



CyberChrome White Paper: The Importance of Instrument Profiling

Introduction

Today's global supply chains, dispersed workforce, and ever-changing technologies bring a unique set of challenges to the color measurement industry. Employees in different countries or even those in the same room can get different readings on the same color samples, leading to frustration, costly recalibration and a high rate of rejected samples. The problem isn't limited to those companies using multiple types of spectrophotometers – even companies using just one brand of spectrophotometer throughout the organization can find that different models of the same brand read color samples differently. In a field where precision is everything, these discrepancies can prove quite expensive.

CyberChrome, the world's leading independent color software provider, created OnColor™ Profiler, a first-of-its-kind independent profiling software package, to address this frustrating and costly problem. OnColor Profiler is a 3-in-1 software package that

- 1) profiles spectrophotometers,
- 2) converts legacy data to match a master instrument, and
- 3) monitors instrument performance.

It ensures data accuracy and compatibility with all spectrophotometers, regardless of brand or model. Using Profiler, companies can share color standards files and colorant databases among many users and instruments both inside and outside of the organization. The result is a cohesive database of color samples that streamlines the collaboration process and allows for simplified sharing of important data, even among different brands of spectrophotometers.

How it Works

Using OnColor Profiler is quick and easy. Three Wizards are provided to guide the user through the process and make operation simple and fool-proof. A "master" instrument is profiled using CyberChrome's proprietary algorithms and a specially designed set of 32 ceramic tiles. These durable tiles retain a constant color over long periods of time, have a planar uniform surface and are sturdy enough to withstand even the most intense lab conditions. The tiles are

measured under controlled conditions on the master or reference instrument and then measured on the target instrument. Profiler calculates a set of instrument correction coefficients based on the initial readings and these coefficients are used to correct all readings from the target instrument so that readings will match the master instrument. The algorithm takes into account differences in the gain, offset, linearity, and wavelength centroids of the target instrument. The correction coefficients are stored in a file that is then applied in OnColor QC and Match software. Profiling of an instrument is recommended at least once a year with periodic checks using the instrument performance wizard. Using the Instrument Performance module regularly flags when an instrument needs re-profiling or factory service.

Profiler is a stand-alone software program that works in conjunction with OnColor QC and Match software. Data is measured and saved in OnColor and then read in Profiler where the sophisticated profiling calculations are done. A company typically uses one Profiling package at the master lab and several OnColor QC and/or Match packages at the various color computer stations.

Procedures

Data collection on the special ceramic tile set is done using CyberChrome's standard OnColor QC software. Profiler does not need to be installed on the computer that runs the Master or any of the Target instruments. Profiler works on data that is collected in OnColor QC. It is important to control the environmental conditions of temperature and humidity when the tiles are measured. All instruments should be calibrated immediately before measuring the tile set.

To profile an instrument, the user first measures the ceramic tile set on the Master instrument in the standard OnColor QC or Match package. The tiles are measured in a specific order and saved as a save-set (WSV) file. The tile set is then taken to the Target instrument when it is measured on the Target instrument using OnColor. The two instruments do not have to be in the same location to measure the tile set. The commonality is the set of profiler tiles. Note that the Profiler package is not needed for the data collection step. The PC with Profiler installation does not need to be at either instrument location. Also, the Profiler hardlock key can be moved and used on more than one computer.

After the data has been collected in a save-set file (WSV), it is then sent or copied to the computer that has the Profiler software installed. None of the instruments ever need to be connected directly to the Profiler software. To profile an instrument, you need two WSV files—one that contains the data on the tiles from the Master instrument and another for the Target instrument. Then using the Profiler package, the operator uses the Profiling Wizard to calculate the profile coefficients file. The Wizard guides the user through the steps to recall the data on the two instruments. It calculates the profile coefficients file and saves it as a CCF file. It also displays and prints a Certificate of Performance for

the Target instrument. This Certificate summarizes the results of each tile used in the profiling and displays the average color difference data in CIE 1976 L*a*b* units for D65/10°. A typical example is shown on the next page. The CCF file containing the profile coefficients are then transferred to the computer that runs the Target instrument. To turn on profiling in OnColor, the operator goes to Options→Profiling, checks the box to enable it and then recalls this CCF file. Checks are done to validate that this CCF file belongs to this instrument. All subsequent measurements done in OnColor are now profiled to the Master instrument!

To check instrument performance, the user measures the tile set on the Target instrument and sends or copies the data to the computer that has the Profiler software installed. The operator then uses the Instrument Performance wizard to compare the current data from the Target instrument to that of the Master instrument. To do instrument self-certification, normally the profiling tile set is used for this check. This provides instrument traceability back to the Master instrument. However, for other projects other sample sets can be used as long as they are measured on the Master instrument and the Target instrument. An example of this would be customer color audits. A collection of color standards would be measured on the Master instrument as well as the Target instrument using OnColor. The data is saved in a WSV file and then used by Profiler to compare the two instruments. Any number of samples can be used in this test. In addition, tolerances can be entered into Profiler and any results that don't pass the tolerances are flagged. The results are printed in a Certificate of Performance and the document can be signed and dated as the official record of the procedure. Only OnColor needs to be installed on the Target and Master instrument computers. Profiler does not need to be installed at either instrument location. Alternately, the Profiler hardlock key can be moved and used on more than one computer.

To convert legacy data, the profile coefficients that are calculated by Profiler are applied to existing legacy data to convert the data relative to the Master instrument. Two things are needed to convert legacy data—a save-set of the legacy data and a CCF file containing the profile coefficients. The user must get the legacy data into the form of a save-set (WSV) file. If not already in WSV format, the data can be imported into OnColor using a spreadsheet file and then saved to a save-set. Using the Legacy Data Wizard in Profiler, the legacy data is then profiled and converted to data relative to the Master instrument. An example of this would be where a company is updating their instruments to new technology. Color standards from many years back may be stored as measured on the older Target instrument. The color standards may no longer exist, or may have changed color due to aging or use. However, the electronic data is still used and now needs to be on the scale of the new instrument. By profiling the older Target instrument to the new Master instrument, the legacy data can be converted using Profiler.

Certificate of Instrument Performance

Master Instrument: Macbeth 7000 Status: CRIPS CalTile # XA0378
 Company: CyberChrome, Inc. / Operator: MDL / Tile Set: A1-32
 Tile Data for the Macbeth 7000 was last updated on 6/3/2008 11:45:30 AM

Target Instrument: SpectraFlash 600 Status: CRIIL CalTile # DC43785
 Company: CyberChrome, Inc. / Operator: EFB / Tile Set: A1-32
 Tile Data for the SpectraFlash 600 was last updated on 6/3/2008 11:45:30 AM

The referenced target instrument has been checked and profiled to the master instrument listed below. The test results below show the conformance of the target instrument to the master on a special set of 48 ceramic tiles designed for this purpose. The reported data is shown for CIE (1976) L*a*b*, II D65, 10° observer. This profile in no way changes the response characteristics of the instrument and therefore does not change the raw data coming from the instrument.
 ***** Only when used in conjunction with OnColor software do these results have validity. *****

Tilename	Actual Data				Correlated Data			
	DL*	Da*	Db*	DE	DL*	Da*	Db*	DE
B-1 GRAY	0.61	0.05	-0.21	0.65	0.00	-0.01	0.00	0.01
B-2 DEEP RED	-0.22	-0.07	-0.27	0.35	-0.17	-0.12	0.00	0.21
B-5 WHITE	0.59	0.02	-0.28	0.65	0.00	0.00	0.00	0.00
B-6 MID GREY	0.57	0.02	-0.22	0.61	0.00	0.01	-0.01	0.01
B-7 DEEP GREY	0.33	0.01	-0.21	0.39	0.00	0.01	0.00	0.01
B-8 BLACK	-0.09	-0.01	-0.13	0.16	0.00	0.00	0.00	0.00
B-9 YELLOW	0.60	0.17	0.76	0.99	0.08	0.19	0.28	0.35
B-10 DEEP GREEN	0.26	-0.23	-0.07	0.35	-0.16	0.10	-0.01	0.19
B-11 MID-BLUE	0.23	0.01	-0.17	0.52	-0.14	0.05	0.07	0.16
B-12 DEEP ORANGE-RED	-0.05	0.19	-0.06	0.20	-0.16	-0.19	-0.11	0.27
B-13 CYAN	0.55	-0.18	-0.49	0.76	0.02	-0.01	-0.18	0.19
B-14 DEEP BLUE	0.05	0.21	-0.56	0.60	0.05	-0.19	0.22	0.29
B-15 MID-ORANGE	0.65	0.37	0.54	0.92	0.19	0.40	0.37	0.57
B-16 DEEP ROSE PINK	0.34	0.34	-0.23	0.53	0.01	0.13	0.13	0.19
F-1 GREY 20%	0.39	-0.01	-0.21	0.44	-0.12	-0.02	-0.01	0.12
F-2 GREY 65%	0.61	0.04	-0.22	0.66	0.04	0.02	0.03	0.05
F-4 GREY 40%	0.42	0.07	-0.18	0.46	-0.13	0.03	0.01	0.13
F-5 GREY 80%	0.62	0.01	-0.27	0.68	0.04	-0.01	-0.03	0.05
F-8 LIGHT YELLOW	0.60	-0.01	-0.03	0.60	0.04	0.01	0.10	0.11
F-9 LIGHT PINK	0.45	0.19	-0.20	0.52	-0.07	0.17	0.10	0.21
F-12 LIGHT CYAN	0.53	0.00	-0.26	0.59	-0.05	0.02	-0.01	0.05
F-15 GREY 50%	0.60	0.03	-0.24	0.65	0.03	0.00	-0.02	0.04
F-16 GREY 33%	0.54	0.03	-0.24	0.59	-0.02	0.02	-0.04	0.05
S-2 DEEP VIOLET	0.02	0.04	-0.33	0.34	-0.06	-0.20	0.01	0.21
S-4 RED	0.11	0.27	-0.15	0.33	0.08	0.10	-0.01	0.13
S-5 YELLOW GREEN	0.54	0.01	0.25	0.60	0.02	0.03	0.01	0.04
S-6 PURPLE	0.22	0.23	-0.53	0.62	-0.06	0.00	0.02	0.06
S-7 YELLOW-ORANGE	0.51	0.13	0.61	0.91	0.00	0.15	0.14	0.21
S-8 GREENISH YELLOW	0.91	0.07	0.89	1.27	0.37	0.12	0.74	0.83
S-9 RED-ORANGE	0.30	0.40	0.20	0.54	0.00	0.23	0.12	0.26
S-11 DARK BLUE	0.38	0.08	-0.64	0.75	-0.07	0.21	-0.16	0.27
S-13 MID-GREEN	0.55	-0.11	-0.03	0.56	0.01	-0.07	0.03	0.08
Average DE			Actual -> 0.58				Correlated -> 0.17	

Certified by : _____ Name : _____

Date : 6/27/2008 9:45:10 AM

Typical Results

The table below shows typical results obtained using OnColor Profiler on several different models of spectrophotometers. Most of these instruments were installed at various sites and represent instruments of varying age and usage.

Master Instrument = CE7000A		Average DE between Master and Target on 32 Tiles	
Target instrument	Status	Before Profiling	After Profiling
CE XTS	SCI	0.35	0.20
CE 2180	SCI	0.24	0.15
CM-2002D	SCI	0.62	0.20
CM-2600D	SCI	0.65	0.27
CM-3600D	SCI	0.36	0.22
CM-3700D	SCI	0.39	0.24
CM-508D	SCI	0.50	0.37
CM-700D	SCI	0.45	0.19
CE i5	SCI	0.26	0.16
CE i7	SCI	0.49	0.18
SF600	SCI	0.58	0.17
CE XTS	SCE	0.36	0.22
CM-2002D	SCE	0.49	0.22
CM-2600D	SCE	0.85	0.22
CM-3600D	SCE	0.32	0.23
CM-3700D	SCE	0.37	0.25
CM-508D	SCE	0.96	0.32
CM-700D	SCE	0.37	0.18
CE i5	SCE	0.24	0.18
SF600	SCE	1.36	0.22

Differentiators

With several profiling software options available, technicians might be unsure of which is the best option for their organization. OnColor Profiler has several competitive differentiators that make it superior to other solutions. Profiler can be used with any make or model of spectrophotometer. While many profiling products work with only one brand of instrument, OnColor Profiler can be used on any spectrophotometer, regardless of its make or model. Profiler also has no yearly subscription fee or per-use fee, enabling users to profile as many instruments as often as needed. Once a user has purchased the software from CyberChrome, it can be used on an unlimited number of instruments for an unlimited number of years, making it the cost-effective choice.

OnColor Profiler does not change the optics or firmware of a spectrophotometer and it integrates seamlessly with the popular and reliable OnColor suite of software packages. In addition, no Internet connection is required to use OnColor

Profiler. Because many color labs purposefully lack Internet access, Profiler can be used without an Internet connection, making use simpler and more convenient for lab workers.

Benefits

The first module of OnColor Profiler's unique profiling method ensures accuracy and consistency of data regardless of the make or model of spectrophotometer. When using Profiler, the resulting measurements can easily be shared across departments, divisions and companies without concern about the confusion and chaos that can ensue when different spectrophotometers produce different data. By providing interchangeable color data, Profiler helps companies foster collaboration and cut down on time-consuming communications to determine which reading is correct. The precision of OnColor Profiler allows companies to meet exceedingly tight color tolerances while reducing the number of color-related complaints. Profiler improves the reliability of readings and virtually eliminates rejects that result from out of spec instruments.

Profiler's second module monitors instrument performance regularly and helps users determine if and when costly repair, service, or factory calibration are necessary instead of undertaking expensive maintenance when it may not be necessary, Profiler helps users diagnose issues with an instrument so that they may be handled in the proper manner without spending money when not necessary. By comparing an instrument to a master spectrophotometer, users can monitor if a target instrument is measuring color accurately and diagnose potential drift problems from dirt, aging or usage. Simple concerns can now be diagnosed and handled internally before making a costly repair call. In addition, users can compare instruments to other spectrophotometers in their supply chain, helping them to see what instruments don't agree or are performing marginally and may need to be repaired or replaced. This wizard also provides a certification report so that companies can now self-certify instrument performance to a master instrument.

The third module of OnColor Profiler allows user to convert legacy data into usable information. Readings from obsolete instruments are no longer obsolete themselves as Profiler can convert that stored data into the current platform. This function is particularly useful for instances in which the color standard no longer exists or the color has been irreparably changed due to misuse, damage, yellowing or aging. Data from any point in a user's supply chain can be converted into applicable statistics, meaning users don't need to worry about each point in the chain utilizing the same make and model of instrument. By converting legacy data into today's technology, Profiler reduces uncertainty and time spent on re-measuring samples and eliminates the concern that data stored on an obsolete instrument is lost forever.

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