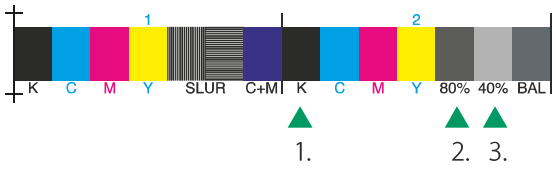
In the lower part of the device display there is shown which patch has to be measured next.

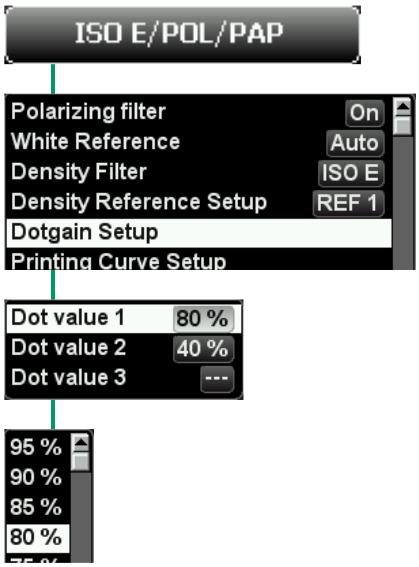
In this case there just has been measured a solid density patch with a density of 1.84.

The double arrow points to the 80 meaning an 80 %-patch has to be measured next.

After the last %-measurement has been done (in this case the 80 %-patch) additionally to the **Dot Gain** value the **Printing Contrast** will be calculated and displayed.

The round escape button will always lead back to the previous step in case a wrong measurement has been made.



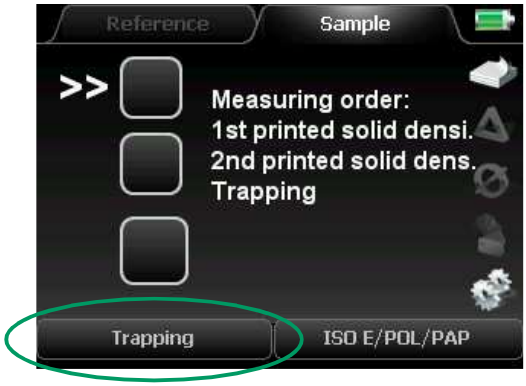


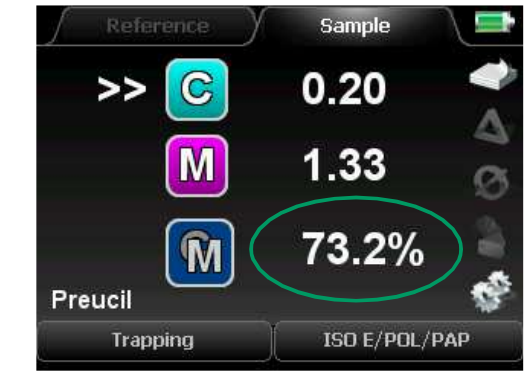
The setting for the %-patches to be measured is done in **Dot Gain Setup**.

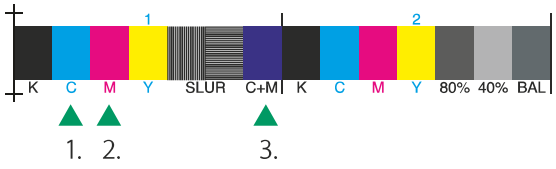
Up to three percentage values can be edited. The TECHKON TCS print control strips include two different %-patches; 80 % and 40 %.

Trapping

With the feature **Trapping** there can be checked, how good two layers of ink which are printed over each other represent the resulting mixed color.







Three measurements are necessary: Two measurements on each of the two separate process colors and finally one measurement on the resulting overprinted patch.

Here in this example first Cyan and second Magenta has been measured. The final measurement is done on a blue patch as the overprint of Cyan and Magenta. The trapping value is 73.2 %. The higher the value the better the overprint of two colors.

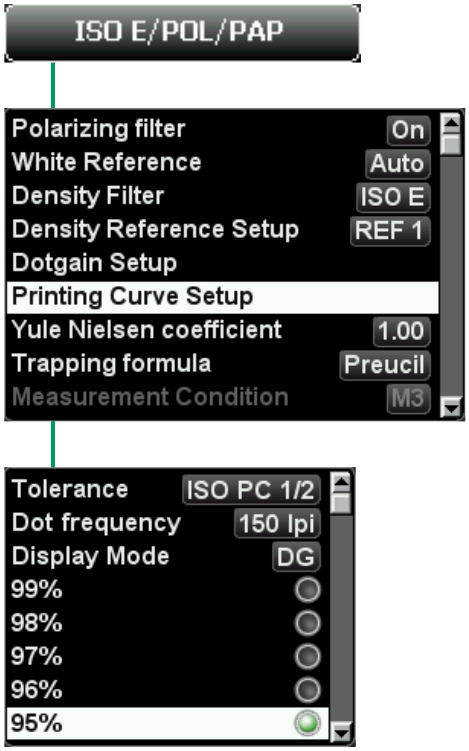
Additionally to the trapping value in % there are the densities for the separate color patches displayed. The densities are always displayed with the filter channel of the second printed ink; in this case Magenta. This explains why the density value for the first printed ink Cyan is so low. SpectroDens will recognize automatically the order of colors as they are printed. Switching the first and second measurement therefore will lead to the same result.

There are no standard values for the trapping measurement. The values which can be obtained depend on the printing process and particularly on the type of ink and paper used. Typical values for standardized print with Paper Class 1 (glossy, coated) are: C+M > 60 %, M+Y > 72 % and C+Y > 85 %.

SpectroDens offers extended trapping calculation according to Professor Ritz and Felix Brunner, which ensure a better comparison between C+M, M+Y and C+Y measurements. An alternative determination how well two separate colors overprint can be checked with a colorimetric function, such as the L*C*h*-feature, where the L*- and C*-values give the information of the printable gamut.

Printing Curve

The measurement function **Printing Curve** displays a complete transfer curve, which describes how screen dots (and tonal values) are transferred during the several process steps of the reproduction process.

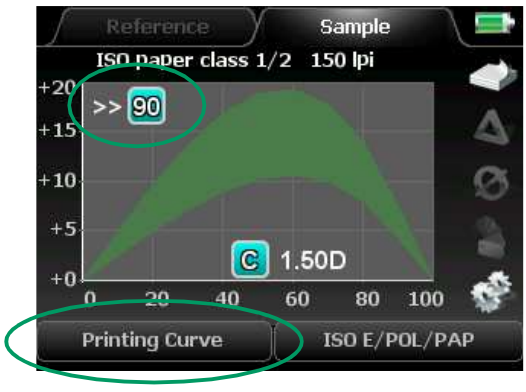


First, make the required settings in the **Printing Curve Setup**:

1. Tolerance range can be set according to standard values (in this case the ISO Paper Class 1/2 was selected)

2. Dot (screen) frequency (only relevant for the display of tolerance values)

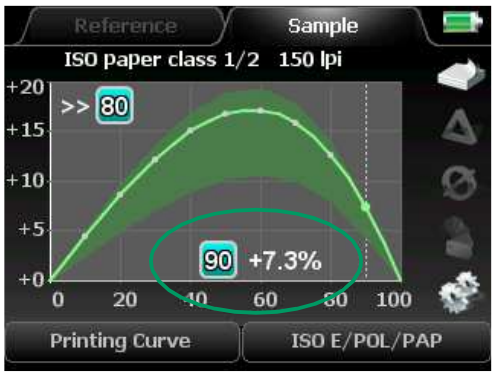
3. Increments of the wedge to be measured, e.g. in 5 % steps



In the first step a 100 %-(solid) patch is measured. SpectroDens recognizes automatically the color and displays the solid density. In this case D = 1.50 for Cyan.

The double arrow in the upper left corner indicates that the next patch to be measured will be a 90 %-patch. Now all other pre-set %-patches can be measured on the measurement wedge.

Step wedges with separation bars (as shown) can be measured by scanning. Just keep the green start-button pressed during the whole scanning procedure.



Now the corresponding current dot area is indicated in the lower right section of the display. In this case: + 7.3 % dot gain is displayed at 90 % dot percentage.
The shaded area close to the curve shows the tolerance range. The curve should be within this area.

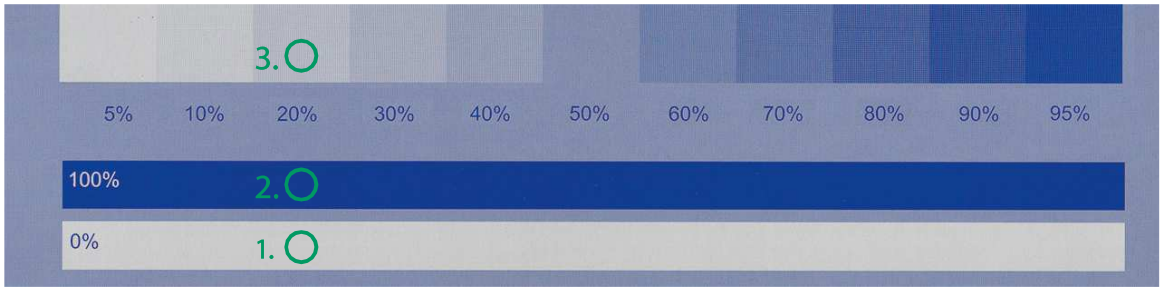
A wrong measurement can be easily deleted by the red escape button and the device will be ready again to read the patch correctly.

When using the scan function we recommend to use a patch width of 5 x 5 mm (min. 4 x 4 mm) with the standard aperture and a patch width of 4 x 4 mm (min. 3 x 3 mm) with the exchangeable 1,5 mm aperture.

Printing Plate

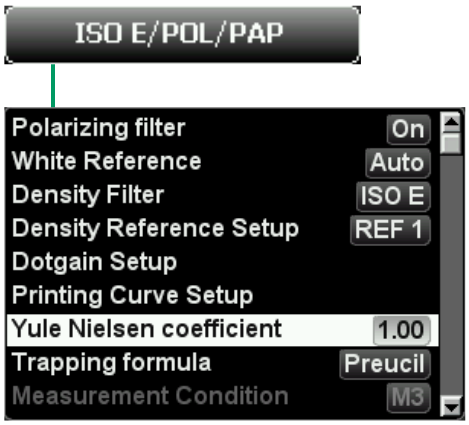
Beside energy and focus of the laser, dot gain is the most important information which has to be checked in plate exposure. Special plate measuring instruments working with video analysis have been developed for this application; for example TECHKON SpectroPlate. Compared to densitometers and colorimeters they offer big advantages. Nevertheless it is basically possible to make measurements with a densitometer on a printing plate. In doing so one should regard the following: Variations in the coating of the printing plates may result in strong influences on the measurements, especially in the crucial range under 10 %. Variations of 0.02 D can cause errors up to 6 %.
The values measured with a densitometer do not correspond with the geometric dot area, due to the fact that the densitometric measurement process is subject to optical influences, which increase the measurement value. Therefore densitometers measure always a higher value than video analysis devices. But the measurement value of the densitometer can be taken as a reference value for the tonal value adjustment.

For the measurement of the zero point (1.), the solid patch (2.) and the screen patch (3.) you should select areas on the printing plate which are located as close as possible to each other.



The measurement feature **Printing Plate** measurement allows reading values directly on printing plates. The process is comparable to reading on printed paper.

Before taking a measurement it is important, that the rubber coating is washed off the printing plate, because otherwise light gets lost and the measurement result will be distorted. In addition a correction factor, the so-called Yule-Nielsen factor, can be set according to the material characteristics of the printing plate. Usually the plate manufacturer will furnish the information about the factor for the different plate types.



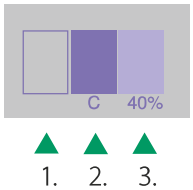
The setting of the Yule-Nielsen factor is done in the settings window of the measurement conditions.

If there is no information about the factor available from the documentation furnished with the plates, we recommend to keep the value in a neutral range at n = 1.00.

The measurement is performed as known from measuring on printed paper:

1. First, calibrate on a light, not imaged area of the printing plate, as it would be a paper white calibration.

2. Now measure a dark, 100 %-imaged patch. SpectroDens will select one of the four CMYK channels where the contrast signal is highest depending on the color shade of the plate. In this case the Cyan channel gave the highest signal, because the plate is blue/violet.



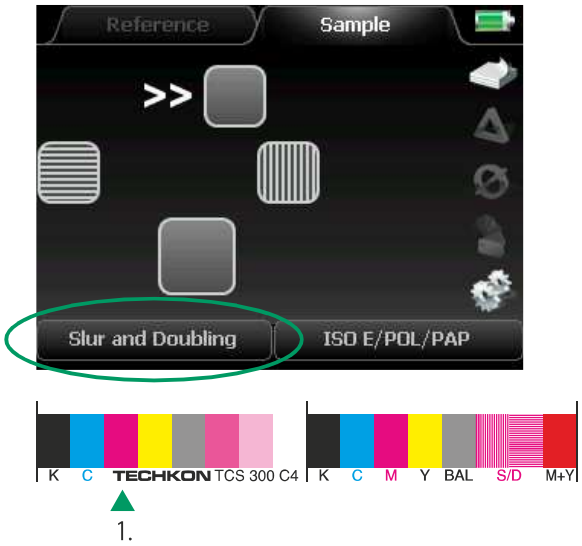
3. Now the measurement on a %-patch is carried out and displayed. Additional %-measurements can be easily made. It is not necessary to measure the solid density again, because it is already saved, which is indicated by the frame around the value.

Slur and Doubling

With the measurement function **Slur and Doubling** printing deficiencies, caused by inexact, geometrical transfer of the image from the plate to the paper can by evaluated.

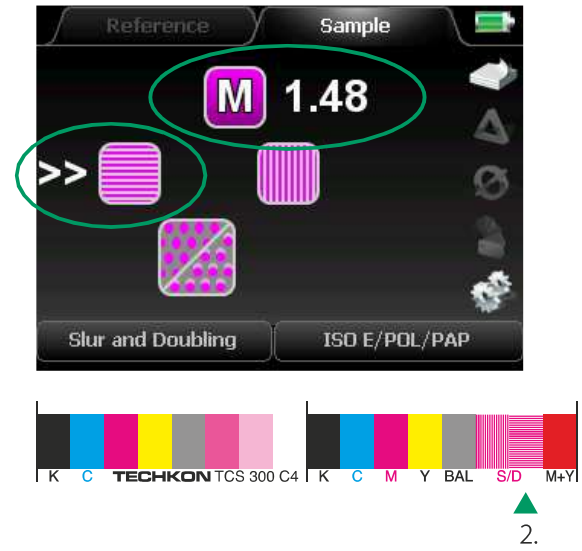
Slurring means that the printed dot deforms from the transfer of the printing plate to the rubber blanket or from the rubber blanket to the paper. The effect of doubling will be present when a printed dot is transferred a second time with less intensity geometrically slightly offset. This ghost image is caused by ink being re-transferred to the rubber blanket which should have stayed completely on the printed paper.

To make the slur and doubling measurement possible, it is necessary to have on the color bar vertical and horizontal lined patches with identical line thickness as it is the case with the print control strip TECHKON TCS.



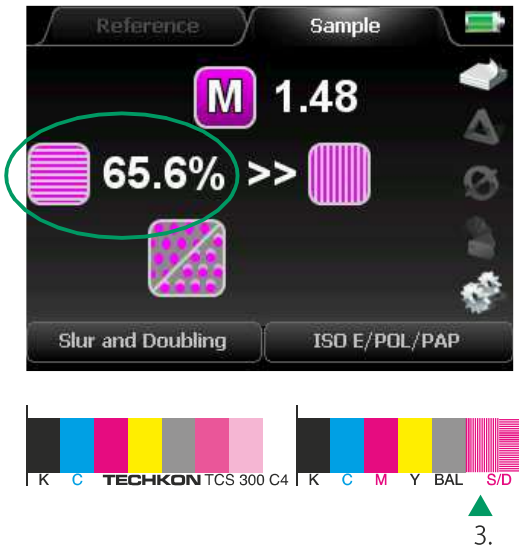
Three measurements have to be carried out:

1. The first measurement on the solid patch; in this case of Magenta.



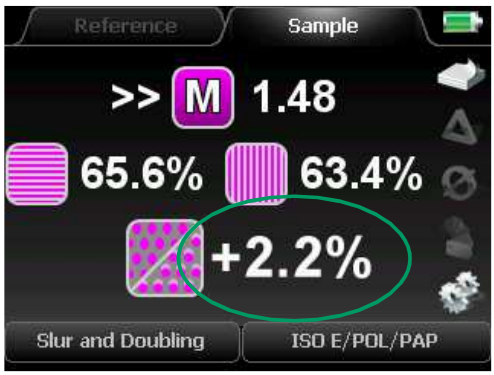
2. The second measurement on the horizontal lined patch of the same process color.

After the measurement of the horizontal lined patch the dot area of the patch is calculated and stored (see the following figure).



3.

3. The third measurement on a vertical lined patch. After the measurement of the vertical lines again the dot area of the patch is calculated and stored (see the following figure).

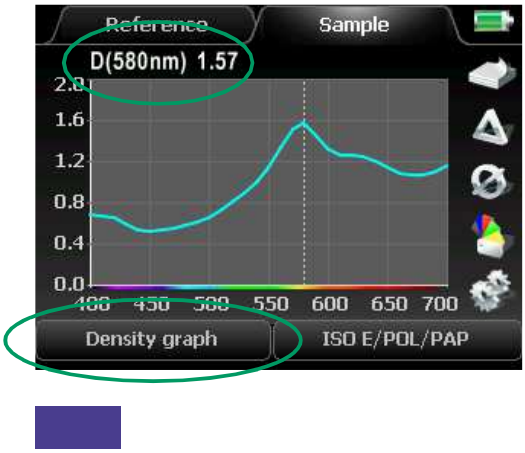


As a result the so-called slur/doubling factor in % is displayed.

0 % is the best achievable factor, meaning the dot transfer is perfect, the horizontal and vertical lines of the measurement patches have the same thickness and that neither slur nor doubling effects are present. Values up around 5 % still are acceptable. %-values higher than 10 % indicate significant geometrical errors in print due to slur or doubling effects. There are no standard values for the maximum allowable %-factor.

Density Graph

The function **Density Graph** enables the exact display of density values for any spot color. Usually the standards define density filter characteristics only for the process colors Cyan, Magenta, Yellow and Black. Thanks to the spectral measurement of SpectroDens, a virtual spectral density characteristic for any spot color can be obtained. The great advantage is that the process control of spot colors can now be as easily achieved as known from the four process colors.

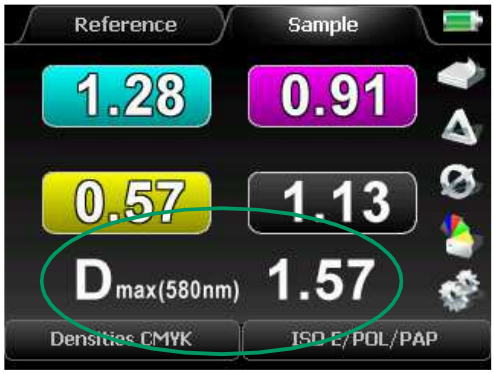


In the following example a measurement has been made on a blue spot color.

The density graph is derived from the remission spectrum and represents the density spectrum for wavelengths from 400 to 700 nm. The peak of the curve displays where the spectral density value has to be taken.

In this case the spectral density for the blue color is D = 1.57 at a peak wavelength of 580 nm.

Only spectral densities relating to the same peak wavelength (Dmax) can be compared.



SpectroDens displays the spectral density automatically as well in the **Densities CMYK** measurement mode.

The density values for CMYK show to what extent the spot color can as well be registered by the CMYK-color related standard density filters.

Here in this case, the blue color is close to a Cyan, therefore the density value in the Cyan channel is quite high.

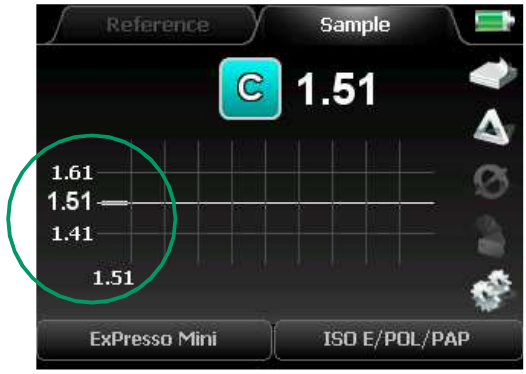
ExPresso Mini

The measurement function **ExPresso Mini** allows the fast control of the printing quality during the printing process. The last ten consecutive measurements of a printing color can be taken on a print control strip of a printed sheet for the ink zone control. In addition ExPresso Mini provides the opportunity to get an overview of the stability of the print run, by measuring the last ten printed sheets.

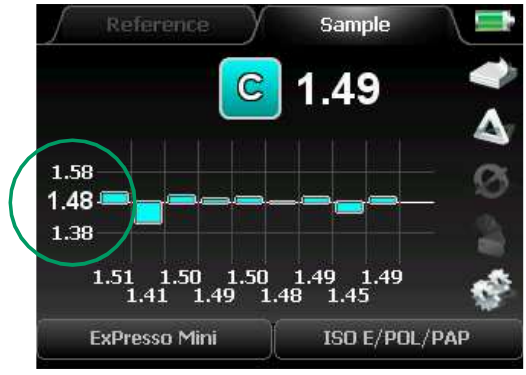
Advanced functions for the fast and comprehensive control of the printing quality during the printing process features the software TECHKON ExPresso 3.0 in connection with the automatic measurement system TECHKON SpectroDrive.

ExPresso Mini can display the last ten measurements per color.

When, after the tenth measurement, the display is filled up with measurement values, the already existing values shift with every new measurement one step to the left, and the first value falls away.



The reference line marks the average value of all measurements.

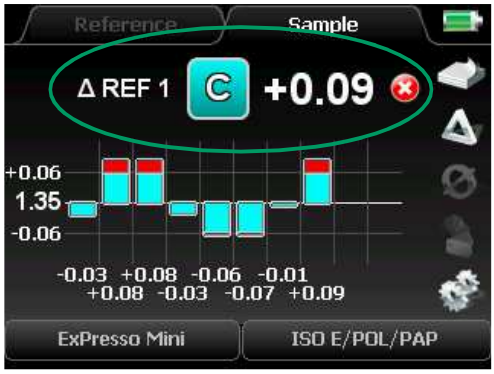


The tolerance area is defined with ± 0.10 density.

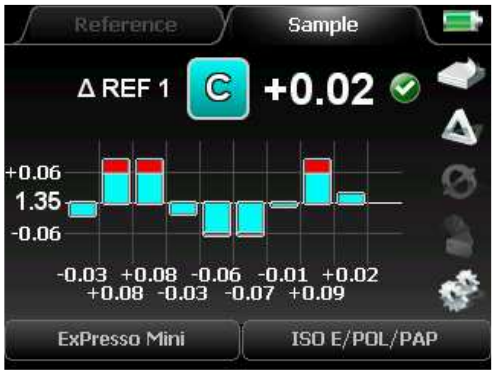
The average value is recalculated after every measurement.

In ExPresso Mini the **Delta Mode** can be activated.

Taken measurements will then be compared to reference densities, pre-set in the **Density Reference Setup**.



The reference data and the result will be displayed. The reference line is always the reference value and the corresponding tolerance.



The figure describes the situation inside and outside of the tolerance and the situation outside of the graphic space.

The measurement conditions M0, M1, M2, M3 according to ISO 13655-2009

Many types of paper contain optical brighteners or pigments to improve the visual performance of the paper. The brighteners and pigments are used to make the paper look brighter and whiter. But for the accurate color adjustment they are quite a challenge, because the type of ambient light influences the color perception in most cases to a large extent. To be able to evaluate these printing substrates precisely when measuring, new standards have been defined concerning the measurement conditions.

The following measurement conditions are selectable in the measurement parameter menu of the SpectroDens color measurement device.

Measurement condition M0 is used when the printing substrate contains no or only little optical brighteners. The measurement light corresponds to the standard illumination type A and the UV component of the source, which activates the optical brighteners, is not specified. Almost every color measurement device in the graphic industries works so far with this measurement condition. This measurement condition should also be used, when measurement values have to be compliant to older devices.

Measurement condition M1 was defined to activate optical brighteners with a specified component of UV light, to be able to evaluate the effect of the brighteners more precisely. The measurement light conforms to the illumination type D 50 with a specified UV component.

Measurement condition M2 describes the measurement without UV light. In older devices this measurement condition was realized using an UV-Cut filter. The comparison of the measurement value M1 to M2 shows clearly how strong the effect of optical brighteners is.

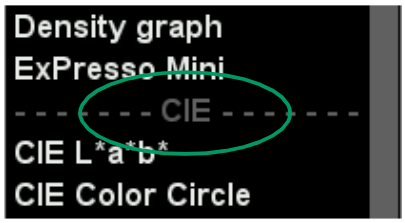
Measurement condition M3 is mainly used for densitometric measurements and only to a less extent for colorimetric measurements. It describes the use of polarization filters which reduce surface reflections to minimize measurement deviations between wet and dry printing sheets.

2.2 Additional functions of SpectroDens Advanced

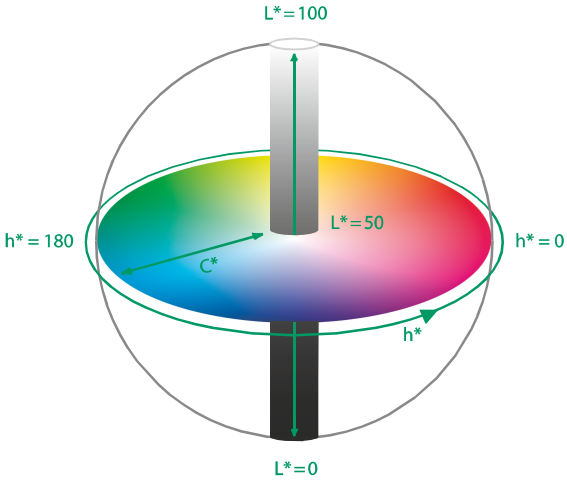
CIE L*a*b*

The previously described measurement functions all were based on densitometry.

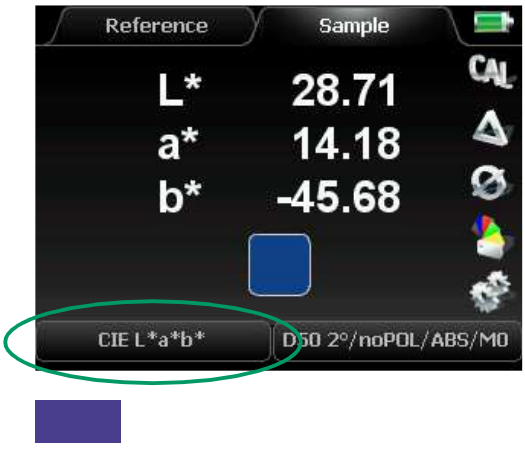
Thanks to the spectral performance of SpectroDens it is possible to calculate and display colorimetric values as well. Measurements in **colorimetry** modes have the advantage of an absolute description of color based on characteristic values.



The thematic separation between densitometric and colorimetric functions is displayed by a dotted line within the measurement function window. CIE stands for the international color institute Commission Internationale de l'Eclairage which publishes the standards for colorimetry.

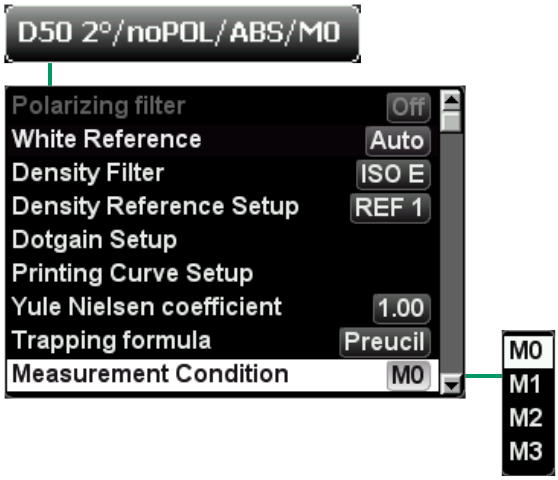


The most popular color system in the printing industry is the CIE L*a*b* color space. Every color is precisely described by three values: The L*-value stands for the luminance and can have values between 0 (a theoretical, absolute Black) and 100 (a theoretical, ideal White). The a*-value describes the color value on the Green/Red-axis (- a*: Green, + a*: Red) and the b*-value the color value on the Blue/Yellow-axis (- b*: Blue, + b*: Yellow).



Colorimetric L*a*b*-measurement on a blue sample. The blue color has a low luminance of L = 28.71 and a low portion of Red (a < 15).

In colorimetry the white reference is absolute in contrary to densitometry where the white is usually referenced to paper white. Before making colorimetric measurements, an absolute white calibration has to be carried out by placing SpectroDens on the charging console and calibrating on the round, white ceramic standard.



Colorimetric measurements can only be compared when the measurement conditions are the same:

- Polfilter: off
- White reference: Absolute
- Illuminant: D50
- Observer: 2°

When selecting **Auto** in the polarizing filter setting, there will be automatically the polarizing filter inactivated when making colorimetric measurements.

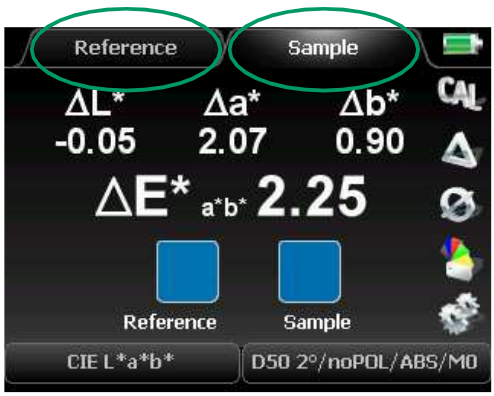
The color distance ΔE* describes how close two different colors match. A value of 0 means that they are identical. ΔE*-color differences in the range of 5 result in considerably perceptible deviations when reference and sample are close together and observed at the same time.

For measurements of the color distance ΔE* of two different colors, activate the **DELTA Mode** first by selecting the "soft key" with the triangle icon.

Color comparison:

Reference Sample

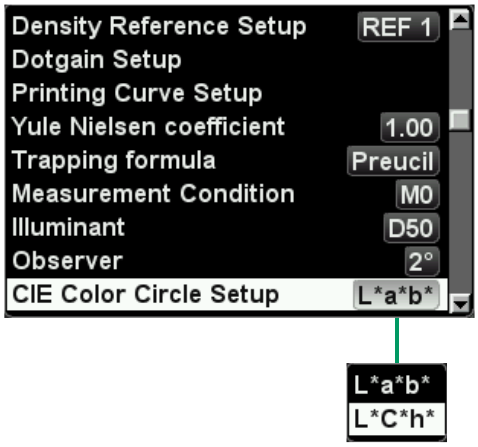
Now two measurements are made:
1. Reference measurement
2. Sample measurement



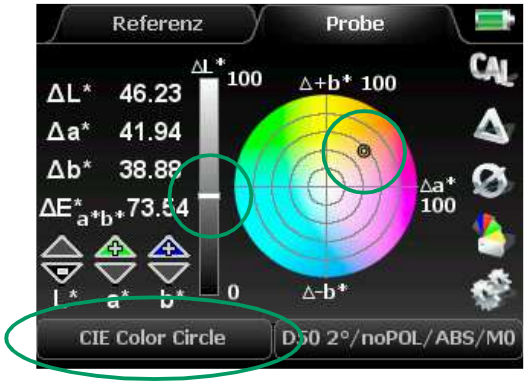
The color distance ΔE* is displayed with two digits. Additionally the components ΔL*, Δa* and Δb* can be seen.

CIE Color Circle

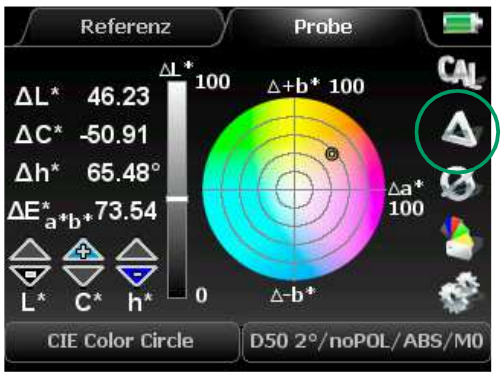
The function **CIE Color Circle** shows the L*a*b*-color values as well. Optionally L*C*h*-values can be displayed. Additionally there is a graphic display and a color is shown as a spot within the color circle.



Select the **CIE Color Circle Setup** function out of the list of measurement conditions. Then choose **L*a*b*** or **L*C*h***.



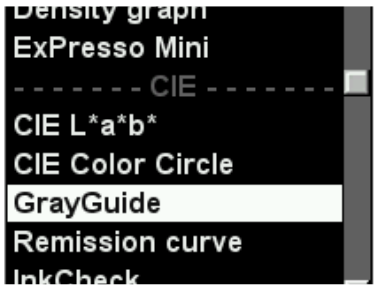
As a result the **CIE Color Circle** feature displays L*a*b*, L*C*h* or L*C*H* values.



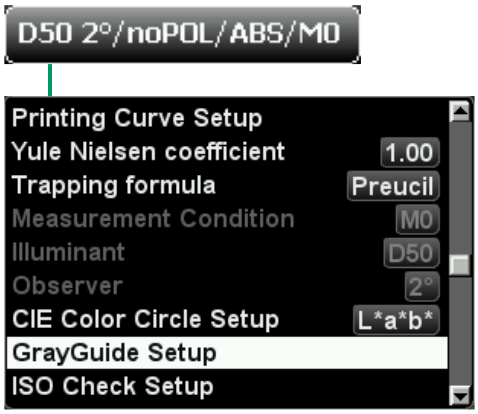
The measurement function **CIE Color Circle**, (as well as **CIE XYZ** and **Remission Curve)**, can be operated in absolute mode with DELTA ON or in comparison mode with DELTA OFF.

GrayGuide

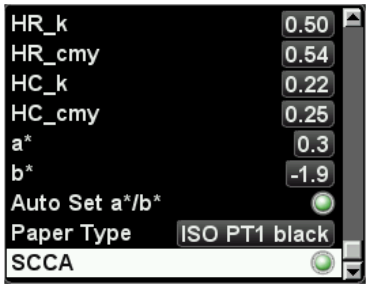
The measurement function **GrayGuide** supports the G7™ calibration of presses and proofs according to the method developed by the IDEAlliance (International Digital Enterprise Alliance).



The **GrayGuide** mode can be selected out of the list of measurement functions.

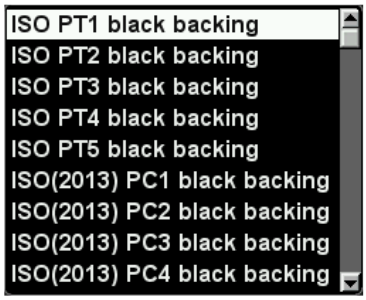


In the pop-up window of the measurement conditions the item **Gray Guide Setup** can be chosen. Now target values can be edited and printing conditions can be selected.



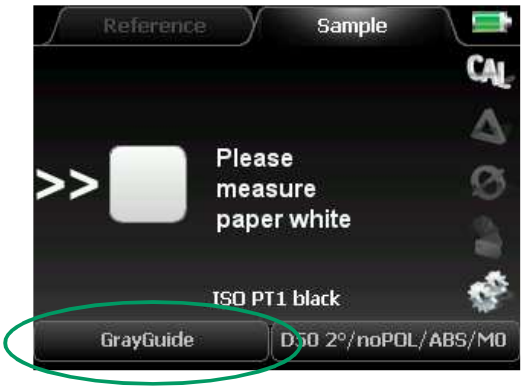
Edit the target values for **SC**, **HR** and **HC** for K and CMY. For **Auto Set a*/b*** use half a*/b* values of measured paper as target value.

You will find a comprehensive description of the **SCCA** function on page 57.



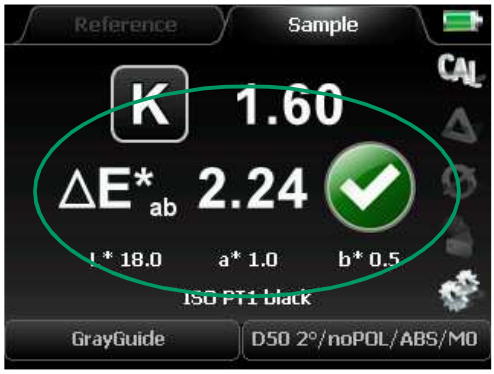
For the comparison to the right ISO reference values the used paper type and backing must be selected.

In order to take correct measurements an absolute white calibration must be performed and will be confirmed in the display when done.



A measurement of the paper white is necessary for correct calculations.

Now the instrument is ready to measure. The selected paper type and backing are indicated in the display.



When measuring solid inks the values are compared to the ISO reference values. The ΔE*-value is indicated and the symbol shows if the value is within or out of tolerance.

The recognized color and L*a*b*-value of the measurement are displayed as well.

The selected paper type and backing type are always indicated.

The ΔE*-value is calculated as long as the difference is in a reasonable range.

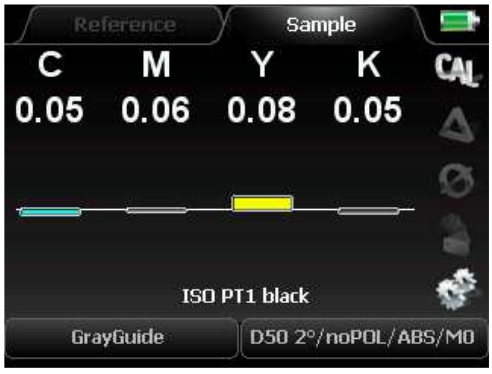
If the difference exceeds a limit, then only the measured density value is displayed without comparison.

This procedure works for all CMYK colors.

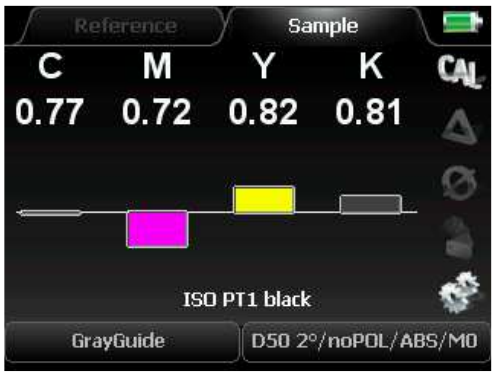
The selected paper type and backing type are always indicated.

The color detection works for trapping patches as well. The recognized type of patch is displayed in the printing order of the two colors.

The measured value is compared with the ISO reference and the difference is displayed as ΔE*.



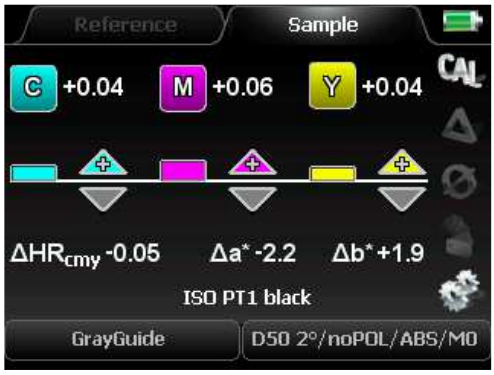
If paper white or **any other** undefined patch is measured then all four densities are displayed simultaneously.



If a gray balance patch is measured all four densities are displayed in a bar chart.

If the value is close to the SC_cmy "neutral density" target it will be displayed with recommended adjustments.

SC stands for "Shadow Contrast".



The HR_cmy is detected as well. The recommended adjustments are shown by the arrows and numbers.

HR stands for "Highlight Range".

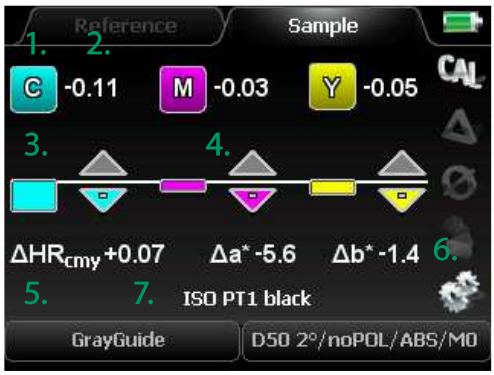
As soon as the value is close to the HC_cmy "neutral density" target it is recognized and displayed.

HC stands for "Highlight Contrast".

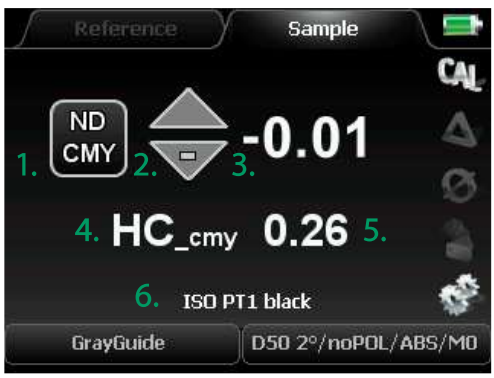
The recommended density adjustments for black patches of SC_k, HR_k and HC_k are displayed in the same way.

1. Detected color
2. Measured density
3. ΔE*-difference compared to ISO reference
4. Indication in/out tolerance
5. Measured L*a*b*-value
6. ISO paper type and type of backing

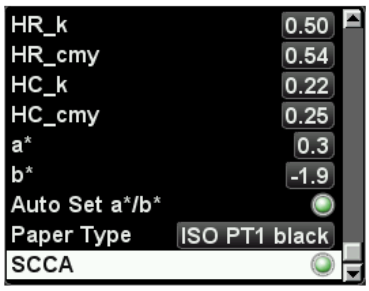
1. Detected color
2. Direction of adjustment
3. Recommended adjustment
4. Detected patch type
5. Measured value
6. ISO paper type and type of backing

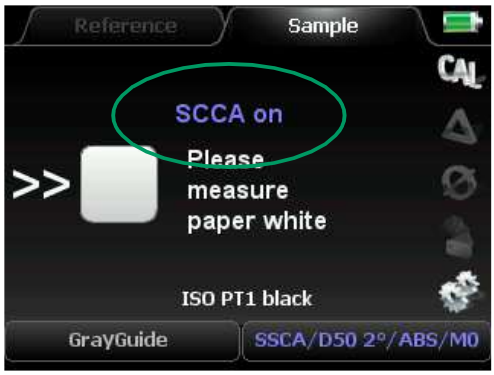


1. Color
2. Recommended adjustment
3. Adjustment as bar graph
4. Direction of adjustment
5. Detected patch type
6. Differences of HR_cmy and a*b* values compared to target values
7. ISO paper type and type of backing



1. Indicator for neutral density ND CMY
2. Direction of adjustment (+/-)
3. Recommended adjustment
4. Detected patch type
5. Measured value
6. ISO paper type and type of backing





SCCA reference value correction

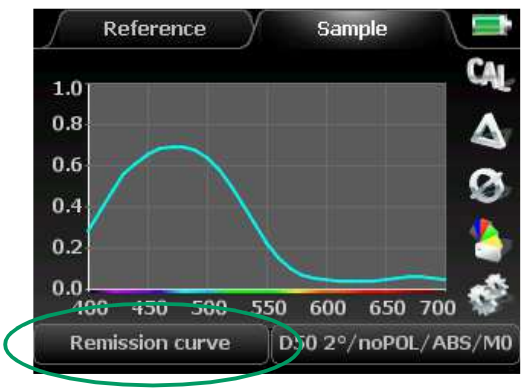
The practice of following print standards like ISO 12647 that pre-defines the combination of ink, paper and target reference colors for commercial printers to use in production is invaluable. But if the paper does not fall within the specified target values the accuracy of the press run is greatly diminished. The more out of spec the paper is the worse the color match will be.

One member of the IDEAlliance Print Properties & Colorimetric Committee, David McDowell, developed a formula that recalculates the data set with new aim points based on the specific paper color being used on press. It is called **SCCA** (Substrate Corrected Colorimetric Aims).

Techkon became aware of this new specification and implemented the ability to measure the paper and based on those measurements and using the **SCCA** formula calculates new aim points right on the instrument. This feature will allow printers to quickly and easily achieve an acceptable color match regardless of the presence of optical brightening agents in their substrates.

Remission Curve

The function **Remission Curve** offers the complete spectral graph.



Remission values are shown in 10 nanometer steps in the spectral range of 400 to 700 nm. A remission value has a range between 0 (no remission, absolute darkness) and 1 (total remission of the emitted light).

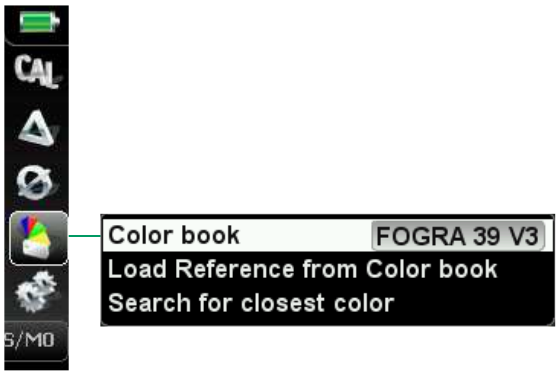
The remission curve is the most exact and total description of a color.

InkCheck

The measurement function **InkCheck** combines in a very easy way the advantages of colorimetry with the familiar densitometry. Thanks to this helpful function, working with the process standard ISO 12647 is simply achieved. The colorimetric deviations are reported and additionally recommendations for amounts of ink supplied in terms of density values are given.

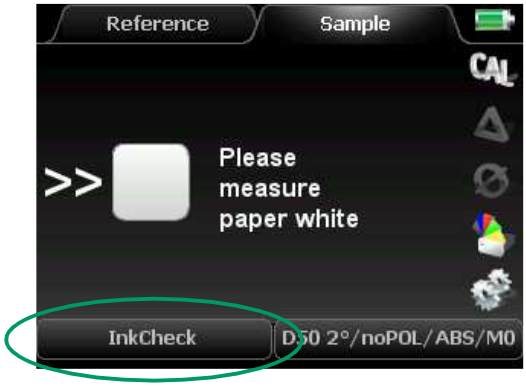
In contrast to the measurement function ISO-Check (see p. 61) the measurement function InkCheck is not only able to check the CMYK print ink, but also spot colors, provided that the appropriate spot colors were chosen as references in advance. In addition to the color books which are included in the contents of delivery, for example the HKS-color books, you can create your own color books for spot colors and use them as a reference.

The recommendations for amounts of ink supplied in terms of density values for spot colors are based on CIE L*a*b* measurements.



First, a color book which holds the reference color data has to be selected in the reference menu. The reference values for the 5 paper classes defined in the ISO standard are pre-set in the device memory. The data set “Proof” is for measurements on white backing and the data set “Print” for measurements on black backing.

Notice: If they can not be found in the device memory, they can be uploaded with the Windows software SpectroConnect.



First, a calibration on paper white has to be made. Position the device on the paper white and confirm the request to measure the paper white by pressing the green measurement button.

Now the device is ready for measurements on solid color patches. In this case a yellow patch was measured.

Density trend: It is recommended to decrease the density by 0.16.

Color deviation: The color distance to the reference is 6.2 ΔE*. After following the density trend it can be as low as approx. 2.0 ΔE*.

A closer color match will be limited because the paper and ink characteristics do not allow to get closer to the reference standard.

Please note that the density values are obtained without the polarizing filter activated and therefore are lower as values obtained with polarizing filter. Please ensure that the right measurement conditions are set.

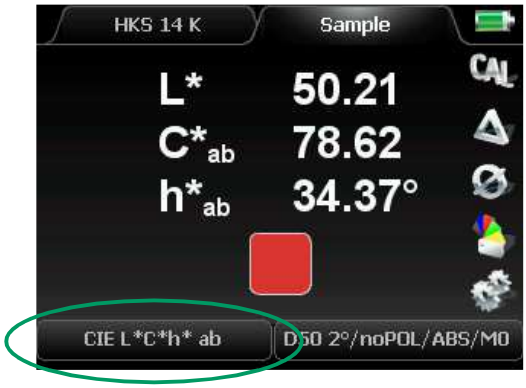
CIE XYZ

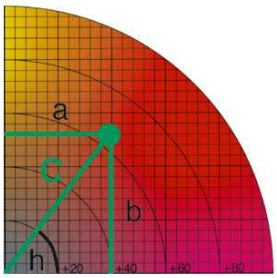
The **CIE XYZ** will display standard color values.

XYZ standard color values are (beside L*a*b*-values) a different way of describing the color values. They are not as practical to use and therefore not as widely used in the printing industry.

CIE L*C*h* ab

The **CIE L*C*h* ab** display is closely related to the CIE L*a*b* display (see p. 49). Instead of Cartesian coordinates, polar coordinates are used. The value C* stands for Chroma and the angular value h* for hue.



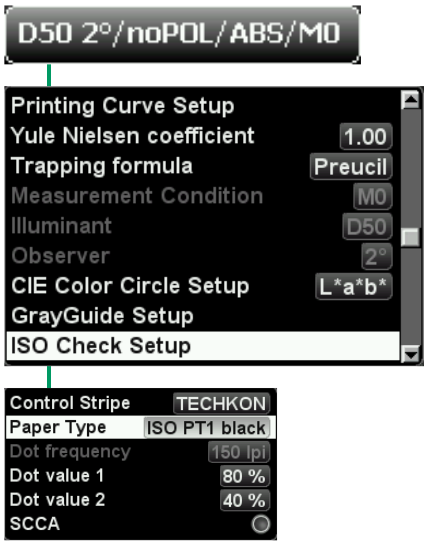


L*C*h*-values are very popular, because they describe colors in a simple way. The further the color is located from the center of the color circle, the more saturated and vivid it appears.

2.3 Additional functions of SpectroDens Premium

ISO-Check

The measurement function **ISO-Check** provides the fast check of a print with regard to the compliance with the ISO standard values ISO 12647-2. The L*a*b*-values, the dot gain and the dot spread of the printing inks CMYK are documented.

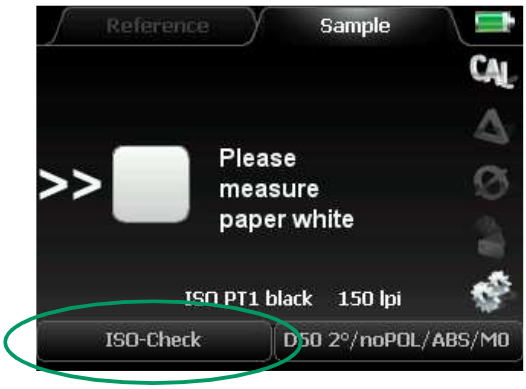


First the **ISO Check Setup** in the menu section of the measurement conditions has to be set.

You can select the control strip and the paper type. If you choose the TECHKON print control strip you can select two dot values additionally.

ISO 12647-2 defines the following standards:

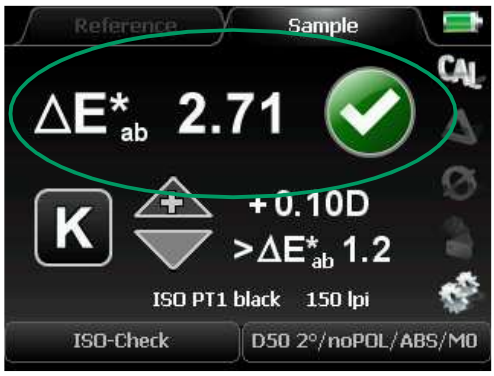
- Dot frequency 150 lpi (60 L/cm)
- Dot values 80 % (75 %) and 40 % (50 %)



In the next step the paper white **must** be measured. When the message for measuring the paper white is displayed, please confirm it by pressing the green measurement button.

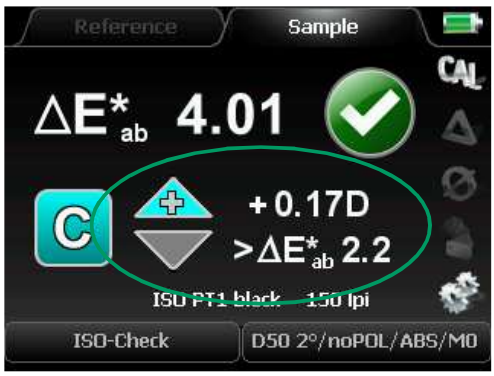
When the ΔL*a*b*-values are marked with checkmarks, the paper white is in accordance with the ISO-standards.

A special ISO/PSO control strip (as shown) can also be measured by scanning. Just keep the green start-button pressed during the whole scanning procedure.

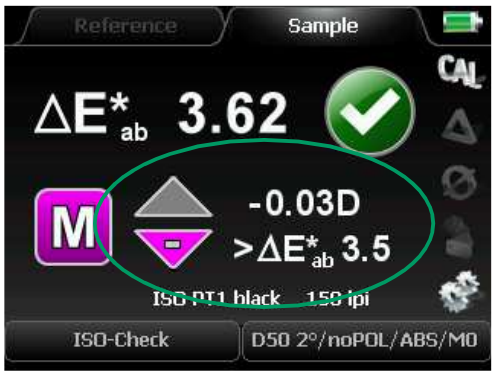


When the solid density is measured, the compliance with the tolerances is checked.

In this example the measurement has been taken on a black solid patch.

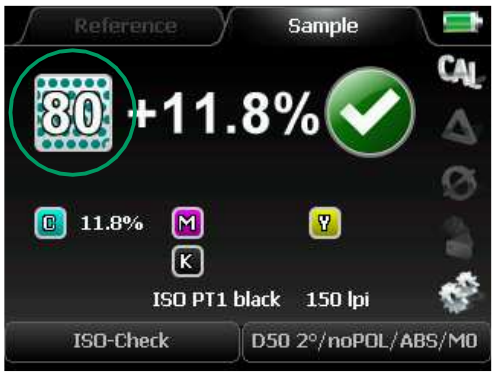


At the same time the recommendation how to adjust the density is calculated.

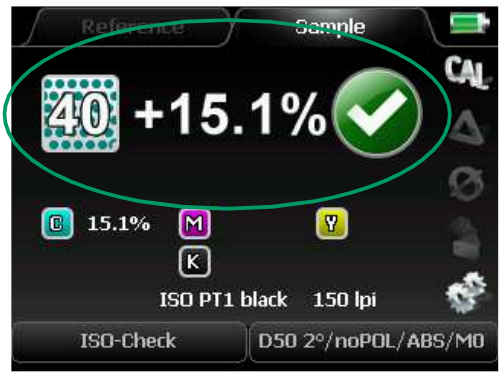


The smallest possible ΔE*-value is calculated in advance.

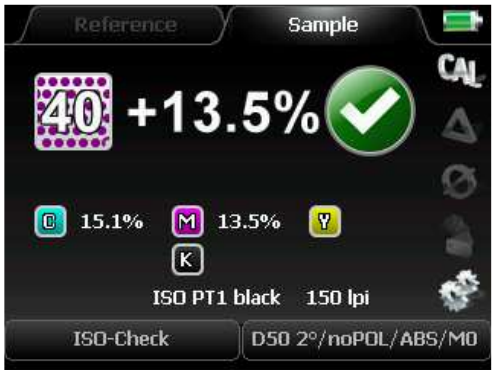
The measurement function ISO-Check recognizes, whether the given tolerances can be achieved with the set of print ink in use. If this is not the case, another set of print ink must be used.

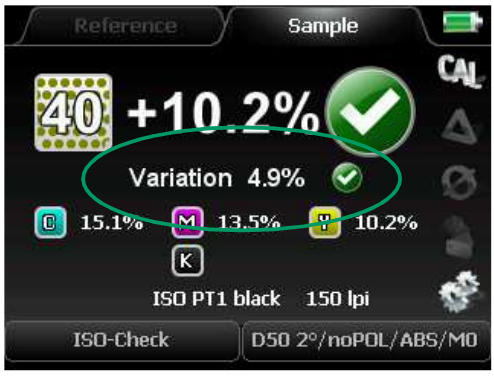


After the measurement of the solid patch, you can measure the %-patch, which you have defined in the setup.



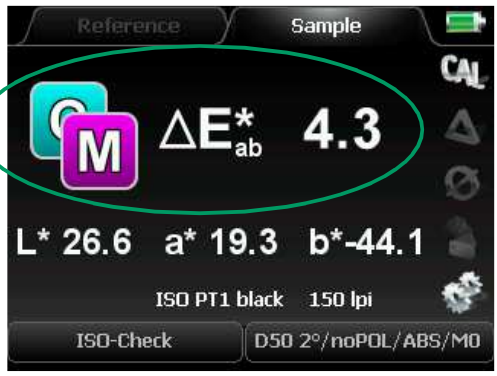
The dot gain is checked in regard to its conformity to the ISO-standards.





Concerning the midtone the spread will be displayed additionally (CMY).

The deviation of the colors CMY is allowed to reach ± 4 % in the middle-tone of 40 % per ink .
But to avoid that the gray balance is disturbed too much, the spread limits the permitted difference between the highest and the lowest tonal value to 5 %.

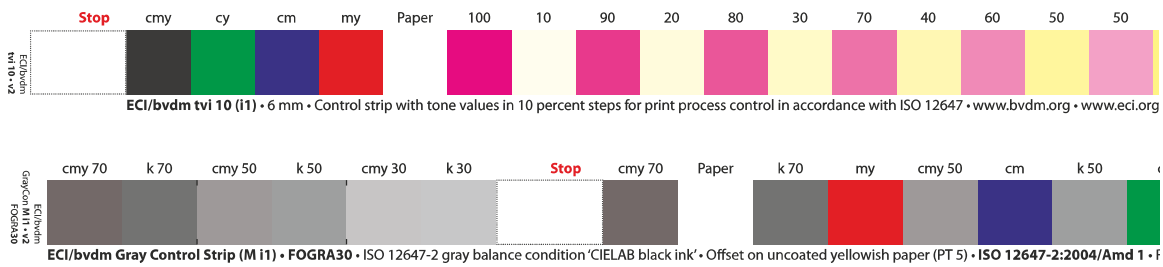


By measuring the trapping only the variation from the reference will be displayed.

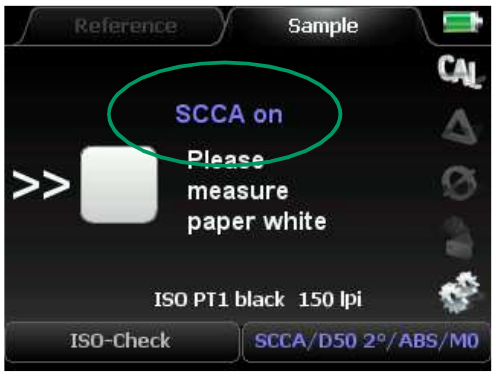
The ISO standards define no tolerances for trapping, only informative reference values are given.

But it is recommended, not to exceed a ΔE*-value of 10 in the secondary colors, which corresponds with the sum of the permitted ΔE*-deviations of the primary colors.

Instead of scanning the TECHKON strip the measurement function ISO-Check can also capture the ECI/bvdm Gray Control Strip version tvi 10 (i1) and (M i1).
When using the scan function we recommend to use a patch width of 5 x 5 mm (min. 4 x 4 mm) with the standard aperture and a patch width of 4 x 4 mm (min. 3 x 3 mm) with the exchangeable 1,5 mm aperture.



ECI Gray Control Strips: ECI/bvdm tvi 10 (i1) and M i1

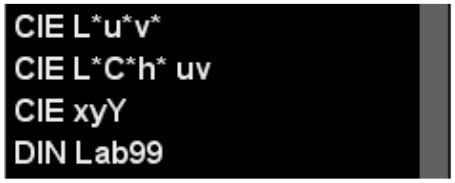


The **ISO-Check** function features the use of the **SCCA** reference value correction (selectable in the **ISO-Check** setup).

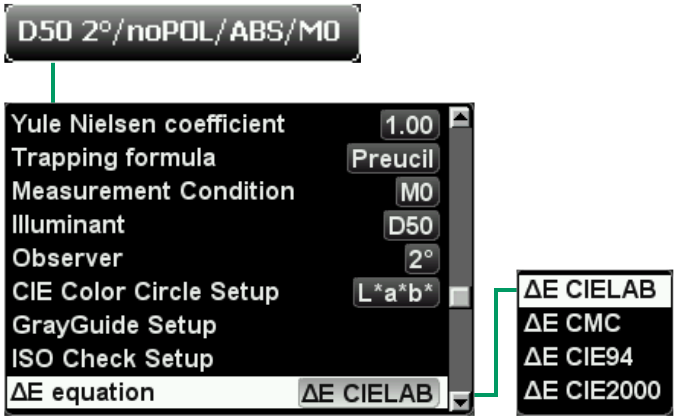
You will find a comprehensive description of the **SCCA** function on page 57.

CIE L*u*v*, CIE L*C*h* uv, CIE xyY and DIN Lab99

The Premium-version of SpectroDens enables the display of additional color spaces, which might be used mainly in industries outside printing:
CIE L*u*v*, **CIE L*C*h* uv**, **CIE xyY** and **DIN Lab99**.



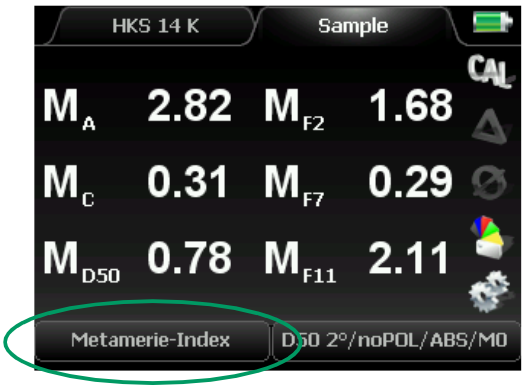
Different formulas for calculating the color distance ΔE* can be selected as well. The Euclidean color distance ΔE* a*b* is the most widely used, although it is criticized that for certain areas in the color space the visual perception of color distances does not match the ΔE* a*b* color distance accordingly.



Metamerism-Index

Metamerism is the visual phenomenon that two colors match under certain light conditions and differ under different light conditions.

Colorimetry offers the possibility to detect this effect by measuring the color distance between the two color samples under two exactly defined light sources. The result of this operation is the **Metamerism-Index**.



For the determination of the **Metamerism-Index** there are two measurements to be made.

1. A reference measurement, which refers to illuminant condition D65.
2. A sample measurement on the sample patch.

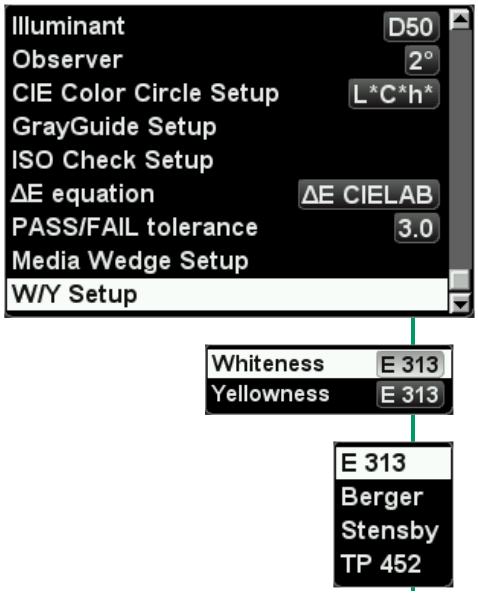
As a result the color distances in ΔE* a*b* for illuminant conditions A, C and D50 are shown.

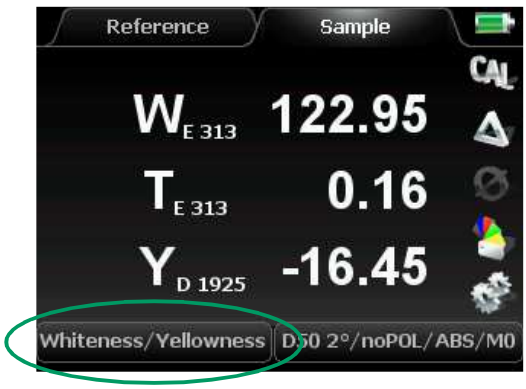
Identical color impression under light condition I:

Color deviation under light condition 2 caused by metamerism:

Whiteness / Yellowness

Whiteness- and **Yellowness**-indices are quality parameters important for the paper industry. SpectroDens Premium will display the whiteness and yellowness indices according to the following standards: Whiteness: E 313, Berger, Stensby, TP 425 – Yellowness: E 313, D 1925.





Whiteness index:
Values are usually between 90 and 120 for "white" paper. The higher the value, the "whiter" (= the brighter) the paper. Artificial optical brighteners in the paper will lead to high values as well.

Yellowness index:
Positive value: the paper has a yellow cast
Negative value: the paper has a blue cast

Whiteness Berger, Stensby
Paper Whiteness is defined by how closely a surface matches the properties of a perfect reflecting diffuser, i.e. an ideal reflecting surface that neither absorbs nor transmits light, but reflects it at equal intensities in all directions. For the purposes of this standard, the color of such a surface is known as preferred white. Whiteness is closely related to our visual perception of the color of paper. Sometimes these variations in whiteness are subtle. For instance two pieces of paper that fall at different ends of the spectrum on the CIE whiteness index may appear white by themselves however when juxtaposed; their variations are revealed.
The type of light paper is viewed under can affect how it looks to the human eye along with other elements like optical brightening agents (OBAs) used in paper production. For example, when OBAs are applied to a dull sheet of paper it will look brighter in natural light and dull in artificial light. When there are little to no OBAs applied the paper will look brighter in artificial lighting when compared to its counterpart with larger amounts of OBAs.
The Techkon SpectroDens uses the Stensby and Berger formula's for quantifying the whiteness of a print substrate.

Brightness T (TAPPI 452)

Like whiteness, paper brightness is also a measurement of the amount of light reflected from paper. Unlike whiteness, it is focused on a narrow wavelength of blue light as opposed to all wavelengths in the spectrum. The higher the number on the brightness scale, the more light a particular sheet reflects. Brightness is just one part of the equation when determining the visual aspects of paper. Two sheets with identical brightness can look drastically different because shade and whiteness are not taken into account.

In general, there are two measurement systems that are widely used for determining paper brightness. One (used in North America) is the TAPPI scale. The other (used primarily in other parts of the world) is the ISO system. Some papers can have a rating higher than 100 on the brightness scale. This is due to optical brightening agents present in the paper. When these are applied, the paper can actually reflect more light than is coming from the source. An easy way to remember this is the brighter, the whiter.

Yellowness CIE

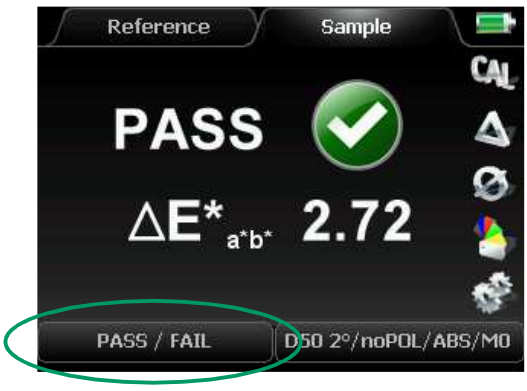
Yellowness is the degree that the color of a surface is shifted from preferred white (or colorless) towards yellow.

PASS / FAIL

The **PASS / FAIL** function shows at a glance if a measured sample is in or out a set tolerance compared to a reference value.

First, set the allowable limits of the ΔE*-tolerance.

Select in the menu section of the measurement conditions the item **PASS / FAIL tolerance** and edit the desired tolerance value by pressing the arrow buttons.



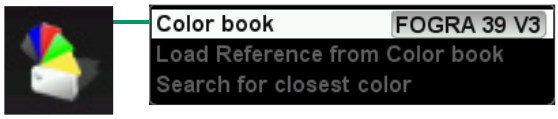
Every sample measurement is compared to the reference.

If the color distance is within the set tolerance (in this case 2.72 < 3.0), PASS will be displayed.

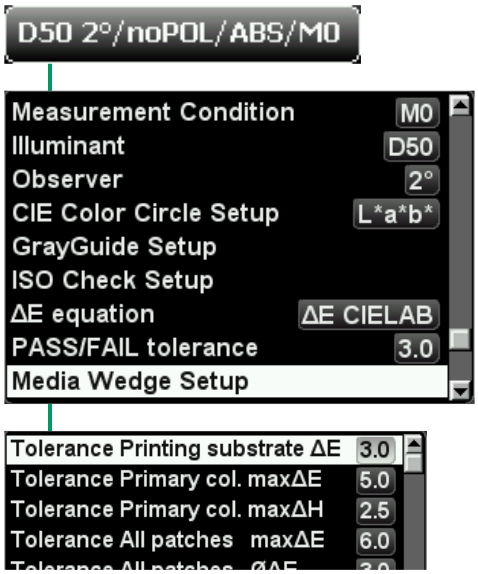
For out of tolerance measurements, accordingly FAIL will be shown accompanied by an acoustic signal of three short beeps.

Media Wedge

The **Ugra / Fogra Media Wedge** CMYK is a control element for checking the color consistency of digital proof systems issued by the printing institute Fogra. This practical function is for measuring and analyzing the patches of this control element.

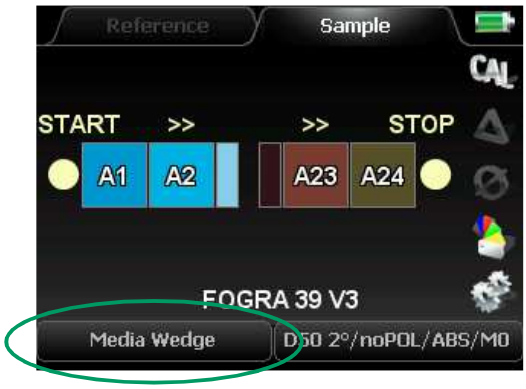


First, a **Color book** has to be selected which contains the Fogra reference data. If not found in the device memory, the color book which is valid for the paper class to be measured, can be uploaded from the Windows software SpectroConnect.



Additional settings have to be made in the **Media Wedge Setup** window. The settings for ΔE*-tolerances are according to Fogra specifications.

By activating **Automatic Measurement** the device will make consecutive measurements automatically with **Measurement Interval** to be set. Starting and stopping a measurement series is done by pressing the green measurement button.



The reading of the media wedge is from left to right and from first to second row. The measurement begins with patch A1, then A2, etc.. Wrong measurements can be corrected by pressing the red escape button and re-measuring.
After all measurements have been performed, the total result will be displayed.

Media Wedges with separation bars can also be measured by scanning. Just keep the green start-button pressed during the whole scanning procedure.

SpectroDens recognizes the version 2 as well as the version 3 of the media wedge by the different number of reference values. The Windows software SpectroConnect allows to analyze the measured data in detail and to print a report (see p. 87 f.).

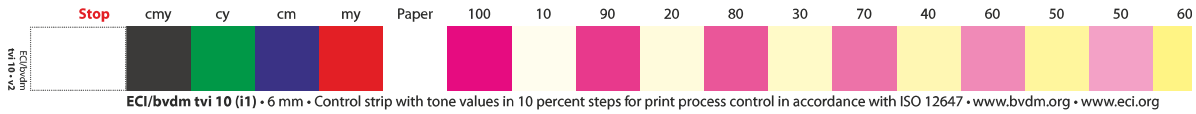
Scan

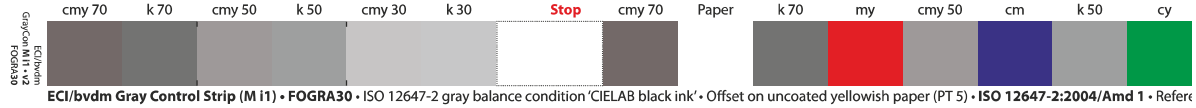
The measurement function **Scan** provides the scanning of individual control elements.

The scanning procedure is very easy. Choose the measurement function **SCAN** in the device menu. Then place the measurement device on the print control strip. Take care that the measurement aperture is positioned on the first measurement patch (= start position) and that the device edge is aligned to the print control strip (see picture).

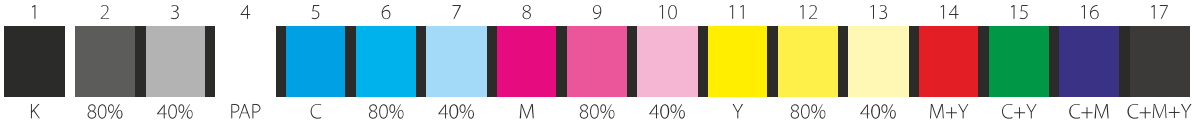
Now press and hold the measurement button, move the device in constant speed along the print control strip until you reach the last patch to be measured (= stop position) and release the measurement button. If the measurement was carried out successfully a short acoustic signal can be heard and all color patches are displayed in the device. Using the SpectroConnect **Export** module measurement data can finally be exported in any other Windows application e.g. Microsoft Excel™, Word™ or other programs which can handle color data, e.g. a RIP calibration software.

Examples of control elements which can be scanned:

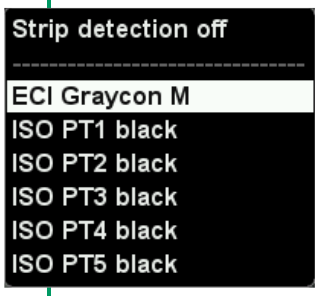




ECI Gray Control Strips: ECI/bvdm tvi 10 (i1) and M i1



TECHKON ISO/PSO Checker



SCAN function with strip detection

The SpectroDens enhanced scanning feature includes:

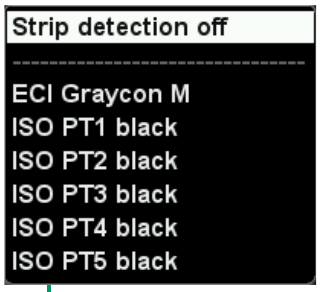
- Define the color bar by uploading a color library to the SpectroDens or by scanning a color bar with the instrument.

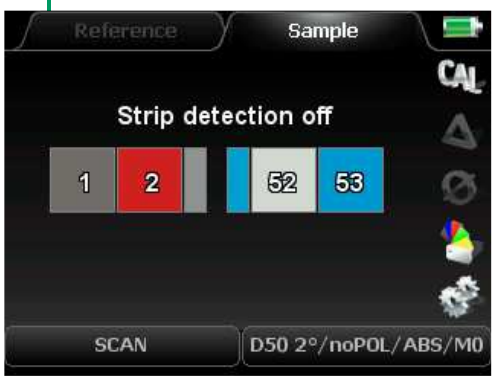
- Advanced pattern recognition algorithm's that automatically detect that the color bar being scanned is correct, has the correct number of patches and the colors are in the right sequence.

- If the incorrect number of patches are scanned or the scanning speed is too fast or too slow the SpectroDens will display an error message informing you.

- No guide bar required. The 4 wheels keep straight alignment while scanning.

- Easily export scanned measurement data to other software applications automatically with SpectroConnect software (included with the instrument at no cost).





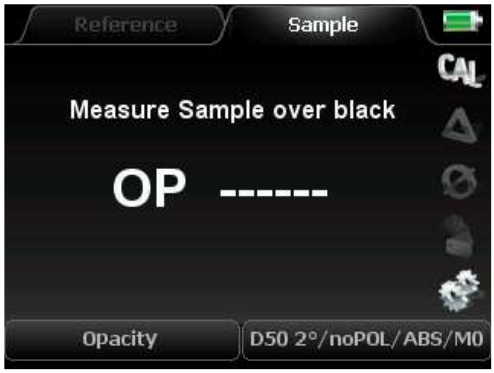
It is possible to scan a sequence of 200 patches.

Just select **Strip detection off** in the SCAN measurement function.

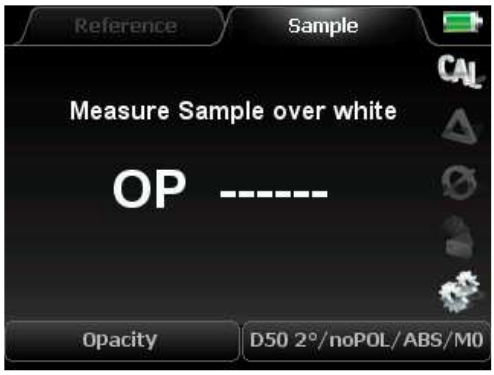
Opacity

Opacity refers to the transparency or opaqueness of paper. Papers with lower opacity tend to let text and images show through more than papers with higher opacity. Opacity is expressed as a percentage in paper. For example, paper with 98 % opacity means that 98 % of light is not allowed to pass through the paper.

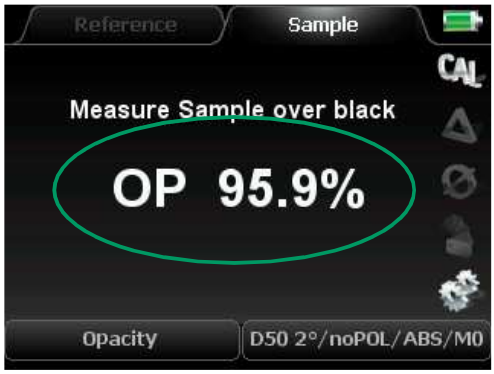
Select the **Opacity** function from the measurement functions menu.



Place the sheet of paper to be a measured on a black backing.



In the next step take a measurement of the same sheet of paper after you have placed it on a stack of white paper (minimum 50 sheets).



Now the measurement device displays the result of the opacity measurement.

For further measurements just press the enter button and repeat the whole procedure.

OBA-Check

Optical Brightening Agents (= OBAs) which are used more and more in the paper production, have a significant effect not only on how we perceive the paper under different illuminants, but also on the results of the printing process. The measurement function **OBA-Check** provides precise information about the intensity of the optical brightening agents used and the shade of the paper.

Choose the function **OBA-Check** from the menu measurement functions.

First you have to switch to the „soft-key" **CAL** to carry out a calibration on the absolute white standard.

SpectroDens performs the **OBA-Check** applying the measurement conditions M1 and M2, i. e. with and without stimulation through UV light (see p. 48). The difference between the two CIEb*-values leads to the final measurement result.

The amount of optical brightening agents according to ΔB (ISO 15397) and its categorization according to ISO 12647-2:

- (0 ≤ ΔB < 1) no OBA
- (0 ≤ ΔB < 4) OBA faint
- (4 ≤ ΔB < 8) OBA low
- (8 ≤ ΔB < 14) OBA moderate
- (14 ≤ ΔB < 25*) OBA high

The table shows the relation between ΔB- and CIEb*-values for the practical application.

OBA amount	no OBA	faint	low	moderate	high
ΔB	0 to 1	1 to 4	4 to 8	8 to 14	14 to 25*
ΔCIEb*	0	-0,3 to -2,0	-2,0 to -3,7	-3,7 to -6,2	-6,2 to -10,4*

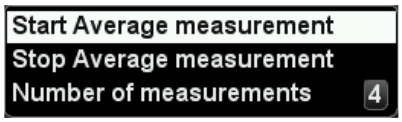
* and beyond

Average values

From a series of single measurements **Average values** can be calculated and displayed. This function may be used when the surface of the sample has no even distribution of color.

By selecting the "soft key" with the average symbol a pop-up window will appear where **Average measurement** can be set, started and cancelled.

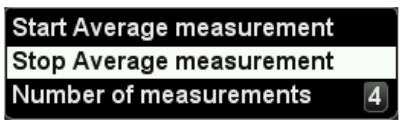
Here the **Number of measurements** to be calculated to one average value is set. The maximum number of single measurements is 9.



Now activate **Start Average measurement**.

The central window indicates how many single measurements have been taken.

After the last single measurement has been taken, the resulting average value will be displayed and the procedure can start again from the beginning.



Activating the menu item **Stop Average measurement** you quit this measurement mode.

2.4 Storage of measurement values

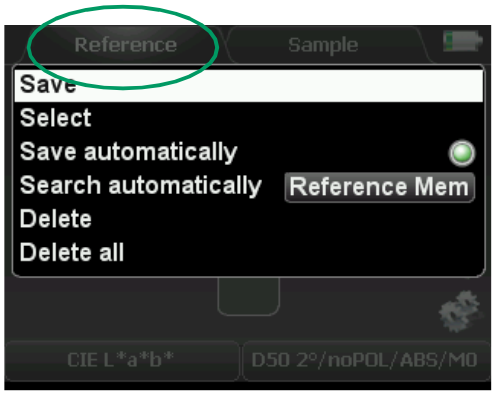
The versions SpectroDens Advanced and Premium include a **Color library**. This is a **digital memory** for storing color values, which can be compared or exchanged with the Windows software SpectroConnect.

There are three different sections where color values can be stored:

- Reference memory for up to 300 reference values
- Sample memory for up to 3000 sample values
- Color book memory for up to 20 color books with a total number of 25000 reference values

Reference memory

To access the **Reference memory**, you have to select **Reference** in the display. A memory capacity for 300 references is at your disposal. After the 300th color value is stored, the message indicates that the memory is full.

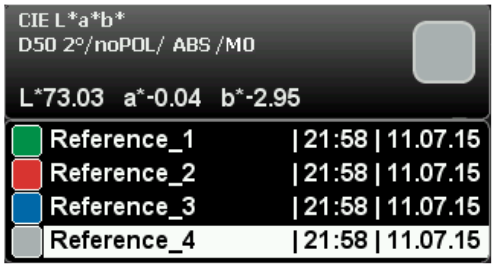


By pressing the enter button with the device in **Reference** mode a pop-up window opens. Within the window navigation is done with the arrow keys.

1.

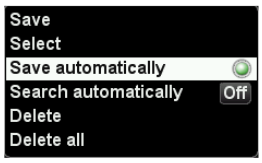
1. With **Save** the last reference measurement is stored.

2.

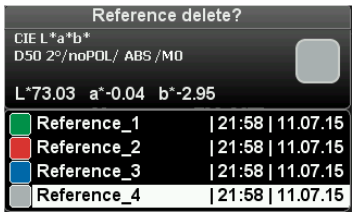


2. **Select** shows a list of stored color values. Within the list, values can be selected and displayed by using the arrow- and enter-buttons.

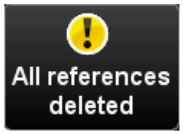
3.



5.



6.



3. By activating **Save automatically** all future reference measurements will be stored automatically.

4. By activating **Search automatically Reference Mem** the closest matching reference color when making a sample measurement will be displayed. This feature is active in the sample mode with DELTA Mode on.

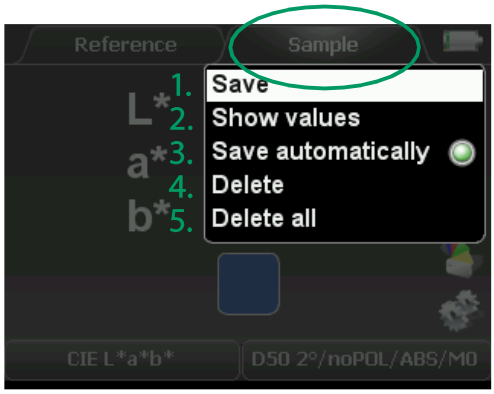
5. **Delete** will remove selected color values from the list.

6. **Delete all** will remove all values in the list.

Sample memory

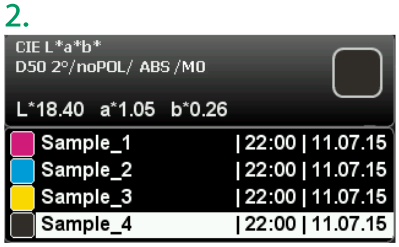
The **Sample memory** has almost the same functions as the reference memory. Here up to 3000 sample color values can be stored. However the sample memory is a ring memory, i.e. maximum 3000 samples can be stored before the first sample will be overwritten by a new measurement.

The pop-up window opens by pressing the enter button with the device in **Sample** mode.

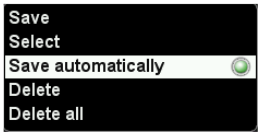


1.

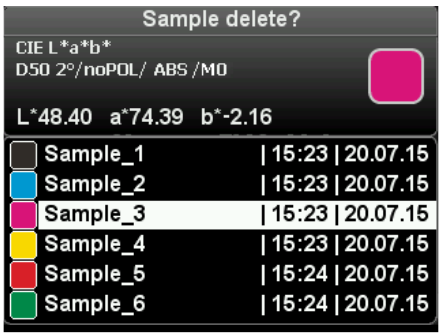
2.



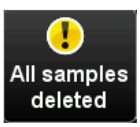
3.



4.

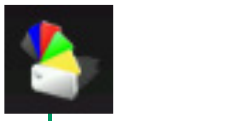


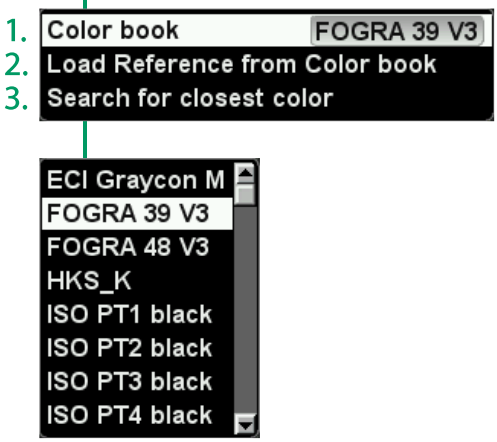
5.



Color book memory

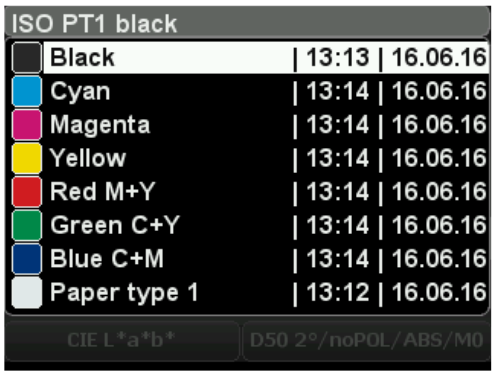
Additionally to storing reference and sample color values, complete **Color books** can be managed. A color book is a folder which can hold up to 25000 single color values. An example are the HKS® spot color collections which are included in SpectroDens with the software package SpectroConnect. New color books can easily be edited and transferred into the device. Up to 20 color books can be stored in SpectroDens; there is no limitation of storing color books in the Windows software SpectroConnect.



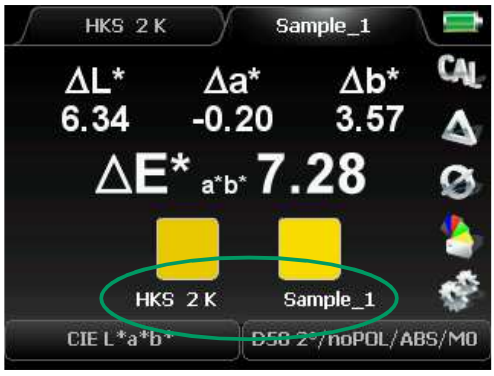


The "soft key" with the color book symbol opens the window for the settings of the color book memory.

1. Here a **Color book** is selected from the list.



2. With **Load Reference from Color book** a single color value from a color book is loaded into the reference memory.



3. **Search for closest color** determines the closest color match in a color book compared to a sample value.