# Color iQC and Color iMatch Paint Database Guide

**Version 8.0 | July 2012**

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## Database Preparation

Refer to the X-Rite Database preparation and prepare all requested samples
Before starting the measurement process, it is good to inspect all samples

- Make sure, that the samples are complete
- Make sure, that all samples are in good surface quality

### *Step 1 – Review General Requirements*

#### Homogeneity

Primary samples must be homogeny. No matter at which location of the sample the measurement is taken, the measurements should provide the same result. If samples are non-homogeneous, multiple measurements could be taken to achieve a statistical homogeneity.

#### Reproducibility

Primary samples must be reproducible. No matter, which person under which condition the samples produced, the same recipe should produce the same sample.
In the process of the sample preparation it is strongly recommended, that the reproducibility will be tested. 3 persons should produce at 3 days 3 recipes – these will be compared to define the reproducibility.
Experiences have shown, that ideally all calibration samples should be produced by the same person.

#### Representative

Primary samples must represent the application and the condition under which later on tests will be done.
Example: Film thickness If the typical paint applications will tested at 100 my film thickness it is recommended to produce the primary samples at the same film thickness.
Example: Pigment load For each pigment the maximum concentration in a given product should be defined and should not be exceeded, when producing the calibration samples. Surface changes like gloss changes or orange peel effects are indications, that the maximum pigmentation has been exceeded.

#### Accuracy

The highest available accuracy is required in each step of the calibration sample preparation process.
Example: Scaling It is not important, that you scale exactly the amount, which is recommended by X-Rite for a defined sample, but it is absolutely important, that the exact scaled amount will be documented. We recommend to use a scale with minimum 3digit accuracy.
Example: Film thickness: Film thickness can be defined using different methods (wet, dry). Whatever method is chosen, it is important that the correct film thickness will be provided. It is recommended, that the film thickness within a colorant calibration file should stay within +-5%

### Sample preparation process

The same sample preparation process should be used for all samples
Example: mixing - The same mixing equipment with the same settings for time and speed must be used for all calibration samples.

Example: application – The same application equipment with the same settings must be used for all calibration samples.

### Substrate

Calibration samples should ideally be applied over non fluorescing black and white contrast cards. These must provide areas of coat over black and white of at least 25mm * 25mm. This allows taking good measurements over contrast background and provides a good base for load calculations. Our customers have collected good experience with Form 5DX from Leneta.

### Filler (f.e. Blancfix)

Filling additives have very often a color contribution. There are methods to define this and take this into account, when formulating.

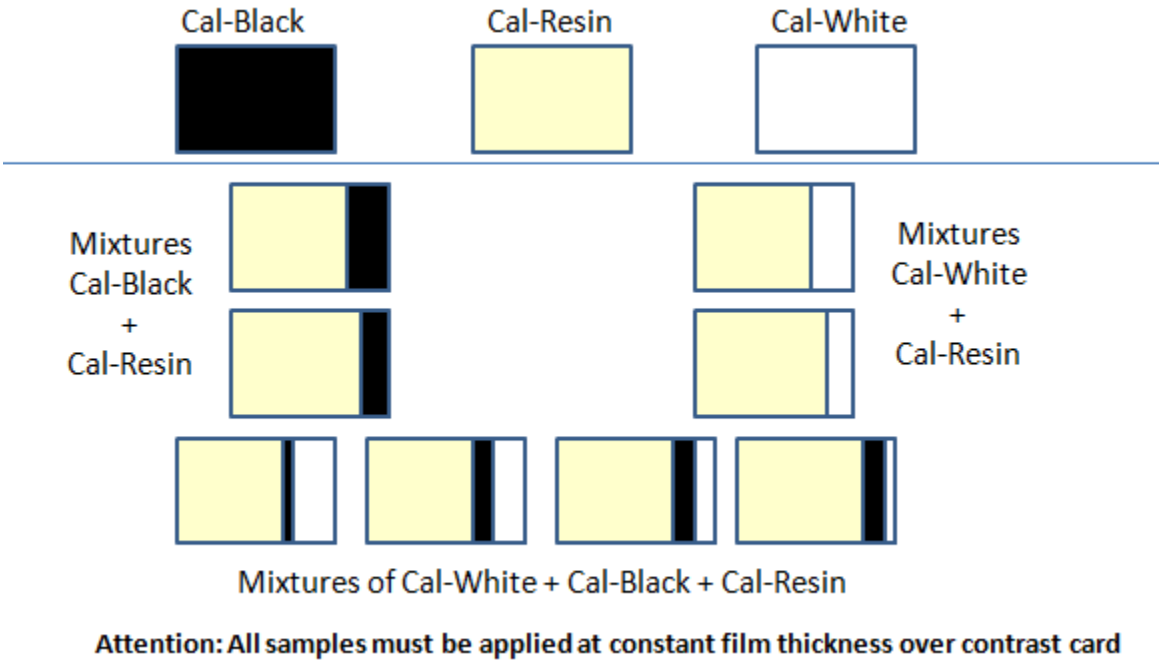
### Calibration Components

The calibration pigments, white and black as well as the calibration Resin are base materials for any new calibration. Mixtures of colorant with white and mixtures of colorant with black are made for any new colorant. That’s why it is important, that enough of these materials is stocked.

## Calibration Mixtures

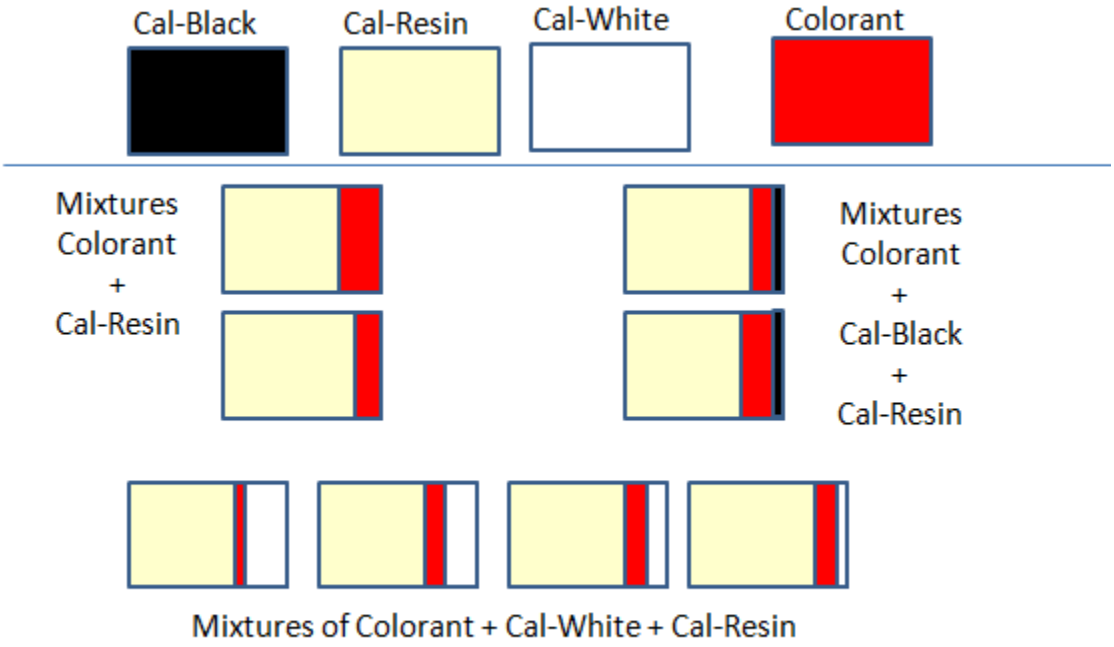
The ideal mixtures of colorant with white, black and resin depend on the individual condition in a given system. An excel table is available to calculate the ratios depending on the condition.

Base Calibration – Black white and Resin




**Attention: All samples must be applied at constant film thickness over contrast card**

Requirements for each colorant




**Attention: All samples must be applied at constant film thickness over contrast card**

***Step 2 – Verification of samples and tools***

Part of the sample preparation process is to define the process and scaling conditions.
For this purpose we would like you to completely prepare 3 different recipes from beginning to the end (scaling, mixing, application, drying) at 3 days by 3 persons. This will produce 3 sets with each 9 samples. This will give you some idea about the reproduce ability within the given working condition.

### Visual verification of sample & process repeatability

Visually compare the 3 sets of 9 samples. Are these visually acceptable?

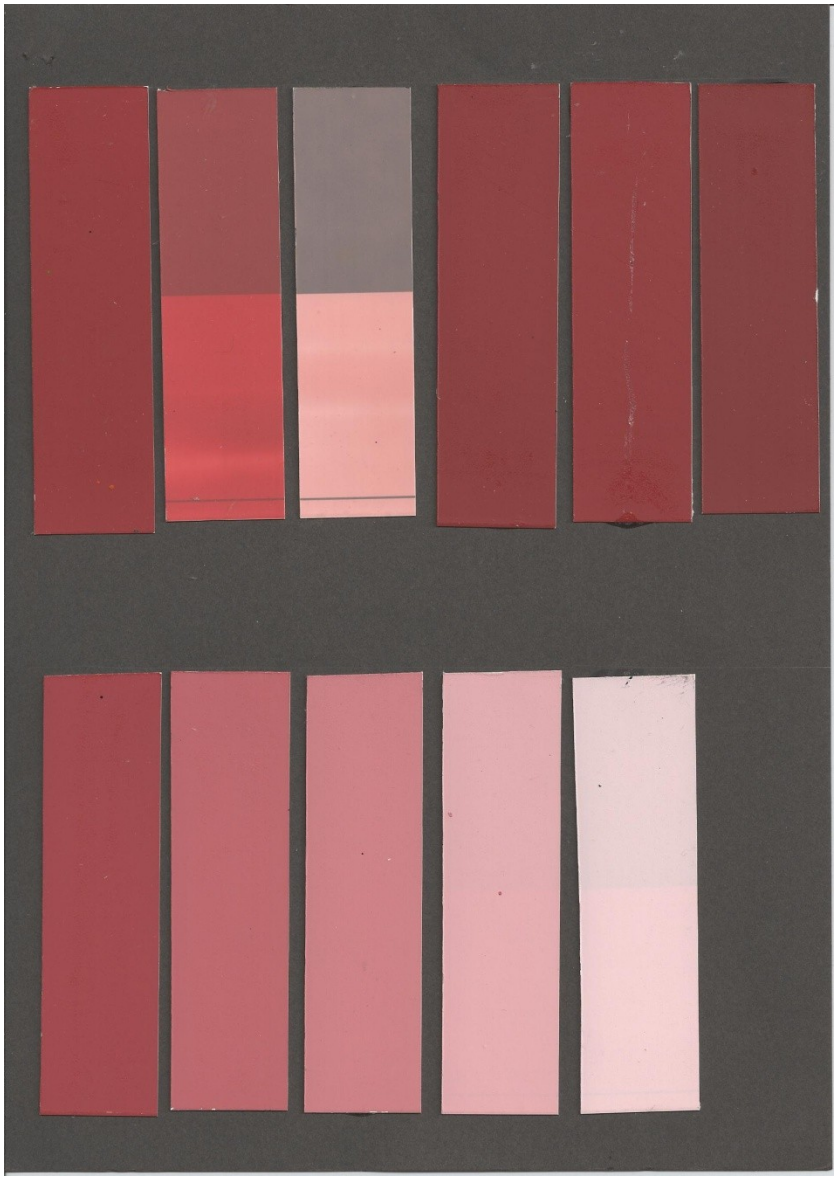
### *Visual verification of calibration mixtures*

Visually check all calibration samples

- Are the surfaces ok?
  - Do you recognize surface effects like bronzing, gloss variations, orange peel
  - Are the samples homogeneous
- Is the build-up logical?
  - Increasing concentrations should lead to samples with increased color strength?

Sample Set for Base calibration with the following samples

- Resin,
- the substrate,
- 3 mixtures of white with Resin,
- 3 mixtures of colorant with black
- 3 mixtures of colorant with white and black.

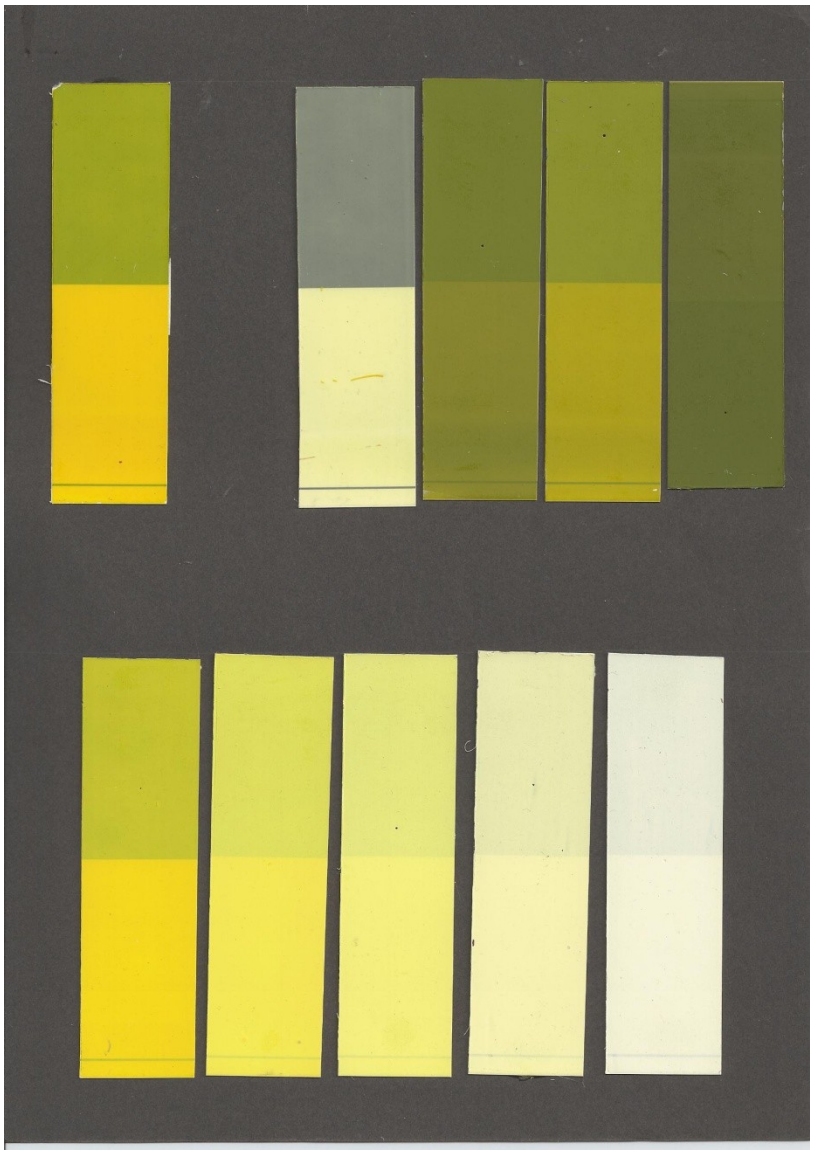


Sample Set for Oxide Red calibration with the following samples

- 3 mixtures of colorant with resin
- 3 mixtures of colorant with black and resin
- 5 mixtures of colorant with white and resin

It is easily to be seen that the samples with transparent are cloudy

On the mixtures colorants with white a good build from right to left is seen.

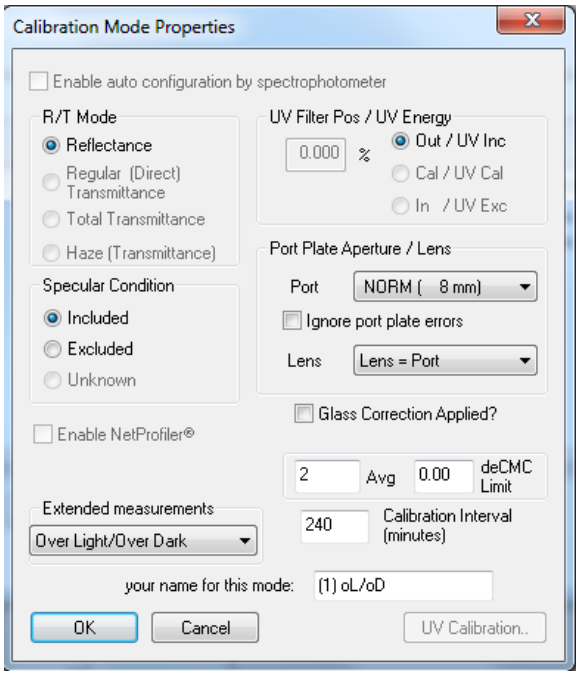


## Measurement verification of sample & process repeatability

Compare the 3 set`s of each 9 samples.

## Measurement verification of homogeneity of calibration samples

Especially, when we build up a paint data file with based on non hiding samples, we often experienced, in homogeneity within the samples. One of the reasons could be thickness variations.
Whatever the reason for in homogeneity is, it is recommended to define the repeatability on those samples. This helps to define, whether single measurements are ok for the measurement of calibration samples or multiple readings have to be taken.



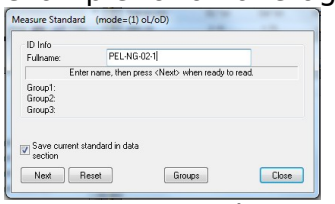
From the job button choose the [select calibration] mode option.

Select the Calibration mode Over Light/Over Dark – if it is not yet available create a new calibration mode.

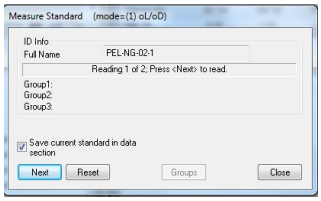
Within the properties of the calibration mode select in the extended measurement mode the Over Light/Over Dark option

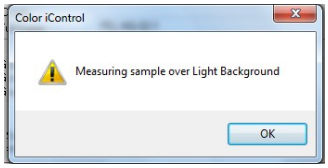
## Measurement sequence for non hiding samples (over OL/OD)

Measurement sequence to measure a standard (or trial) over black and white. In this example for an average of two measurements

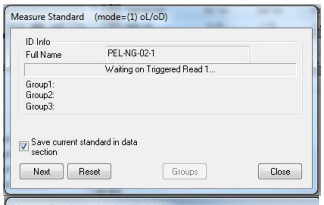



Enter Name and Group data and continue with next

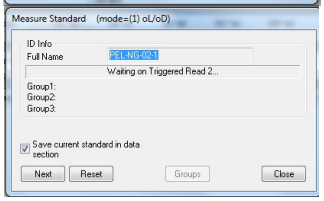


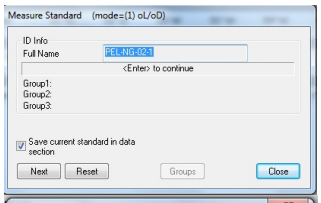



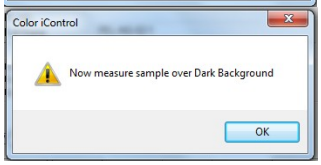

Measure



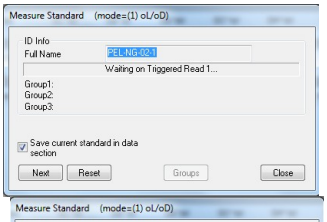

Measure



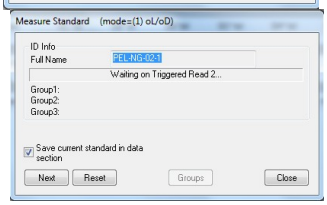



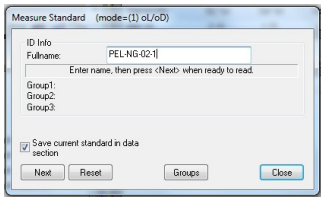




Measure




Measure



With the above measurement sequence a few measurement comparisons have been made. Results are shown underneath

| Tolerances: | DL* tol | Da* tol | Db* tol | DC* tol | DH* tol | P/F tol | Margin | l:c |
|---|---|---|---|---|---|---|---|---|
| D65-10 | 2.30 | 2.30 | 1.80 | 2.35 | 1.75 | 1.00 | 0.10 | 2.00 |

| Standard Name | L* | a* | b* | C* | h° |
|---|---|---|---|---|---|
| Test 1 - Average of 2 | 71.43 | -53.74 | 4.76 | 53.95 | 174.94 |

| Trial Name | DL* | Da* | Db* | DC* | DH* | DE* | Opacity_CR |
|---|---|---|---|---|---|---|---|
| Test Sample - Repeat 2 | 0.67 L | 0.42 R | -0.14 B | -0.43 D | 0.11 B | 0.80 | 46.08 cr |
| Test Sample - Repeat 1 | 0.59 L | 0.30 R | -0.09 B | -0.31 D | 0.06 B | 0.67 | 46.24 cr |
| Test Sample - Repeat | -0.22 D | -0.11 G | 0.03 Y | 0.11 B | -0.02 | 0.24 | 47.39 cr |

Example: Average of 2 – measurement at random positions created differences of about 0.5 DE and variations of about +- 0.5 in CR as well. In the following example an averaging of 3 showed differences of about 0.1 DE*

| Tolerances: | DL* tol | Da* tol | Db* tol | DC* tol | DH* tol | P/F tol | Margin | l:c |
|---|---|---|---|---|---|---|---|---|
| D65-10 | 2.30 | 2.30 | 1.80 | 2.35 | 1.75 | 1.00 | 0.10 | 2.00 |

| Standard Name | L* | a* | b* | C* | h° |
|---|---|---|---|---|---|
| Test 2 - Average of 3 | 72.04 | -53.38 | 4.62 | 53.58 | 175.05 |

| Trial Name | DL* | Da* | Db* | DC* | DH* | DE* | Opacity_CR |
|---|---|---|---|---|---|---|---|
| Test 2 - Repeat 3 | -0.04 D | 0.01 | -0.00 | -0.01 | 0.00 | 0.04 | 45.72 cr |
| Test 2 - Repeat 2 | -0.01 | 0.03 R | 0.01 | -0.03 D | -0.01 | 0.03 | 45.77 cr |
| Test 2 - Repeat | -0.03 D | 0.00 | 0.02 | -0.00 | -0.02 | 0.04 | 45.84 cr |

***Step 3 – Measurement of all Calibration samples***

For this function a job will be created to store all calibration samples in this job.

Certainly all measurements could be done directly in the Pigment Calibration routine, but there are some advantages, if all samples have been measured before in a separate process.

- All measurements are made at the same time with more focus and less interruptions
- If something goes wrong with the calibration – the samples can be recalled any time
- Easy to do additional tests, if there are doubts about the measurement for difficult samples

Typically all mixtures would be measured and sample identifications would be provided, which makes it easy to recall the correct sample

A measure routine for OverLight/OverDark would be defined and all samples will be measured.

| Trial Name | L* | a* | b* | C* | h° | Opacity_CR |
|---|---|---|---|---|---|---|
| Sheen Contrast | 94.28 | 0.21 | 0.31 | 0.37 | 56.53 | 6.95 cr |
| PEL-BWR-00 | 91.86 | -0.54 | 5.71 | 5.73 | 95.43 | 26.87 cr |
| PEL-BWR-01 | 95.04 | -0.67 | 3.15 | 3.22 | 101.99 | 92.18 cr |
| PEL-BWR-02 | 92.87 | -0.88 | 6.12 | 6.18 | 98.19 | 56.07 cr |
| PEL-BWR-03 | 92.28 | -0.72 | 6.01 | 6.05 | 96.87 | 29.98 cr |
| PEL-BWR-04 | 26.56 | -0.01 | -0.45 | 0.45 | 268.23 | 100.00 cr |
| PEL-BWR-05 | 41.83 | 0.03 | -0.33 | 0.33 | 275.61 | 81.06 cr |
| PEL-BWR-06 | 76.33 | -0.12 | 3.78 | 3.78 | 91.79 | 41.78 cr |
| PEL-BWR-07 | 35.39 | -0.69 | -3.58 | 3.64 | 259.14 | 100.00 cr |
| PEL-BWR-08 | 51.60 | -1.25 | -4.75 | 4.91 | 255.24 | 100.00 cr |
| PEL-BWR-09 | 88.25 | -0.89 | 0.16 | 0.90 | 169.79 | 98.93 cr |
| Pel-Red-01 | 49.45 | 58.10 | 32.73 | 66.68 | 29.39 | 67.80 cr |
| Pel-Red-02 | 66.20 | 45.19 | 13.28 | 47.10 | 16.37 | 46.21 cr |
| Pel-Red-02a | 86.44 | 10.57 | 4.40 | 11.45 | 22.61 | 32.91 cr |
| Pel-Red-03 | 56.35 | 52.00 | 18.36 | 55.15 | 19.45 | 87.33 cr |
| Pel-Red-04 | 67.82 | 39.61 | 7.77 | 40.36 | 11.10 | 95.08 cr |

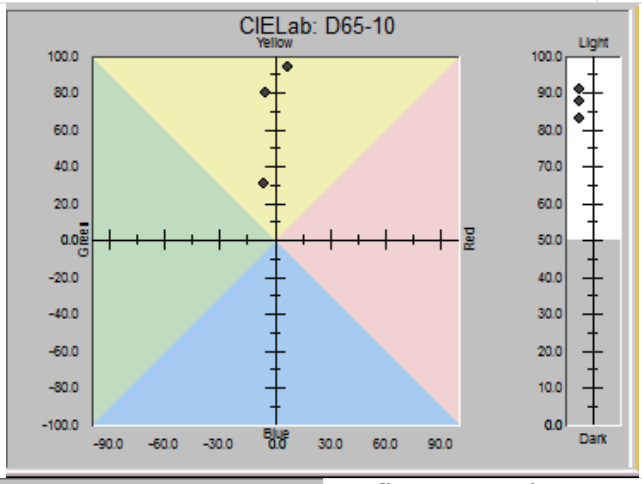
At the end all samples have been measured and stored in the job file. The display (printer) form contains the information about CR as well.

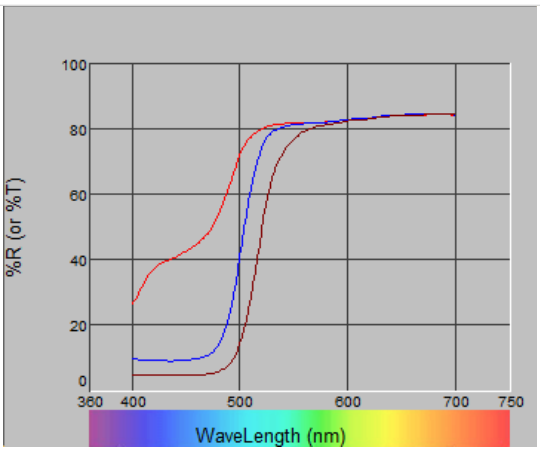
## Mixtures of colorant with Resin

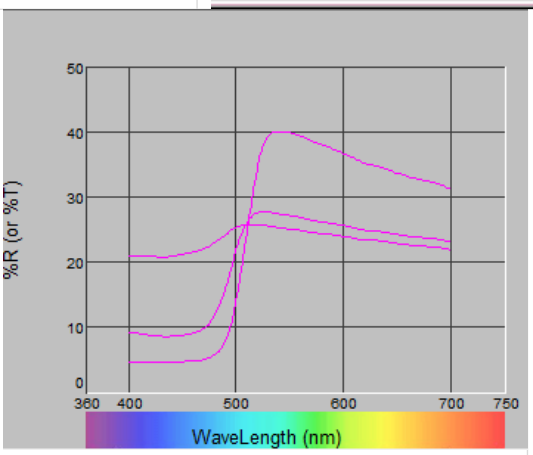
| Trial Name | Meas | L* | a* | b* | C* | h° | Opacity_CR |
|---|---|---|---|---|---|---|---|
| Pel-Y-02a | %R MAV SCI UVI XRite SP62/SP... | 90.73 | -6.12 | 30.96 | 31.56 | 101.18 | 30.96 cr |
| Pel-Y-02 | %R MAV SCI UVI XRite SP62/SP... | 87.44 | -5.36 | 79.84 | 80.02 | 93.84 | 34.11 cr |
| Pel-Y-01 | %R MAV SCI UVI XRite SP62/SP... | 83.23 | 7.14 | 93.64 | 93.91 | 85.64 | 51.36 cr |

Each group of colorants can be analyzed. In this case 3 mixtures of yellow color with resin viewed. 1 = highest concentration 2a is the lowest concentration.
In the above data group we can see, that the concentration line is represented by the Contrast ratio 1=51 / 2=34 / 2a = 31.

On the right side, we see that the samples have more or less the same hue angle,




Reflectance data over white and black

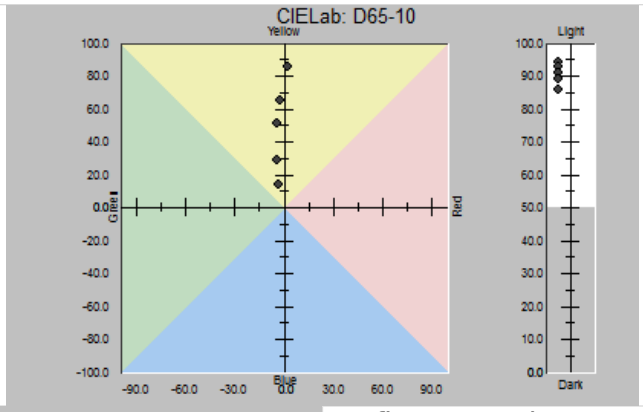
The measurements over white show a good separation
The measurements over black show strange behaviour for the lowest concentration

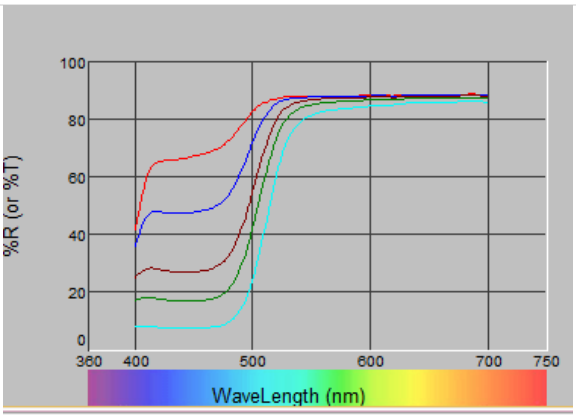
## Mixtures of colorant with white

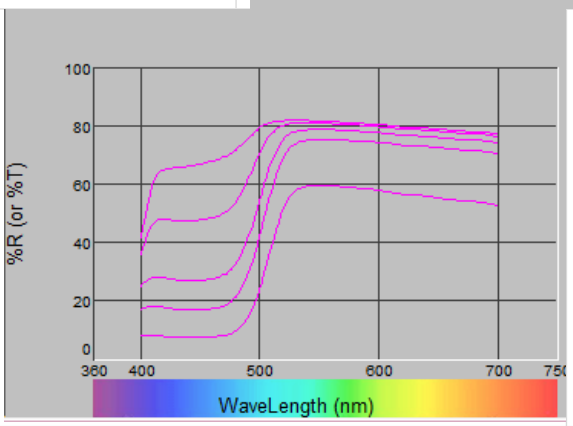
| Trial Name | Meas | L* | a* | b* | C* | h° | Opacity_CR |
|---|---|---|---|---|---|---|---|
| Pel-Y-07 | %R MAV SCI UVI XRite SP62/SP... | 94.18 | -3.20 | 14.00 | 14.37 | 102.86 | 92.77 cr |
| Pel-Y-06 | %R MAV SCI UVI XRite SP62/SP... | 92.86 | -4.65 | 29.11 | 29.48 | 99.07 | 92.45 cr |
| Pel-Y-05 | %R MAV SCI UVI XRite SP62/SP... | 90.78 | -4.40 | 50.72 | 50.91 | 94.96 | 91.00 cr |
| Pel-Y-04 | %R MAV SCI UVI XRite SP62/SP... | 88.95 | -2.61 | 65.32 | 65.37 | 92.29 | 88.82 cr |
| Pel-Y-03 | %R MAV SCI UVI XRite SP62/SP... | 85.82 | 2.31 | 85.22 | 85.25 | 88.45 | 73.51 cr |

Here we have 4 mixtures of the yellow with white.
The increasing yellow concentration from 7 (lowest) to 3 (highest) can be seen on the b-value.
The higher contrast ration of sample 7 (higher white content) agrees with the expectation.

On the right side, we see that the samples have more or less the same hue angle,




Reflectance data over white and black
There is a good separation between the concentration

Each of the calibration sets should be analyzed and any anomalies should be noted.

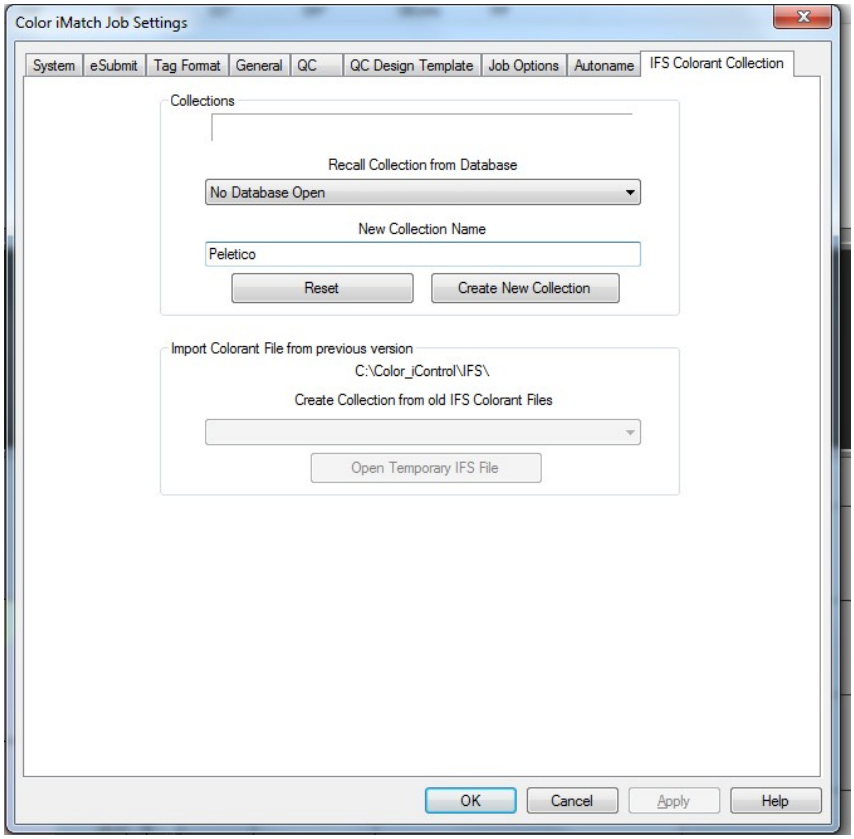
### *Step 4 – Prepare all data for the creation of the Colorant Collection*

Within the process of a Colorant Collection the following information are required:

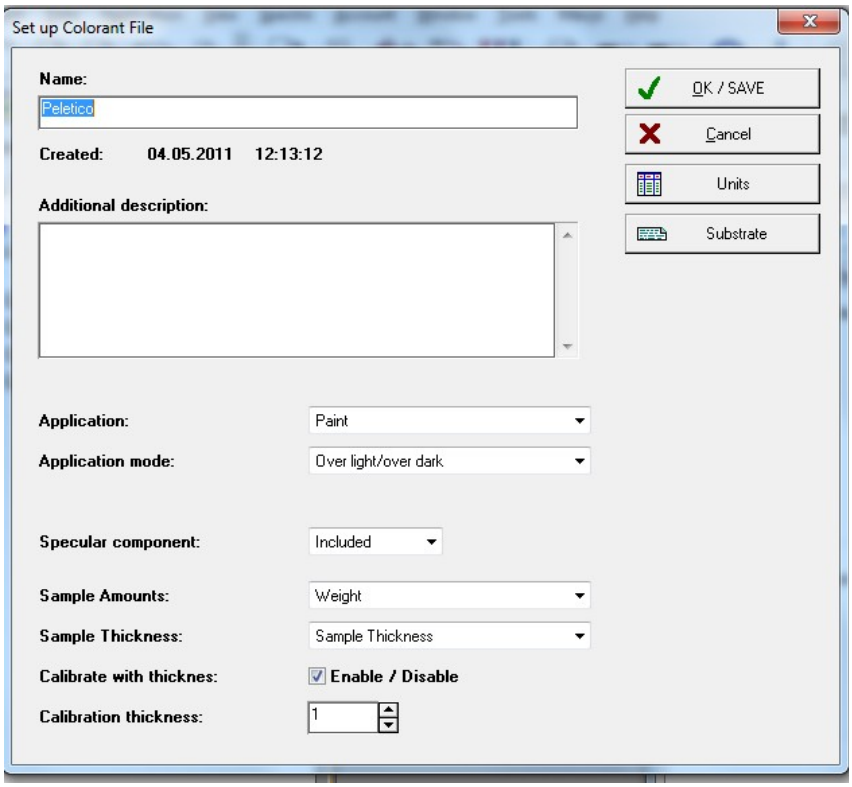
1. Job with all reflectance data
2. All concentrations of the calibration samples
3. All Specific Gravities, Colorant Prices,

### *Step 5 –Creation of the Paint Data File and storage of Base Data*

## Create a data base




With F2 the SET-UP will be called. On the Tab IFS Colorant Collection – a new collection name will be provided and the Create New Collection button will be clicked.




The Set Colorant File windows will come up and file definitions have to be made.

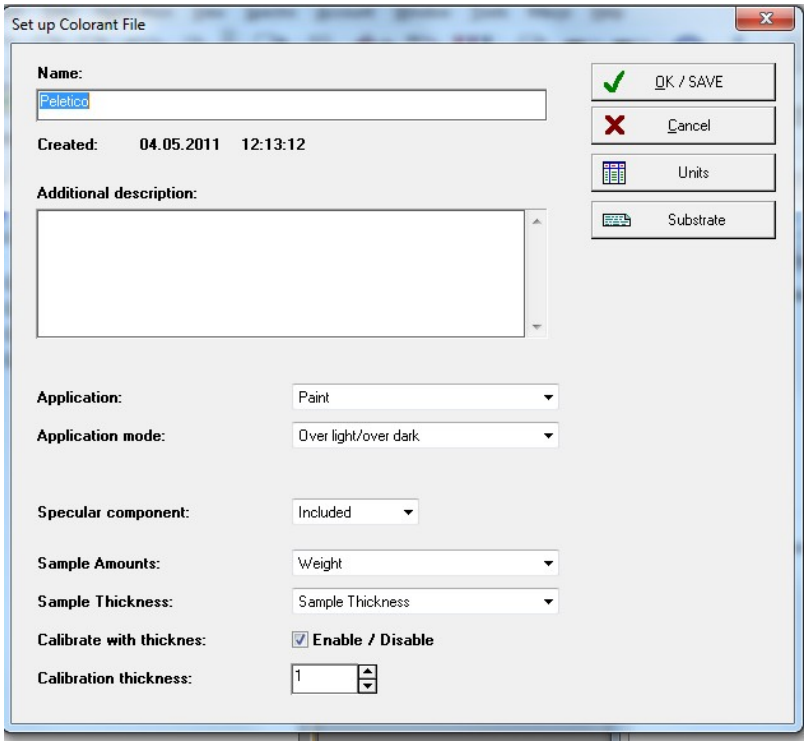
For Paint Application with non hiding samples the OverLight/OverDark application mode will be selected.

Typically the Specular component included mode will be selected

Typically the Sample Amount method – weight will be selected, since scaling of calibration samples is typically done by weight.

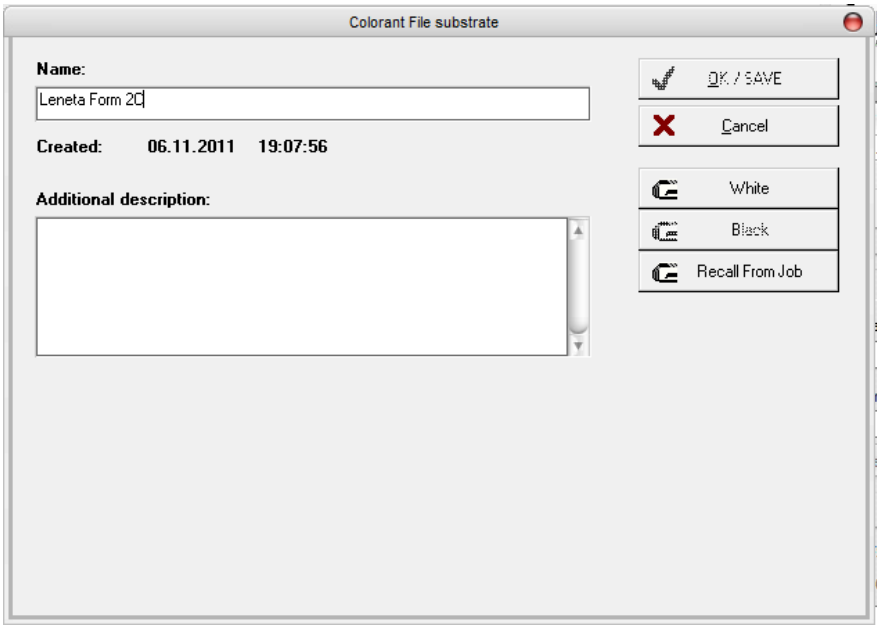
Typically the Sample thickness will be defined in the sample thickness.

If the calibrate Enable is activated, the film thickness will be part of the calibration




Next the substrate has to be measured or called from Job This is done by clicking the substrate button.

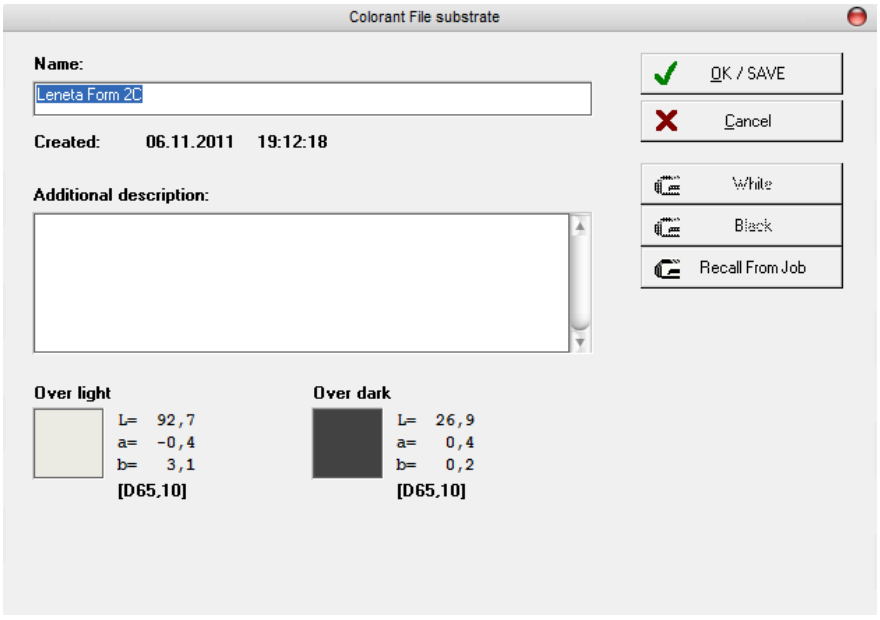
## Enter substrate data




This is done by clicking the substrate button.
By pressing the [White] button the measurement of the white background would be initiated.

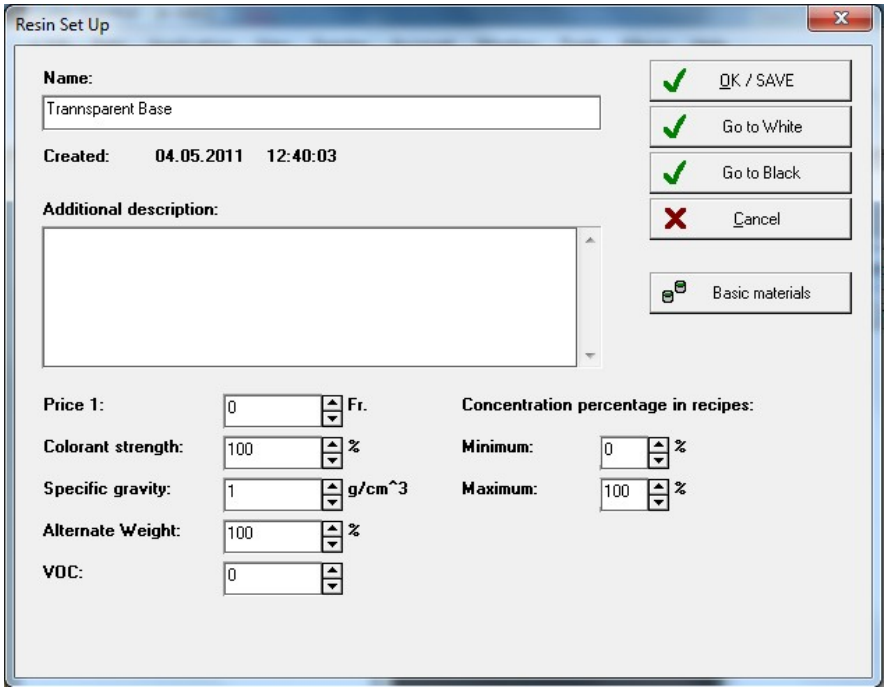
By pressing the [Black] button the measurement of the white background would be initiated.

Since all measurements have been done in the job we press [Recall from Job].
This allows to retrieve the measurement data from the job.



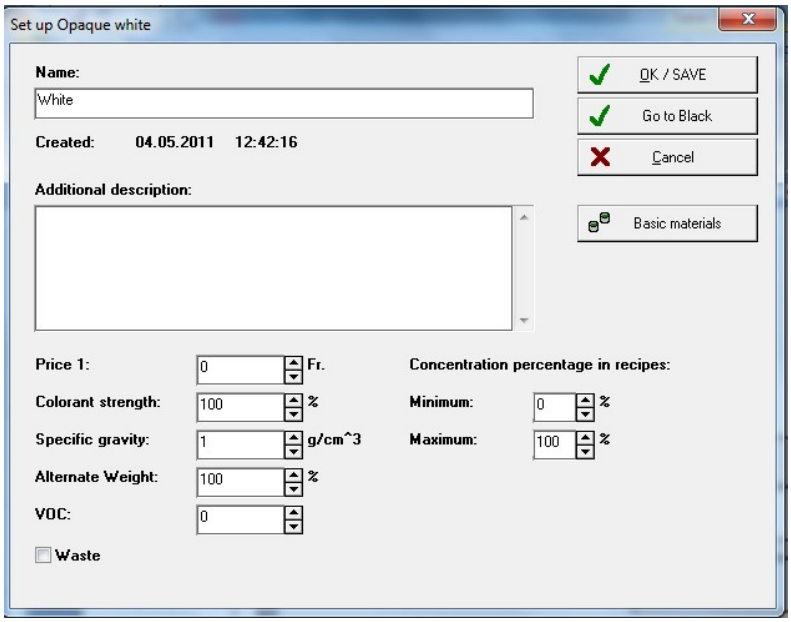

As soon the measurement data have been retrieved the lab – values for the over light and over dark will be shown.

## Enter the Name, Price, Colorant Strength, SG,.. for Base, White and Black

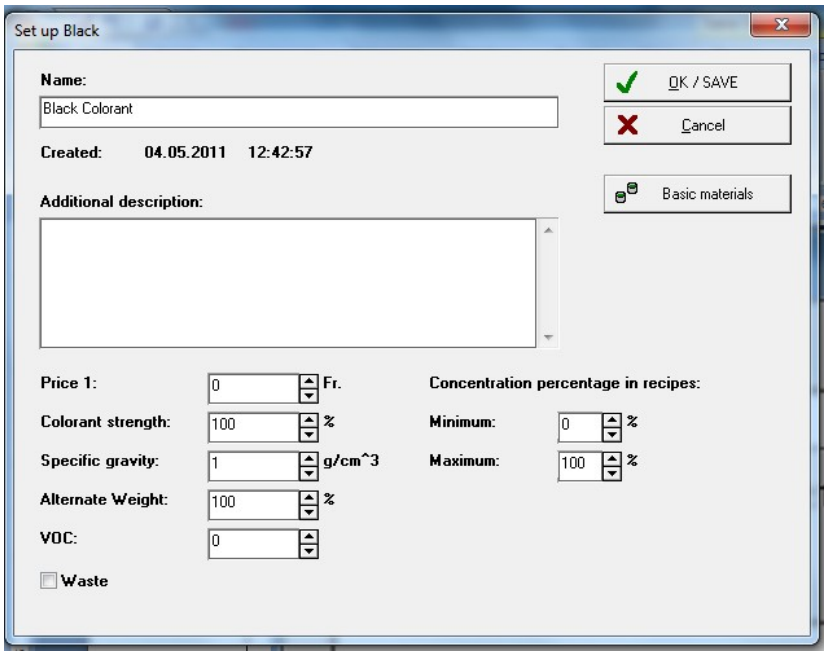



In the next step enter the Name and data of the transparent base.
As soon this is done press the [Go to White] button.

This switch to the windows to enter the White Colorant Data.

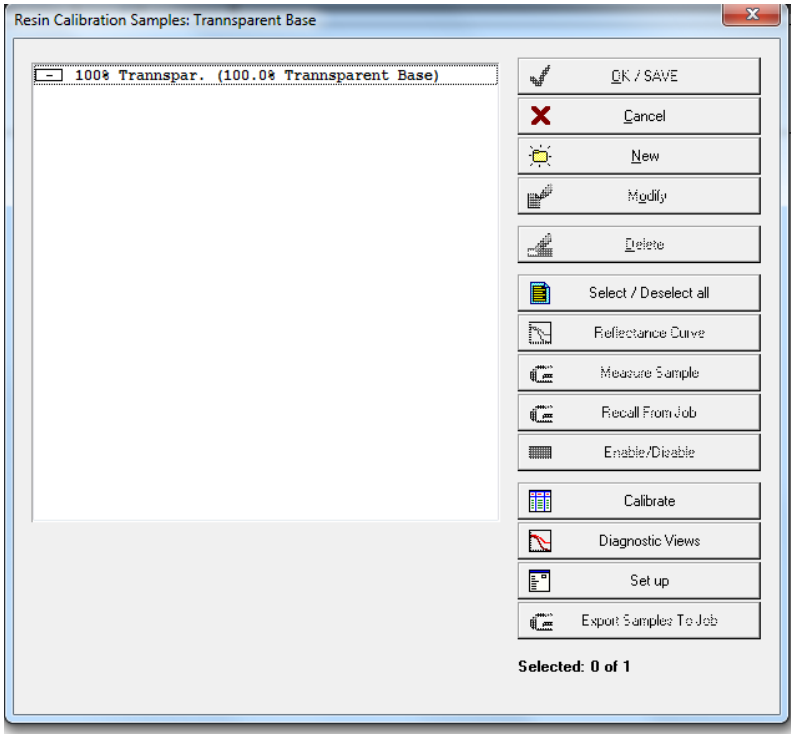



In the next step enter the Name and data of the white.
As soon this is done press the [Go to Black] button.
This switch to the windows to enter the Black Colorant Data.



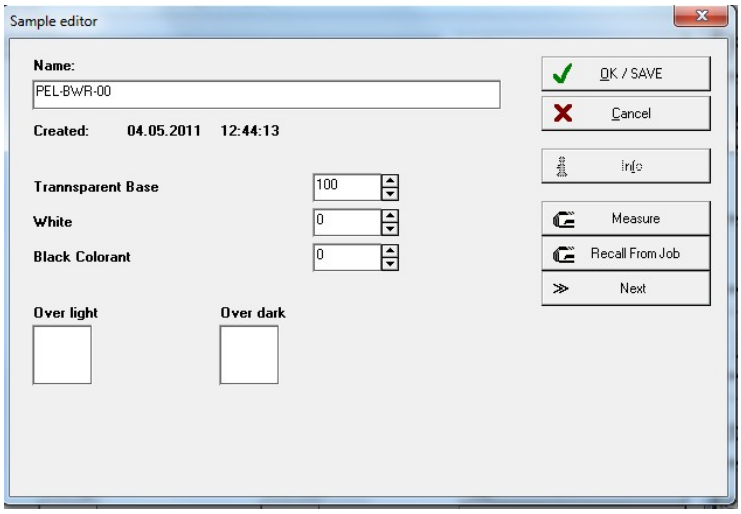

In the next step enter the Name and data of the Black.
As soon this is done press the [OK Save] button.
All technical data and prices for the Base, the White and the Black have been entered now.

## Insert Calibration samples



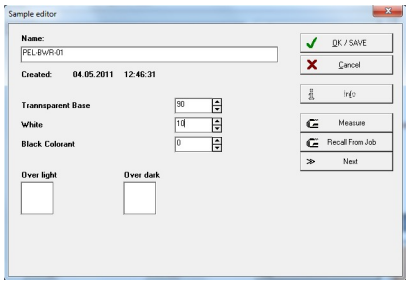

In list of calibration data a sample with 100 % Transparent is already listed.
The – sign in the sample indicates that no reflectance measurements have been stored yet.

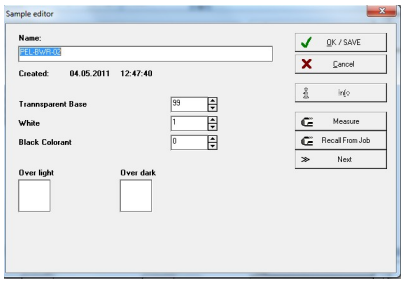
If we mark this sample and press modify, we can view the details of this input

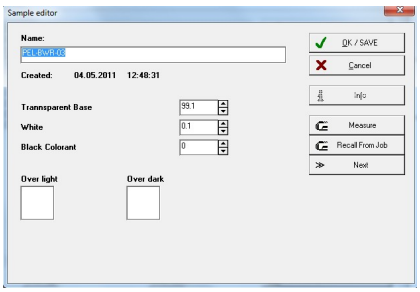



We change the Name to agree – to the name we used in the job for the 100 % Transparent PEL-BWR-00
Pressing next will allow to enter the next concentration

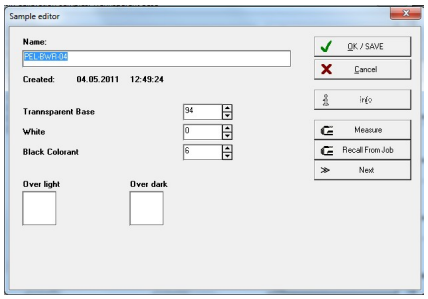
For the next series of samples – the mixtures of White with Resin - the name and concentration will be entered.

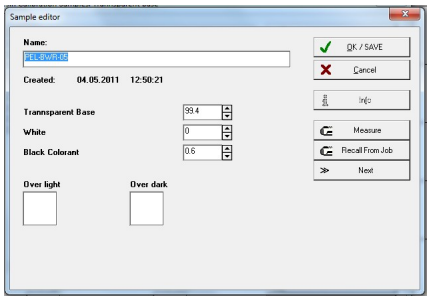


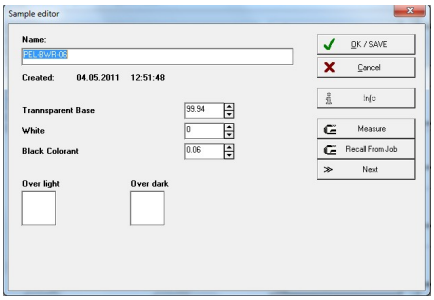



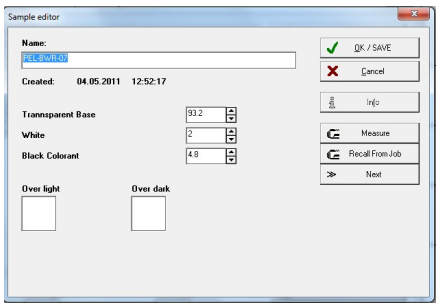

For the next series of samples – the mixtures of Black with Resin will be entered

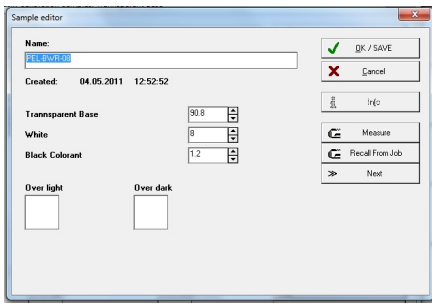


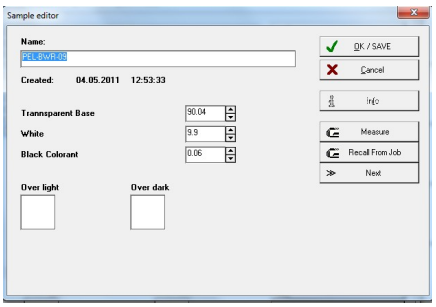




For the next series of samples – the mixtures of White and Black and Resin will be entered

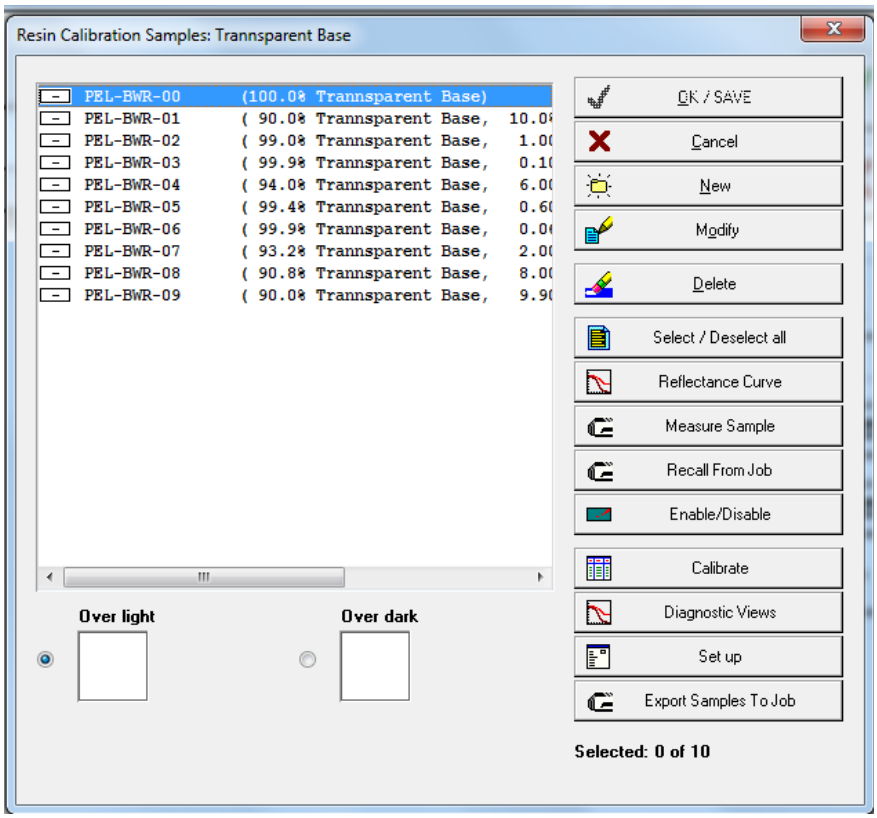


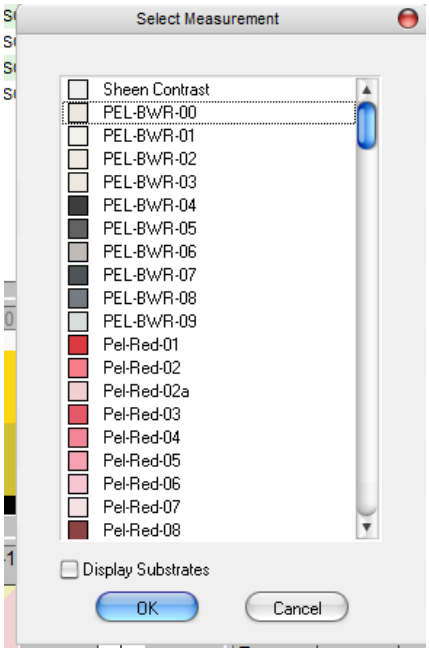



## Recall reflectance data for the calibration mixtures

As soon all concentrations have been entered press the ok button

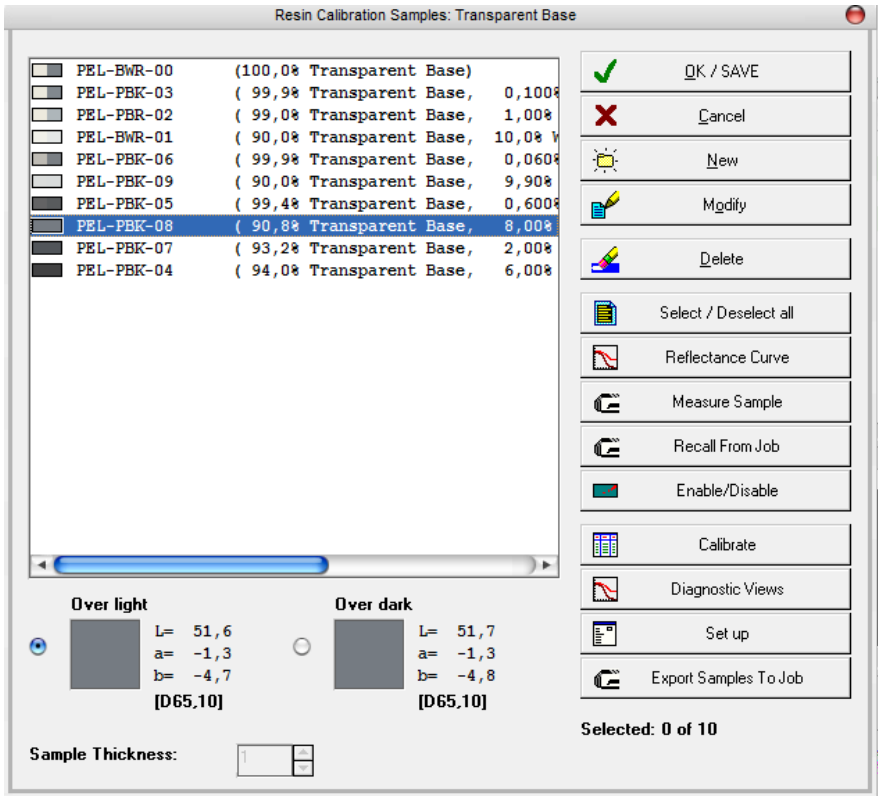



When all concentrations have been entered a list of all samples will be shown. The – sign will indicate, that no reflectance readings are available.
Mark the first sample and press the [Recall from Job] button.




Select from the job the sample which contains the reflectance for this concentrations

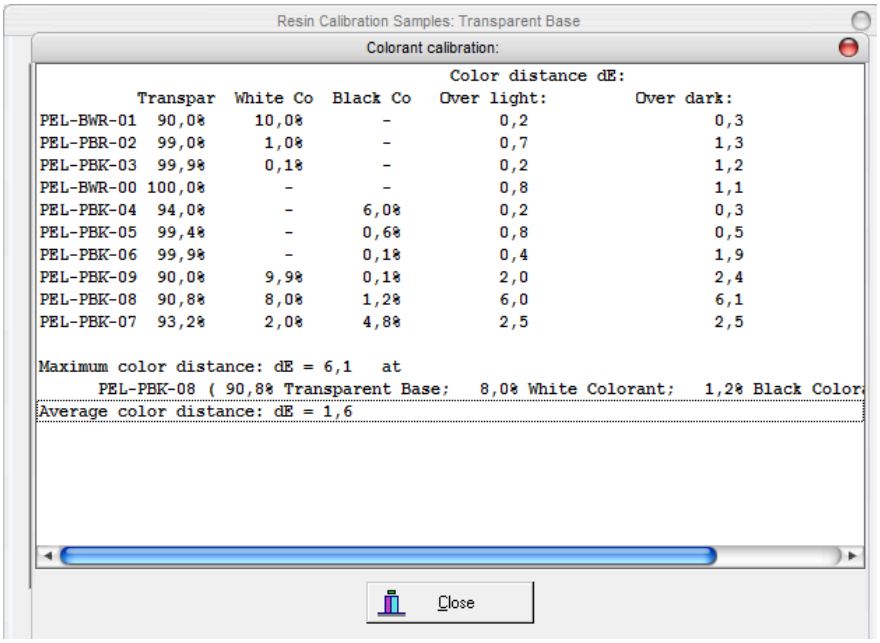
Repeat this for all samples in the list.



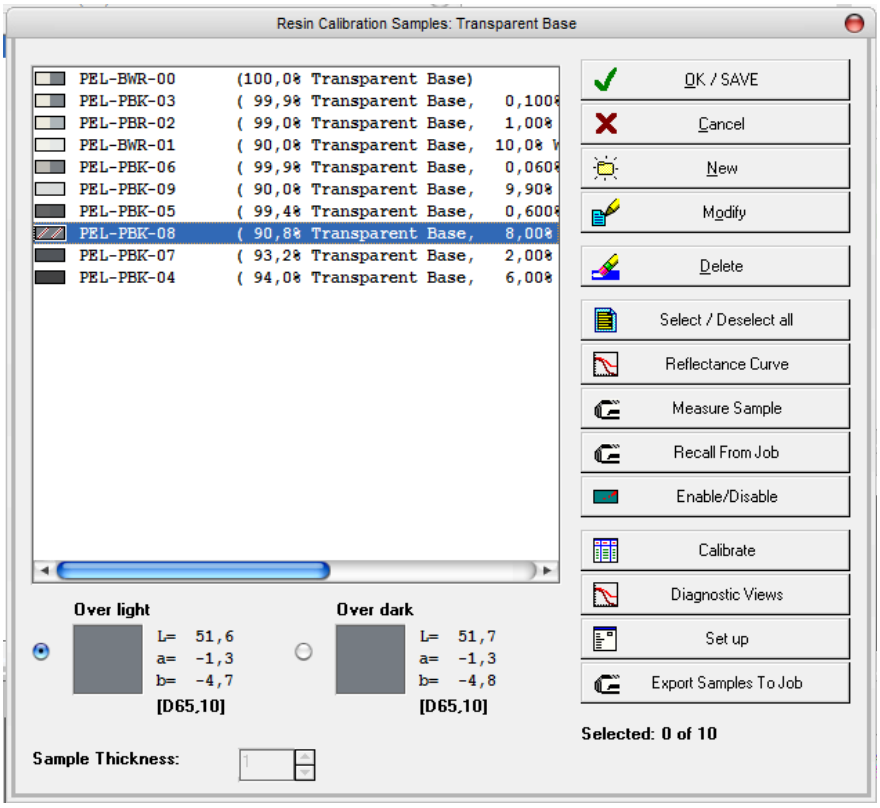

As soon all for samples a reflectance curve has been added the listing would like this.
Instead of a – there is a sample icon with a measurement over white and black background for the non hiding samples and a solid icon with the color of the sample for the hiding samples.

For whatever sample is selected detailed information will be provided underneath.

## Analysis of data – with the Calibrate and Diagnostic Views

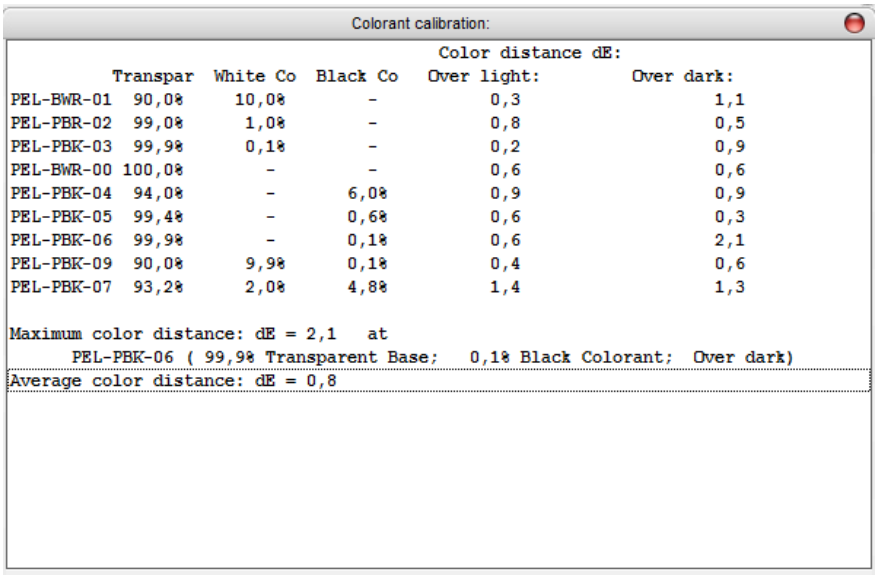



In this example of the calibration view there is a quite good back calculation of all samples over white except for sample 8 which shows a difference of 6 DE over light and 6.1 over black.




The program allows to disable easily the questionable samples

Once the questionable sample has been disabled – the calibrated function will be used again.



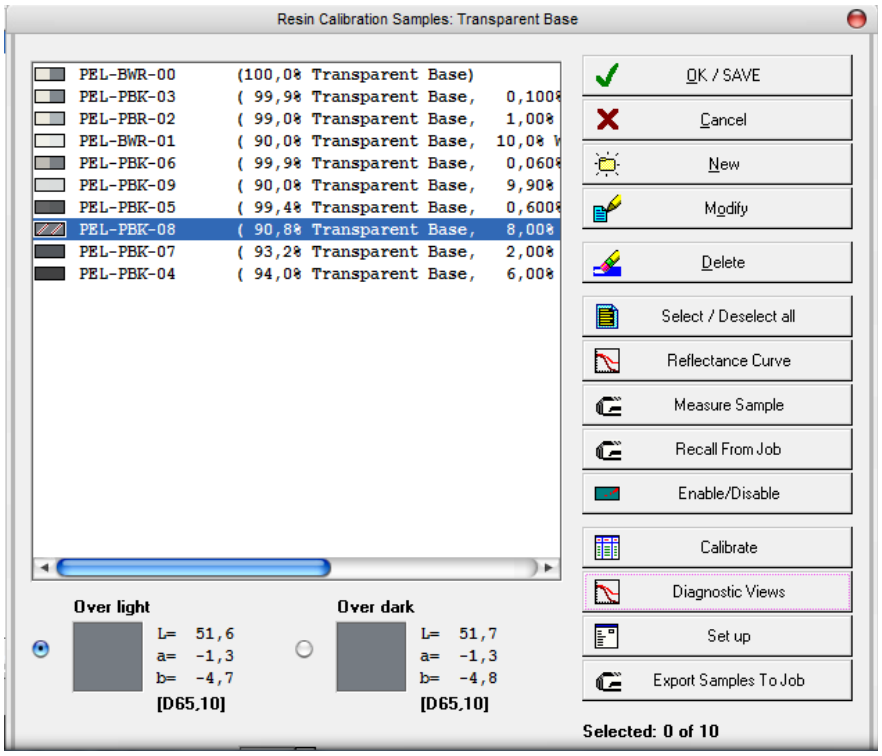

After disabling the sample 08 the average color difference has dropped down from 1.6 down to 0.8.

As better the average dE is, as better the agreement of the samples to each other is (as better the process control) in the sample preparation.

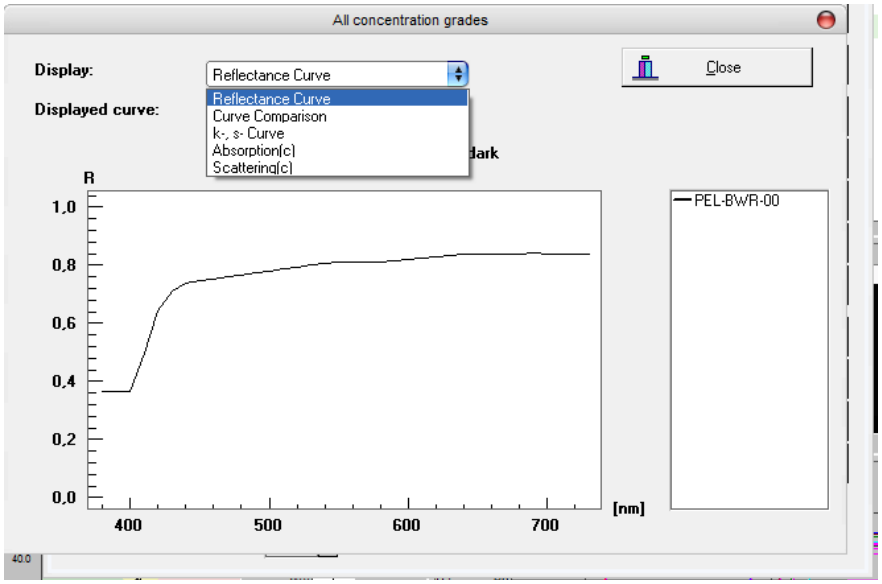
## General Rules for evaluation of concentration samples, which do not fit

If there are samples, which do not fit to the rest of the samples proceed in the following way:

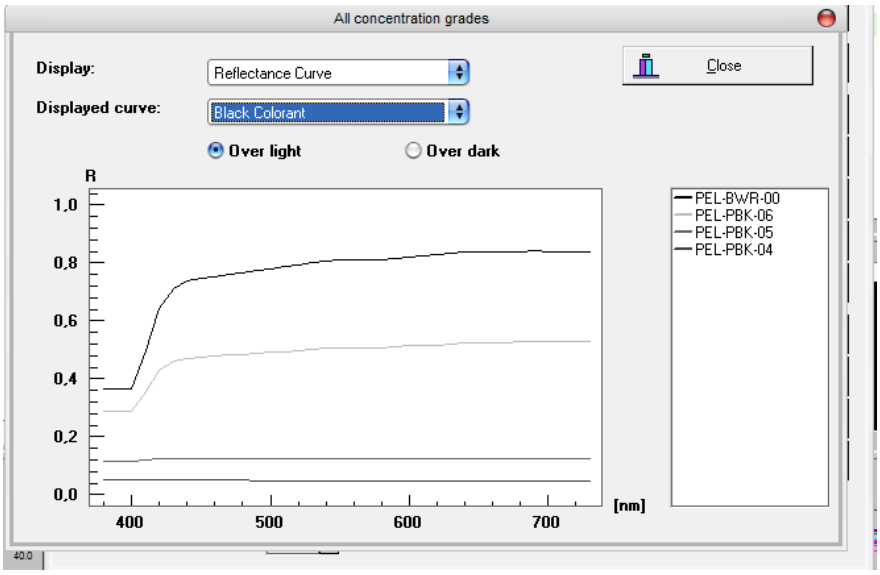
- Check the concentration – is the right concentration entered
- Check the film thickness entry
- Recall the sample once again (to avoid that a wrong sample has been used)
- Remeasure the sample
- Remake the sample



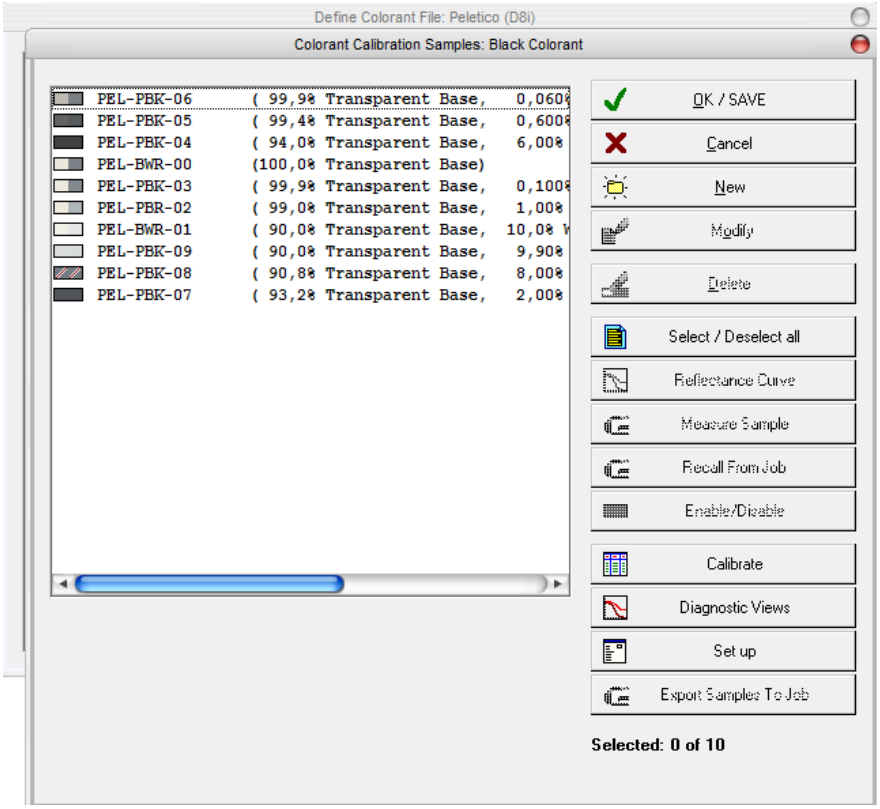

With the diagnostic views further information can be received.



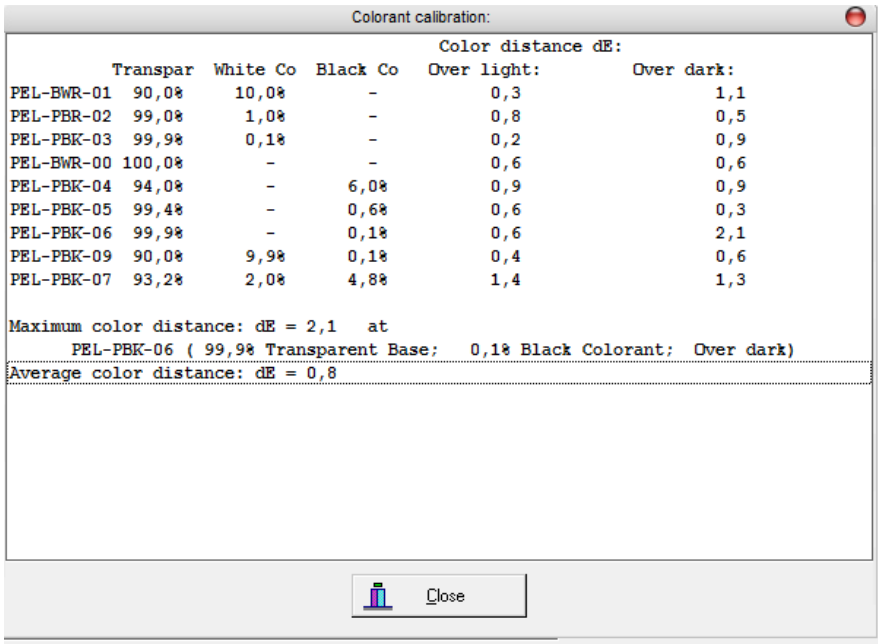

In the diagnostic views the reflectance curves, Absorption, Scattering and K vs. S curves and Curve comparisons can be made.



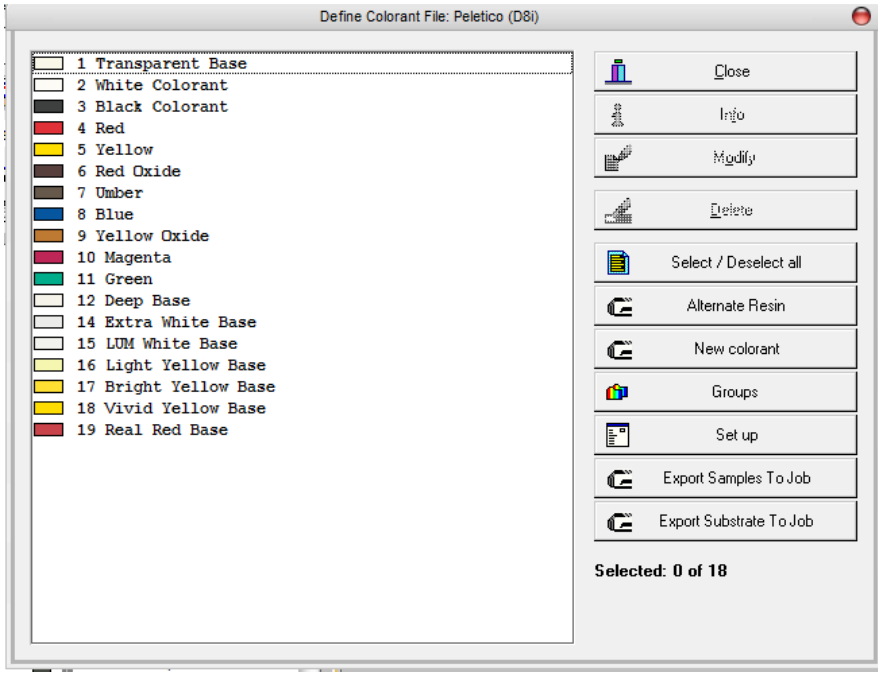

One of the items you should look for is a good representation over the total reflectance area.




Once the samples have been approved press OK / Save



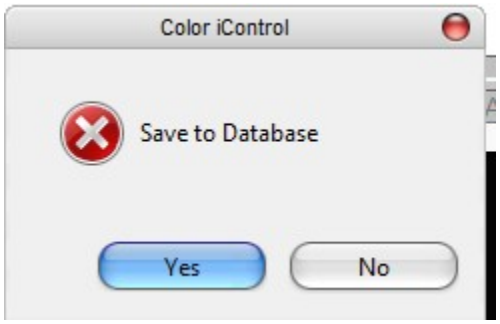
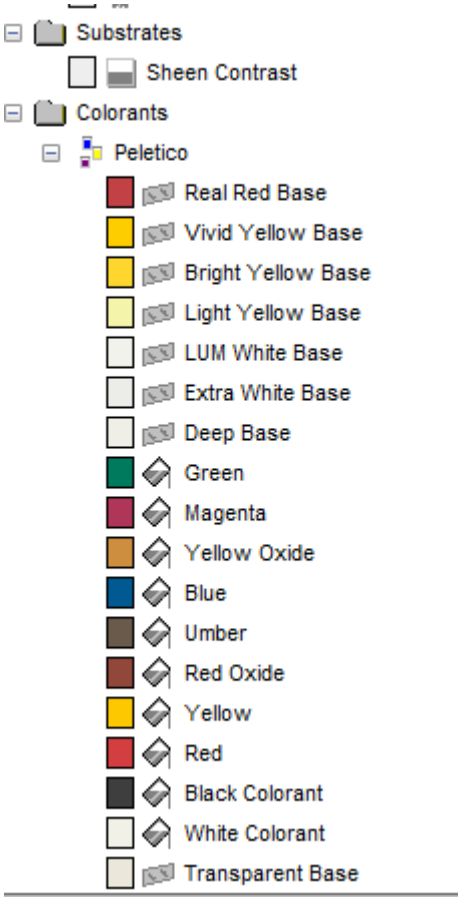

This will review the calibration of the samples




Repeat the procedure for all colorants

- Enter data (price, SG, …)
- Enter Data (Price, SG, min max, ….)
- Recipes
- Recall samples
- Evaluate samples

From to time close the colorant file

| | |
|---|---|
|  | Save to Database and save job afterwards |
|  | The colorant set is now available in the data base and can be used for formulation,<br><br>The next step would be to create a job template with the colorant collection. |