

Color Management Concepts



Color Management Concepts

Color Science Hardware - Quantifying Colorimetric Data:

• Some of the Industries that Rely on Accurate Color



Building Materials

From the cement and concrete that make up the walls or flooring of a building, to vinyl siding for the exterior, the window frames and flat glass of the window itself, the carpet and flooring tiles and the grout used to hold them down, and even the roofing materials, leading building material manufacturers around the world need the quality and reliability of color science to provide consistency.

Cosmetics

Cosmetics come in a variety of hues and textures and advanced spectrophotometry offers quantifiable data which corresponds with the way color is viewed by the human eye. Creating consistent and reliable products ensures consumer satisfaction, but measure-ability of color cosmetics affects more than just the final product outcome. Color cosmetics are made up of a variety of chemical compounds that are carefully formulated together to create the perfect blend of color. The FDA (Food and Drug Administration) regulates many of the raw materials used in color cosmetics in order to ensure consumer safety. Spectrophotometry can be applied to these chemical compounds as well, and helps ensure compliance with these strict guidelines.

Spectrophotometry can also be applied to color cosmetics throughout the various stages of processing and development. With the ability to offer on-line color measurement data, these tools can provide valuable information regarding formulation errors that can occur during the early stages of production, saving both time and money in the long run. Final product analysis is also an important step in the quality control of color cosmetics. Spectrophotometers offer a quick and easy-to-use method of analysis.



Food

Food is not only an essential ingredient to life and the survival of a human being; it is also used to celebrate, calm and comfort, as much as to satisfy one's appetite. For food manufacturers and producers around the globe, maintaining consistency of the color of their food products is not only a statement about their product quality, it is a quality statement about their brand.

Packaging & Printing

Both the Packaging and printing markets have a long history with color, in fact they are all about color reproduction. Great focus has taken place over the last 50 years to the quality and color fidelity on the printing press from process separations, to photographic reproduction and special color packaging with specialty inks and including the papers as well.



Paint and Coatings

Latex, Oil, Acrylic and Automotive paint coating have undergone rigorous tests for ingredients, safety and durability. Many of the raw ingredients for the base paints undergo colorimetry testing for quality control tests and the mixing of the paint color pigments for the perfect color you need are based on over 70 years of color science.

Plastics and Polymers

From polymer pellets, plastic sheeting, to a wide variety of ophthalmic lenses and vision care materials, there are instruments for plastic's hard-to-measure color samples. Plastics industry professionals depend on the uncompromising color consistency that delivers from sample to sample and facility to facility.



Scientific Community

For many decades, science has relied on refractometers in gemstone identification, turbidimeters in water science, spectrum analyzers in physics, and various photometers for multitudes of experiments and verification of experiments. It has been science that has created the industry of photonics and science continues to refine and augment its capabilities.

Sporting Equipment

From the orange of a basketball, the neon green tennis balls and the color of the skis' brand and image are all about color consistency. There have been numerous studies done by many sports equipment manufacturers on the perfect color that consumers expect, use as a guide for quality, longevity and base purchasing decisions on color alone.



Textile Color Measurement

Unwoven fabric manufacturers standardized on colorimetry equipment to ensure color and material quality. Whether measuring shades of denim or apparel linings and carpeting, uncompromising color quality and reliability is expected by textile manufacturers.

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Color Science Hardware - Quantifying Colorimetric Data:

•Types or Classifications of Measurement tools

To read the color in all the mentioned processes, multiple tools are available. In the next few pages, we will cover some of the major ones.

Densitometers: A pressroom densitometer—the traditional and, until recently, the most widely used control element on press—measures light reflected off the press sheet. A pressroom densitometer or spectrodensitometer measures ink density on a color bar, providing feedback to the press operator as to how to adjust ink levels should density readings be too high or low. Proper density values are checked in each ink zone using a color bar or other areas of solid single-color ink.



Spectrophotometer: Color measurement devices used to capture and evaluate color. As part of a color control program, brand owners and designers use them to specify and communicate color, and manufacturers use them to monitor color accuracy throughout production. Spectrophotometers can measure just about anything, including liquids, plastics, paper, metal and fabrics, and help ensure that color remains consistent from conception to delivery. The spectral reflectance curve provided by a spectrophotometer is commonly known as the color's "fingerprint".



Spectrum Analyzer: A spectrum analyzer measures the magnitude of an input signal versus frequency within the full frequency range of the instrument. The primary use is to measure the power of the spectrum of known and unknown signals. The input signal that a spectrum analyzer measures is electrical, however, spectral compositions of other signals, such as acoustic pressure waves and optical light waves, can be considered through the use of an appropriate signals. Optical spectrum analyzers also exist, which break down frequencies of light into electronic signals, much like the eye, to display spectral characteristics.



Refractometer: an instrument for measuring a refractive index. Refraction is the bending of a wave when it enters a medium where its speed is different. The refraction of light when it passes from a fast medium to a slow medium bends the light ray towards the boundary between the two substances.



Turbidimeter: Turbidity is the measure of relative clarity of a liquid or opacity of a solid. It is an optical characteristic of water and is an expression of the amount of light that is scattered by material in the water when a light is shined through the water sample. The higher the intensity of scattered light, the higher the turbidity. Turbidity can be used as a guide for measuring the density of proteins in suspension to bacterial growth in water. It can play a key role in determining the purity, readiness and chemistry of samples. Some people refer to these as a Haze Meter.



Vectorscope: A vectorscope is a special type of oscilloscope used in both audio and video applications. Whereas an oscilloscope or waveform monitor normally displays a plot of signal vs. time, a vectorscope displays an X-Y plot of two signals, which can reveal details about the relationship between these two signals. Vectorscopes are highly similar in operation to oscilloscopes. Most Editing software programs have a software vectorscope built into them for calibrating color.



Note: Colorimetry equipment can also be broken down into the types of energy they can read like Infra-red, Human-Visual or Ultraviolet

Color Management Concepts

Color Science Hardware - Quantifying Colorimetric Data:

• Types of Color Readers - Hand Held/Portable Color Spectrometers

The introduction of hand held color readers has been fairly recent. Gretag Macbeth/X-rite have been a revolution to the Color Sciences industry with the ability to take the device anywhere and read color targets and spot checking color information.



Color QC at your Fingertips

A simple, reliable tool everyone can use to maintain an accurate, reliable color program. Setting and maintaining color standards throughout the manufacturing process is a daunting challenge. The eye test is no longer good enough. Basic colorimeters or color swatches aren't accurate enough. The newest generation of hand held color readers are very sophisticated and are designed to give the user completely accurate readings to match the human visual experience.

Almost all of these devices can be attached to a computer to run Color QC software and are easily programmed through a GUI interface. Furthermore they are easily calibrated and kept in spec for several years. Many offer additional adapters to be mounted on desktop robots to automate the reading of color targets, effectively giving them double duty as a hand held spot checker and a desktop Color Management device.

Advantages of hand held devices:

Increased Quality Control with quick and responsive tools
Allows measurements of up to 20 reference standards and store these on the device, each date and time stamped with the option to name them using the on screen keyboard. Hundreds of sample measurements can be stored on the device and compared to the reference standards.

They Can offer:

- Graphical Pass/Fail indicator
- Display of delta E for all common methods i.e. CIELAB, CMC, CIE 94, etc.
- Display of measured and differences with multiple standards and samples
- Graphical Color plots
- Opacity Checks
- Reflectivity
- Portable and easy to use
- Measurements for multiple materials like plastic, paper, textiles and stone.



Sekonic C-700 SpectroMaster
Designed to interface with photography lighting and camera setup, automating many tasks.



i1 Pro Hand Held
"Spectro" with stand. Designed to calibrate monitors, to take spot samples or hook up to a computer.



X-Rite Hand Held Imaging Spectrocolorimeter with Color Imaging Graphical Interface.

Color Management Concepts

Color Science Hardware - Quantifying Colorimetric Data:

• Types of Color Readers - Table Top/Bench-top Color Spectrometers

This class of spectrophotometers offer greater flexibility when measuring a sample's color or color difference as it would appear under different lighting conditions. In addition to routine quality control, these instruments are also well suited for research and process control applications.



Bench-top Colorimetry

These devices offer the ultimate in sample measurement precision and versatility. Whether your product is liquid or solid, powder or flake, smooth or textured, a bench-top system will provide the best solution to sample measurement needs. They offer greater flexibility when measuring a sample's color or color as it would appear under different lighting conditions. In addition to routine quality control, these instruments are also well suited for research and process control applications.



i10 Table top Scanner

The i1iO robot extends the power of your i1 Pro device by adding automated hands-free test chart reading capabilities on various substrates up to 10mm - from thin polybag material to ceramics and textiles. Simply plug in the i1Pro reader, align the test chart, and the scanning table is automated to read color targets, or can be programmed to do custom measurements using x-rites software.

Automated Scanning Table is ideal for creative professionals, photographers, prepress, corporate design, ad agencies, as well as for print for pay, fine arts, sign shops, textile printing, large format printing and high speed digital printing environments.

Also, they are pretty fun to watch too!



Stand Alone CM-5

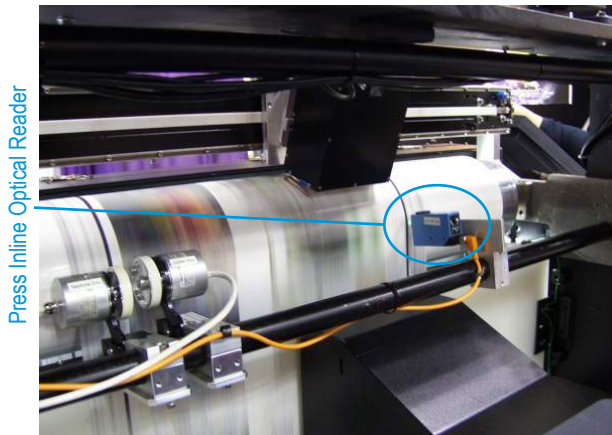
The CM-5 is a very versatile bench-top spectrophotometer to measure the color of solid, pasty granular and liquid samples. The top-port concept, offering various aperture sizes, allows measurement of almost any kind of samples. It is designed to work as a stand alone unit with no additional software.

Color Management Concepts

Color Science Hardware - Quantifying Colorimetric Data:

• Types of Color Readers - Online/Inline Manufacturing Color Spectrometers

On-line systems provide continuous, real-time measurement of your product on a process line. This allows you to respond to product color changes when they happen, as they happen. These types of Color Spectrometers are high speed, high capacity transmission readers designed for quality control, ease of use and instant feedback in the production process.



We have looked at hand held devices, desktop readers and now we move on to industrial process Online or Inline scanning photometers. These devices are designed to fit in with your manufacturing process and review the colorimetric data as it rolls through your industrial processes. These Inline readers can be further broken down into the categories of built in (an optional hardware integration) or third party integration.

Built in Units

These types of inline colorimetry devices will be offered by the manufacturer of the equipment as a optional way to augment and further speed up the process of Quality control during the production cycle. They will often have additional control over the manufacturing equipment in either a manual or automated fashion to keep the processes in check easily. An excellent example of this, is a built in camera reader on a printing press that will check the printed sheets based on the criteria of the press crews input. It will adjust the ink keys to within tolerance for color fidelity, help keep the press cylinders in registration, and warn the crews of any problems it detects.



Your Consumer Brand Ink-jet Printer

Another example is your home ink-jet printer. If you have ever run it through a setup after installing new inks, it will self calibrate the ink head and print out a form to show you. It is actually checking itself with a built in camera. Many Professional series plotters offer a built in photospectrometer to calibrate the plotter internally to ICC profiles.

Third Party Colorimetry

It is often the case, that a manufacturer has purchased the equipment it needed at the time to produce its products, before there was a case to include color tracking quality control steps. Over time it became evident that the additional QC was not available to its current equipment, or the option provided by the equipment manufacturer were overly costly to implement or didn't do the needed job. This is when various third party solutions step in to fulfill the need. Quite often, these industrial color control systems can integrate directly with the equipment, or they provide instant feedback to the operations crews for manual adjustments. They can be self contained systems that need no additional software/hardware to operate, or they plug into a computer/software package to track the data and keep the records for the production processes needed.



Above: Graphic Vision's 500 Series third party integrated system designed to be a complete hardware/software solution for visually tracking packaging and labeling QC. It will visually compare thousands of images per second to a standard and warn the operators of any differences to that standard in color and data content. It also records this data in its own database.



Left: Tricolor Systems Colorimetric High Density Camera Reader designed to provide color recognition and scanning photography information to a computer system. It is essentially a networked device that plugs in with controlling software that can be configured for multiple tasks.

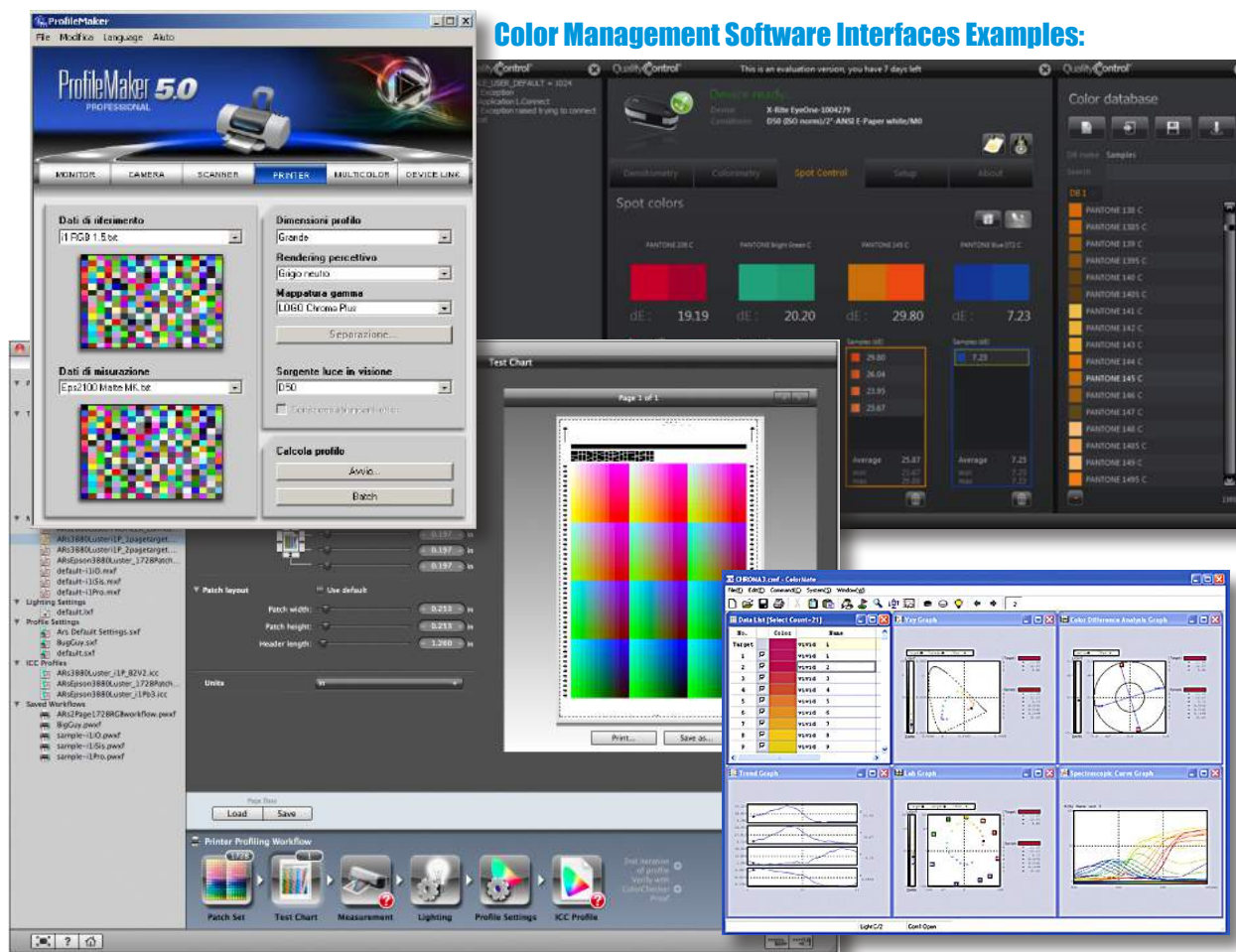
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• Types of Color Readers - Color Matching Software

I would be remiss not to include the software that is the bases for controlling all these devices that allows the end users to calibrate, control and generate the color profiles for all color reproduction devices and manufacturing processes.

Color Management Software Interfaces Examples:



Color Calibration Software

All the Hardware that we have discussed is excellent at taking the color targets and samples and converting them into hard analytical data. That in itself is very useful for process control, but without the software to really drive the devices to communicate a vast amount of data back to us, all they really do is take samples of points and maybe graph some of it.

Color Management software allows you to tap the potential of these devices and complete the steps of defining the complete color space of a device or product. They will allow you to adjust your internal processes to any standard you need to hit and allow you to gain feedback in an ongoing basis. They can also allow you to create the color profiles you need to define a device and calibrate it to your standards, read color targets with hundreds of color patches, track spot color patches and keep your devices in calibration over time. It is just as essential as the hardware device(s) you may use for color management.

Good Color Software will:

- Automate the Reading of Color Targets
- Generate ICC Color Profiles
- Define Color Gamuts
- Track Color Device Performance
- Help keep Devices in Check
- Create Device Links for Your Workflow
- Keep your Device Color Expectations