Spectraflow

Color Insight: Color Optimization

Rev March 2016

Document Outline

1. Function of the optimization process

The Color Insight Optimizer is used to generate color values that, when printed, produce the best possible visual match to a color in the CIS database. To do this Color Insight creates charts containing all the colors to be adjusted. These are then printed and measured using a spectrophotometer. The results are processed by the Color Insight application to produce an improved color match. This process is repeated until the printed results match the digital standard to an acceptable tolerance.

This document applies to version 2013R1 – 2015R3 of ColorInsight.

2. Color Insight Terminology

Color Insight uses the following terms to describe various components of the optimization process.

Digital Color Standard – A type of color stored within Color Insight that contains spectral data. Standards are generally supplied by 3rd party Color Service Providers.
Optimization – The process of adjusting output color values to produce an improved match to a digital standard.

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Workflow – A set of parameters in Color Insight that describe the combination of printer, paper and color matching conditions such as illuminant and tolerances.

Spectrophotometer – A device that measures the quantity of light reflected(or emitted) by an object across various wavelengths. The spectral curve created by these devices can be used to calculate the color of an object.

Illuminant – A source of light. Common Illuminants like incandescent bulbs, daylight, or classes of fluorescent bulbs are often standardized by software makers and used to represent an approximation of a specific source.

∆e (delta E) – A unit of measure for quantifying visually how far apart two colors appear. 1 ∆e should correspond to a "just noticeable" color difference. A value of <1∆e between two colors should mean that the colors are indistinguishable from one another.

Optimized Value – The adjusted color value generated by the optimization process. Used to produce an ideal printed color match.

Source value – The color value generated directly from standard. Used when communicating the color of the standard.

Metamerism – The phenomenon under which two colors with different spectral curves produce a visual match under a particular illuminant.

Color constancy – A corollary of metamerism. Color constancy is a measure of how much a sample's perceived color changes under different light sources. This is sometimes referred to as flare or metameric failure.

3. Color Matching Preset Creation

In many cases the digital standard that is trying to be matched will have been produced using a different technology than the printer that is being used to create a match. In this situation we can often only achieve a metameric match under a specific illuminant / observer combination. Color Insight is capable of matching color under a wide range of conditions. The Parameters for the matching process are stored in the "Color Matching" preset and used by the optimizer process to determine how color is converted and managed.

A color Matching Preset has the following fields:

- **Name** - Name of the preset
- **Color Mode** - Determines the color mode of the correction charts that Color Insight produces, currently RGB or L*a*b*.
- **Bit Depth** – Precision of the values used to produce a color match. 16 bit will allow for more precise corrections but only if it's supported by your workflow. Most printers can accept 16 bit data but many applications will only import palettes in 8 bit mode. ASE is limited to 8 bit color values.
- **CAT (Chromatic Adaptation Transform)** - This determines how color conversions between color spaces is handled. For agreement with Adobe applications select Bradford. CAT02 is a more modern and accurate implementation.
- **Delta E (∆E)** – A measure of perceptual color difference. The formula determines

the color weighting formula. Delta E 76 uses simple math but it can overemphasize the perceived difference between out of gamut colors. Delta E CMC is the de facto standard for the apparel and textile industries. Delta E 2000 is the newest and in many tests has been shown to most closely predict visual results overall.

- **Ideal/Required** – There are two sliders that control the ideal and "required" tolerance for the matching process. The "required" tolerance sets the ∆e tolerance that the measured sample value must be under for the color to be considered in tolerance. The "Ideal" value can be set to have the optimizer target a tighter tolerance than what is set by the required tolerance.

4. Optimization Process Overview

Before colors can be optimized they must first be added to a Color Insight library. This can be accomplished by importing color files (QTX, CXF) into the application or by taking measurements directly from a physical sample.

Color Insight Optimizations are stored in the database and linked to the color being optimized. All optimizations are organized by "Workflows" which describe the conditions under which a color is to be matched. Colors can be matched in small batches or many thousands can be processed at once. While the optimizer makes it possible to define multiple workflows and optimize colors to multiple conditions the same optimization workflow should be used as long as the color matching/printing parameters are the same. It's not uncommon to have only one workflow in use.

Once colors are optimized they can be exported in a variety of different file formats including adobe ASE. Optimized values can also be used to produce printed palettes of collection colors. In many cases Color Insight will present you with an option for choosing Optimized or Source values. The source values are the original color values derived from the imported or measured color. The optimized values are pulled from the optimization workflow that is chosen.

Optimized values can be edited after they are created using the visual correction tools. This provides the option of making subtle visual adjustments to account for viewing conditions or optically brightened paper. Optimized values can also be deleted, exported, and later imported.

5. Optimization, Step-by-Step

The process for creating a new optimization workflow is slightly different than adding colors to an existing workflow. A new workflow should only be created when first generating optimized values or when creating values for a new print/color matching criteria.
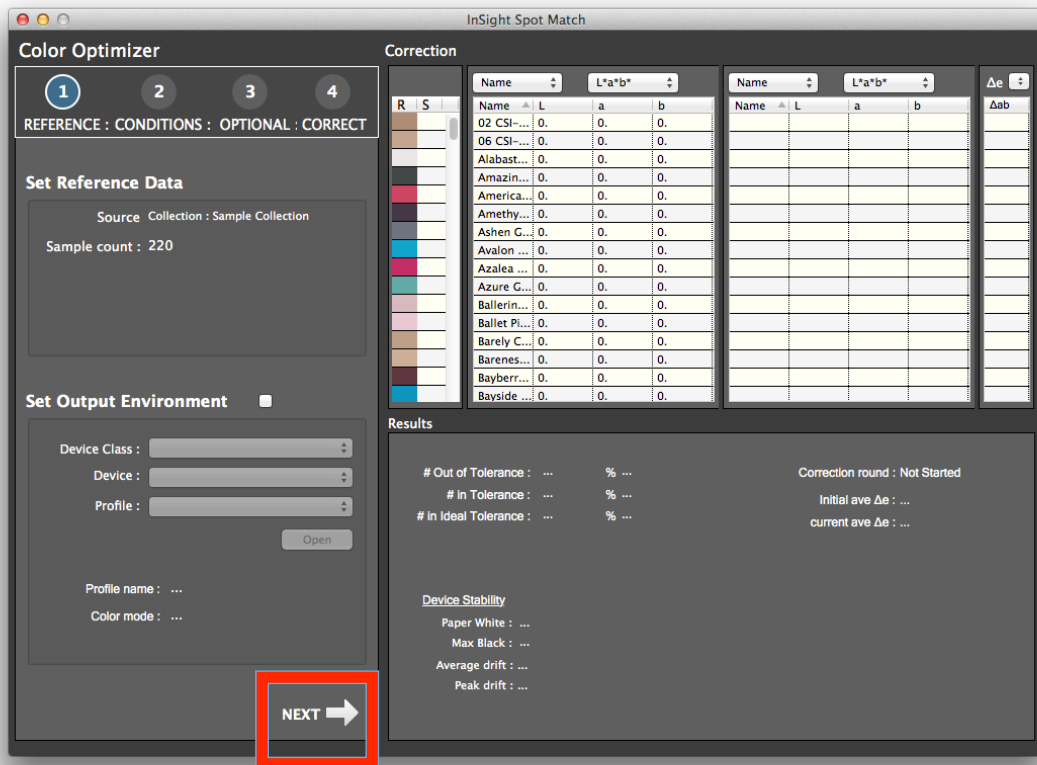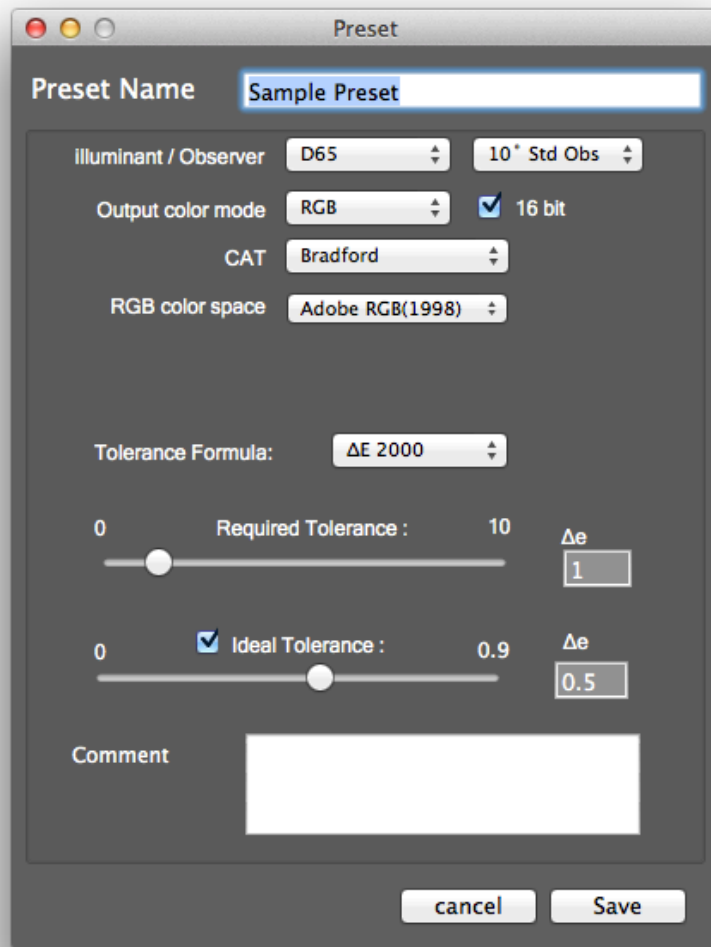
NEW OPTIMIZATION

a. New Workflow:

1. Click on a Collection or Library to select colors to be Optimized.
2. Click on the optimize icon from the menu bar, choosing "New Optimization Workflow" from the pop-up list.
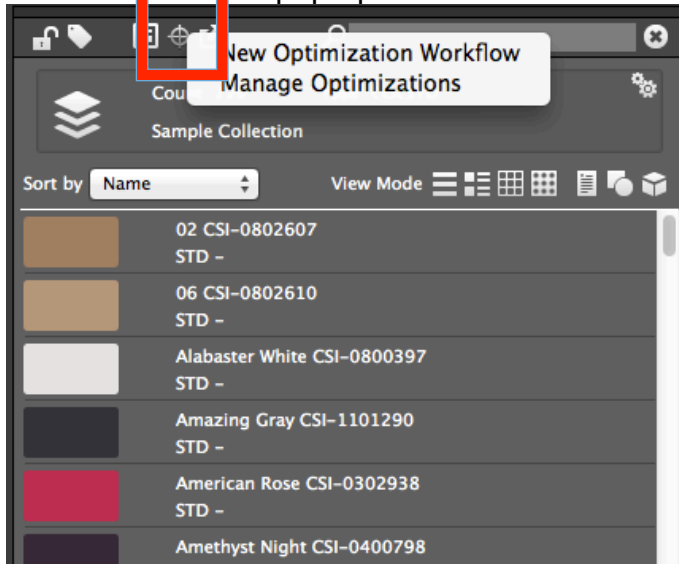
3. The first screen of the optimization setup window displays a number of OPTIONAL fields. If you have the ICC profile for your printer this can be selected at this stage. If not, click the next arrow in the lower right of the display.

4. The next screen prompts you to select the Color Matching preset. Color Insight ships with some standard options but you will likely want to create your own. Click the "New" button to create a new color matching preset. When you have selected the preset you wish to use click the right arrow in the lower right of the display.

5. From here you will be ready to start the optimization process.

b. Adding colors to an existing Workflow:

1. Click on a Collection or Library that contains the colors you want to add to the optimization workflow.
2. Click on the optimize icon from the menu bar, choosing "Manage Optimizations".
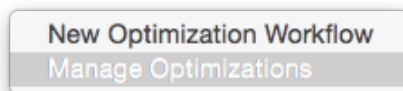
3. Select the optimization workflow you want to add colors to. The window will display the number of colors in the selected group that do not have an optimized value. From here you can choose one of two options:
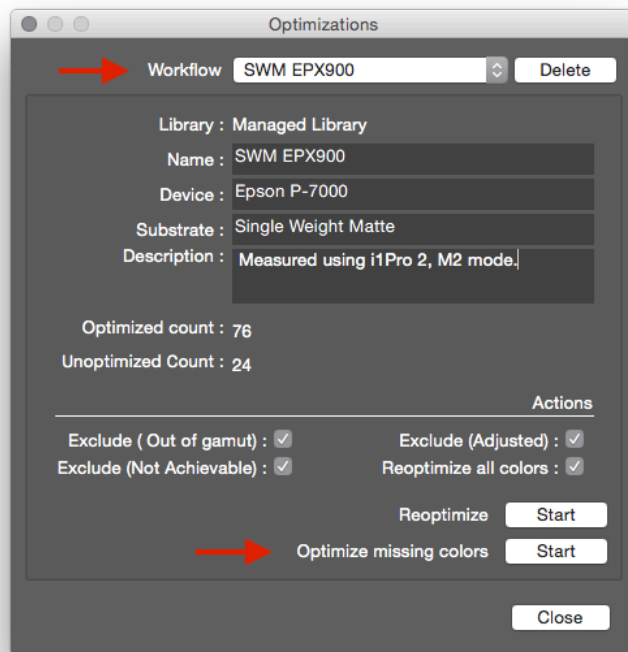
Optimize missing colors - This will create an optimized value for any colors in the selected group that does not have an optimized color value for the selected workflow.

Re-optimize - Will update the current optimized colors to address printer drift or other minor variations. The checkboxes give you control over how the re-optimization process will affect out of gamut colors and color with a visual adjustment applied.

c. General Optimization Process:

1. Click "Save" button to select the folder that will store the optimizations assets. By default this is stored in your "User" folder
2. Select the measurement device that will be used to read the printed charts
3. Choose a page size for the correction chart, legal is selected by default
4. Click on the "save" button to save the measurement chart. This chart will start the first round of color correction. The chart should be printed using your standard print settngs/workflow.

   Clicking the show button at any time will open the folder where all the charts are saved.

5. When the chart has been printed click the "Measure" button to measure the chart and record the color values.

   See the measure section for details on measuring charts with specific devices.

6. When the first round measurements are completed the window will be updated with the results and the chart count will be advanced. The measure button will now be grayed out and the save chart button indicated in step 4 will save the next round of correction charts.

   The optimization process is continued by printing a correction chart then measuring the printed chart as many times as needed.

FINISHING THE OPTIMIZATION

Correction rounds may be repeated as many times as needed. Typically the results will be in an ideal state after 2-4 rounds of correction. You can judge Delta-E results for individual colors in the right column of the window. These results are color coded, with in gamut colors highlighted in green, marginal colors highlighted in orange or yellow, and out of tolerance or out of gamut colors highlighted in red or purple. Overall results for the optimization appear in the lower right of the window.

Name	L	a	b	Name	L	a	b	Δab
04-CW-03...	40.398	47.662	30.089		42.669	40.556	27.466	7.907...
04-CW-03...	39.707	46.457	34.055		42.261	39.037	29.534	9.056...
14-0755 T...	77.646	6.074	81.929		77.708	6.139	81.587	0.354...
19-3230 T...	29.562	26.46	-19.668		32.012	25.118	-19.933	2.806...
19-1764 T...	42.989	48.164	30.136		44.318	42.902	28.813	5.586...
19-1955 T...	38.433	44.222	12.568		40.739	38.798	12.628	5.894...
19-1762 T...	40.909	47.907	27.74		42.911	41.247	26.032	7.160...
19-3952 T...	24.581	-0.953	-46.38		27.627	-1.59	-45.53	3.226...
17-4735 T...	45.385	-37.621	-26.157		45.857	-33.812	-25.273	3.938...
13-0650 T...	84.676	-8.743	86.56		84.537	-8.386	89.553	3.018...
18-1761 T...	44.645	51.441	32.834		46.312	45.47	32.223	6.229...
19-3540 T...	31.305	22.829	-27.219		31.456	23.448	-28.232	1.196...
19-5917 T...	27.289	-9.218	2.641		27.394	-9.548	2.644	0.345...
19-6110 T...	26.154	-6.463	2.31		26.294	-6.313	2.292	0.206...
19-5513 T...	29.915	-12.545	4.598		29.389	-13.028	3.949	0.964...
19-5920 T...	29.292	-11.552	2.827		28.909	-11.43	2.959	0.423...
19-4151 T...	32.155	-13.404	-49.627		32.565	-10.242	-48.738	3.310...
18-4537 T...	39.661	-28.684	-44.038		40.886	-22.117	-41.747	7.062...
18-4735 T...	44.199	-37.782	-23.288		44.479	-33.325	-22.511	4.533...
15-0751 T...	71.193	7.52	71.856		71.293	7.472	71.599	0.280...
19-1758 T...	38.975	45.014	34.869		41.255	37.607	29.648	9.345...
19-5406 T...	20.149	-8.057	0.02		23.548	-5.714	-0.591	4.173...
19-6050 T...	28.052	-14.145	8.204		28.775	-13.83	7.42	1.111...
18-6030 T...	40.228	-37.013	17.146		40.664	-34.226	16.868	2.834...
18-4434 T...	30.978	-19.019	-35.174		31.485	-14.701	-34.155	4.466...
17-1463 T...	56.74	54.465	60.333		56.85	53.879	60.238	0.603...
17-1349 T...	62.887	44.806	76.879		62.508	44.803	68.558	8.329...

Results

Out of Tolerance : 17   % 62.96296
in Tolerance : 3   % 11.11111
in Ideal Tolerance : 7   % 25.92593

Correction round : Not Started
Initial ave Δe : 4.218546
current ave Δe : 1.743287

Save Results [Save]

Device Stability
Paper White : 96, 0.3, -4.3
Max Black : 17.4, 0.6, 1.8
Average drift : 0.43
Peak drift : 1.01

If you are satisfied with the results you can click the finish and save button. If this is for an existing workflow, you are finished. If you are creating a new optimization then you will be asked to enter a name for the optimization workflow. You can also optionally enter other details about the optimization, such as measurement condition or color management details.

6. Chart Measurement Window

When the measure button is clicked from the optimization window the Chart Measurement screen will be displayed. The measurement screen is the same for all measurement devices but the process is slightly different depending on the measurement devices.

When the measure chart screen opens the instrument type should be selected already. If the device type is not displayed check that your device is plugged in and the drivers are installed. If the device is connected you may be prompted to calibrate the instrument

before you can use it. This takes up to 30 seconds. If you are using a scanning type device like the X-Rite Isis, the instrument will generally autocalibrate.

The status of the connected device is displayed in the upper left of the top bar. If the device allows for different measurement modes those will be displayed in the two drop down menu options outlined in red. By default, Color Insight uses M0 measurement mode for optimizations. So for each round of measurements, ensure that that the measurement parameters are properly set, as these setting can have a significant impact on the optimization results.

Once the measurements are complete, click the Finish button. This will take you back to the Color Optimizer window and calculate the Δe between your target and the baseline patches. Colors that converge to the desire tolerances will have a background of green behind their Δe number, close numbers will be orange, and far off will remain red. Note - this window defaults to showing a Delta-E ab('76). If you are using CMC, 2000, or some other metric, you can click on the Δe in the upper right hand corner to show your preferred metric. It will also automatically calculate new and improved RGB values. Now click the Save button and repeat the process for a few more rounds. Note – Round 3 uses a different method that prints 8 color patches for every color that has not yet converged. This typically results in more patches to be measured. After 4 rounds, no further improvements are possible, and out of gamut colors will be identified in purple.

Measuring the Chart:

When using an automated chart reader like an X-Rite iSis Click the "start" button, wait for the prompt to appear then place the chart in the device.

For an i1 Pro, place the device in the ruler. Place the ruler over the first row and the i1 to the far left in the ruler. Make sure that the i1 is initially placed over the paper and not on a color patch. Push and hold the measurement button and then at a deliberate pace drag the device to the far right letting go of the button when the device is over paper white again. If you need to re-measure a row for any reason you can select the row from the pop up menu(1).

The software shows the colors for each row with each patch having a white hole in the middle. This fills in with a successful measurement and provides visual feedback that you are measuring the correct row. There's also a blue progress bar on the left. When measuring with an i1 Pro2, the final row doesn't always fill in, but you can tell the measurement was successful because the blue progress bar fills in complete.
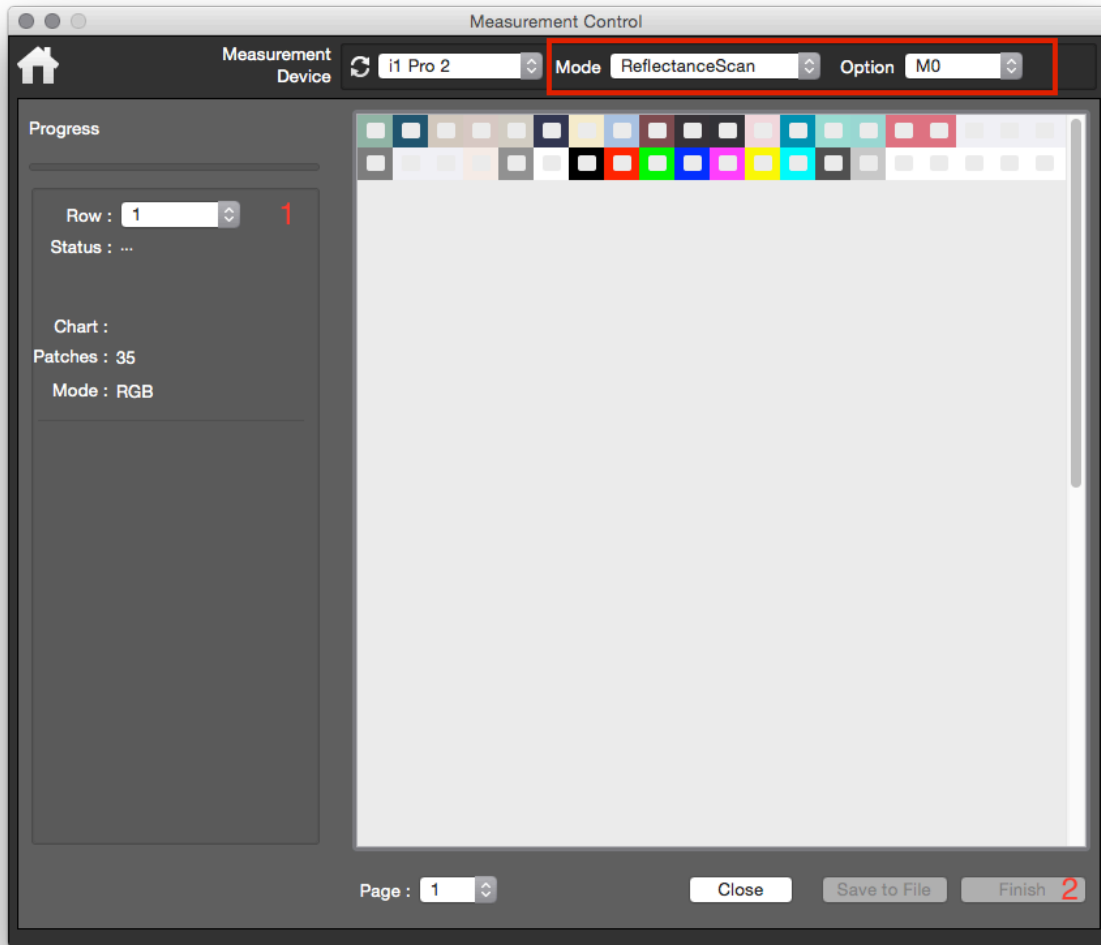
When all rows have been measured click the finish button(2). The results of the measurement will appear in the optimization screen. If you want to save a copy of the measurement files to a different directory you can optionally click the "save measurement" button. By default all measurements are saved in the working folder you created in Step 1.

Notes on using the i1 Pro2

When using the i1 Pro2, there are a few things to remember to make the process go smoothly. Since there's a lamp in the spectro that turns on during measurements, the color of the surface that you are measuring upon can effect the measurements. Therefore, we recommend measuring upon a second piece of your printer paper. Alternately, you can use backup board that ships with the i1, which comes with a convenient clip to hold your paper.

When starting a measurement, position the i1 Pro2 on a white section just to the left of the row you are measuring, press and hold the button on the i1 and leave it on white for about ½ second, slide across the row until you get to the white space at the end of the row and hold for another ½ second, then release. It should take about 1 second to scan a row of patches on letter-size paper. If the measurement was successful, the i1 will pulse green. If it wants you to measure again going the other way (M2 mode), it will pulse with a blue arrow pointing left. If you go too slowly, it may error out and pulse red. You then just need to re-measure the row. If you need to re-measure a row other than the one you are currently on, you can click on the row number just below the progress bar on the left.