Application Note

AN 1031.01

Identification of Measurement Parameters

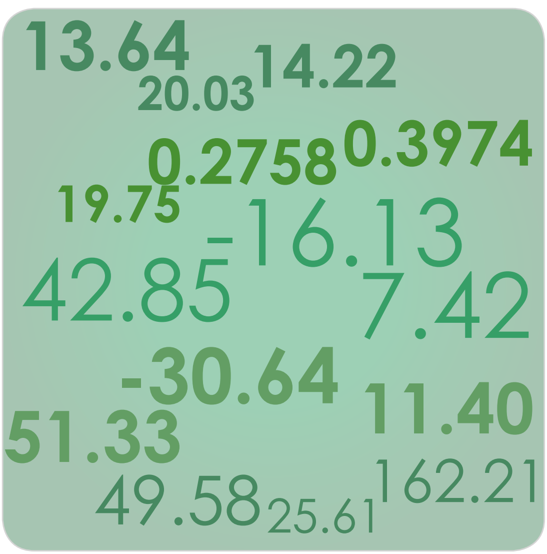


Figure 1. The same sample was measured at 5 different sites. What color is it?

ABSTRACT

In a physical measurement of weight or volume, there is only one measurement parameter that can affect the measured values - the expression of metric or American standard units to accompany the number.

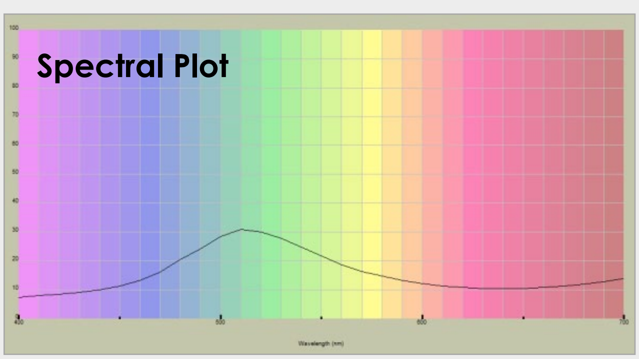
In a psycho-physical measurement that quantifies the human perception of color, a complete color quantification is always 3 numbers with 6 measurement parameters. Changing any parameter will affect the color numbers. The first step is to clearly define those parameters.

The world's true measure of color

HunterLab

1. ***Color Scale*** *- One of the confusing aspects of colorimetry compared to other measurement sciences is the many color scales developed at different times in color science history. A complete color scale consists of 3 numbers but there are 5 different color scales in active use for expressing those values - CIE X, Y, Z; CIE Y, x, y; Hunter L, a, b; CIE L*, a*, b* and CIE L*, C*, h. The values will be different depending on the scale used. Most people use one of the two L,a,b-type color scales - Hunter L, a, b or CIE L*, a*, b*. If you are unsure which color scale to use, choose CIE L*,a*, b*. Are these numbers expressed in absolute values (L*, a*, b*), or differences (delta L*, delta a*, delta b*, delta E*) relative to a product standard? It is also necessary to clearly identify any special single metrics used for quantification of selected attributes of whiteness (WI), brightness (Y or Z%) or yellowness (YI).*
2. ***CIE Illuminant*** *- There is a choice of several illuminants - A (representing tungsten or home light), F02 (cool white fluorescent or office light), C (average daylight) and D65 (noon daylight) are the most common. If unsure which to use, choose D65.*
3. ***CIE Standard Observer*** *- You have choices of the 1931 2 Degree or the 1964 10 Degree Standard Observer. Both are very similar but not the identical. If unsure which to use, choose the 1964 10 Degree Standard Observer.*
4. ***Instrument Geometry*** *- The geometry of an instrument used for light and color measurement defines the relative positions of the major components - light source, sample plane and detector. There are two general categories of fixed instrument geometries - directional 45°/0° or 0°/45° instruments, and diffuse/8° sphere instruments. The appropriate instrument geometry to use is dependent on the type of sample - opaque non-metal, metal, translucent or transparent.*
5. ***Sample Preparation*** *- How is the sample prepared prior to measurement? To attain the best inter-instrument agreement at all sites, sample preparation must be thesame at all sites.*
6. ***Sample Presentation*** *- What is the area of sample view at the measurement port, method of positioning the sample, number of readings averaged, measurement pattern, etc.? This must be the same to attain the best inter-instrument agreement.*

Site	Color Values			Color Scale	Illuminant	Observer	Instrument Geometry and Mode
1	13.64	20.03	14.22	CIE X, Y, Z	D65	10°	Directional 0/45 reflectance
2	19.75	0.2758	0.3974	CIE Y, x, y	C	2°	Directional 0/45 reflectance
3	42.85	-16.13	7.42	Hunter L, a, b	F2	10°	Directional 0/45 reflectance
4	51.33	-30.64	11.4	CIE L*, a*, b*	D50	2°	Directional 0/45 reflectance
5	49.58	25.61	162.21	CIE L*, C*, h	A	10°	Directional 0/45 reflectance



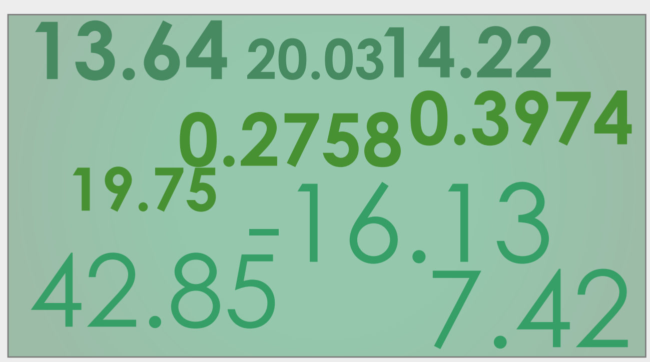


Figure 2. The measurement was the same at all sites, but the color values are different. To match the color values, first identify the color measurement parameters and make them the same.

If your measurement methodology is clearly identified to include the 6 parameters above you will be able to communicate numerical color values effectively to other sites so they can replicate your measured values.

Site	Color Values			Color Scale	Illuminant	Observer	Instrument Geometry and Mode
1	51.87	-30.52	15.05	CIE L*, a*, b*	D65	10°	Directional 0/45 reflectance
2	51.87	-30.52	15.05	CIE L*, a*, b*	D65	10°	Directional 0/45 reflectance
3	51.87	-30.52	15.05	CIE L*, a*, b*	D65	10°	Directional 0/45 reflectance
4	51.87	-30.52	15.05	CIE L*, a*, b*	D65	10°	Directional 0/45 reflectance
5	51.87	-30.52	15.05	CIE L*, a*, b*	D65	10°	Directional 0/45 reflectance

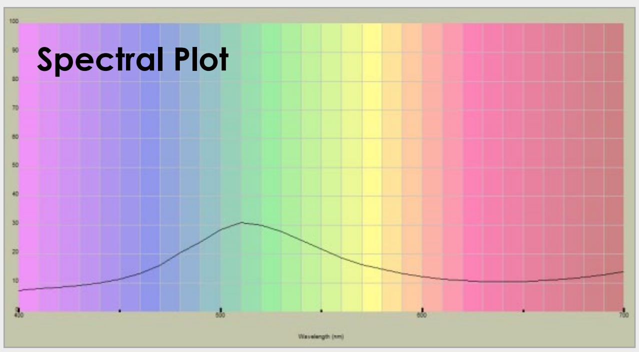


Figure 3. To communicate color values effectively, the reporting parameters must first be the same at all sites. When this is done, the same color measurement becomes the same color values at all sites.

Once everyone understands this concept of making the parameters the same for inter-instrument agreement and effective communication, it is possible to shorten the form to something that will fit in a few lines on a spec sheet, **such as: CIE L*, a*, b* target and tolerances, D65°/10°, 45°/0° geometry, sample preparation, sample presentation including area of view and number of readings to average.**

The best inter-instrument agreement in absolute color values is achieved using the same model of instrument with the same measurement method implemented at all sites.

If some of the parameters are not the same, this can be overcome by reading in a physical product standard on each instrument and a tolerance based on an acceptable color difference from that physical product standard. Instruments of the same geometry should agree on absolute differences from a physical standard, even if they don't agree exactly on absolute color values.

If you still need to see agreement in absolute values, the hitching feature can be used as a last resort after aligning all of the 6 parameters of the measurement method as closely as possible.

More Information about Color Measurement on our HunterLab Blog

measuretruecolor.com

ABOUT HUNTERLAB

HunterLab, the first name in color measurement, provides ruggedly dependable, consistently accurate, and cost effective color measurement solutions. With over 6 decades of experience in more than 65 countries, HunterLab applies leading edge technology to measure and communicate color simply and effectively. The company offers both diffuse/8° and a complete line of true 45°/0° optical geometry instruments in portable, bench-top and production in-line configurations. HunterLab, the world's true measure of color.

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