Applications Note

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Maximizing Inter-instrument Agreement

Customers often ask HunterLab Applications Specialists how they can make readings of their samples taken with several different HunterLab instruments—often at different locations—correlate more closely. They would love to wave a magic wand and bring the instruments into perfect alignment, but unfortunately inter-instrument agreement is actually quite a complex topic. The answer to the question is that they need to standardize how those measurements are made on all instruments at all sites.

There are six parameters that affect the color values obtained from an instrument. They are:

1. The **color scale** being reported
2. The CIE **illuminant** being used to calculate the color values
3. The CIE standard **observer** being used to calculate the color values
4. The **instrument type, geometry, and standardization mode**
5. The method of **preparing** the samples
6. The method of **presenting** the samples to the instrument.

When any one or more of these parameters is changed, the resulting color values also change. Said another way, if two different sites or users vary any of these parameters, the color values cannot be expected to agree. **The best inter-instrument agreement in terms of absolute color values will always be found using the same model of instrument from the same manufacturer with all of the six parameters matching at all sites.**

As an example, consider a company with a ColorFlex 45/0 at one plant and a D25A DP-9000 at another plant. Each plant is reading powder samples and comparing the color values to an absolute color specification. The table below shows each of the six parameters for the two plants.

Plant	A	B
1. Color Scale	CIE L*a*b*	CIE L*a*b*
2. Illuminant	D65	C
3. Observer	10°	2°

Plant	A	B
4. Instrument Configuration	ColorFlex, circumferential 45°/0°, xenon flash lamp, reflectance	D25A, bidirectional 45°/0°, tungsten lamp, reflectance
5. Sample Preparation	Dry sample for 8 hours and grind to fine powder with no lumps	Dry sample for 8 hours and grind to fine powder with no lumps
6. Sample Presentation	Scoop into glass sample cup and read once through glass bottom of cup.	Press into a smooth plaque and measure once at open sample port with port down.

Let's compare the parameters for the two plants and discuss how we might make them correlate as closely as possible.

1. **Color Scale** - The same for both plants. Good.
2. **Illuminant** - No match. Since only the C illuminant is available for the D25A, we should use C at both plants.
3. **Observer** - No match. Since only the 2° observer is available for the D25A, we should use 2° at both plants.
4. **Instrument Configuration** - The models are not the same. Both have a 45°/0° geometry, through the means of illumination and the type of lamp are slightly different. If the two instruments have already been purchased, we will not be able to completely standardize this parameter. If we were starting from scratch, we would choose one instrument model or the other and purchase the same for both plants.
5. **Sample Preparation** - The same for both plants. Good.
6. **Sample Presentation** - No match. However, plant A feels strongly that pressing a plaque takes too much time, so plant B should switch to the sample cup presentation method.

Once these parameters are standardized as much as possible, the next step is to establish how different the readings are at the two plants. A single standard tile could be sent around as a round robin and read on both instruments. However, it would be better if a stable powder sample could be used. Compare the readings. If the difference you are seeing between sites is not acceptable, you have two options for reconciling the problem:

1. Read a physical product standard on each instrument and establish a new tolerance specification based on differences from that product standard. Instruments of the same geometry should agree on difference values from a physical standard, even if they don't agree exactly on absolute color values.
2. Establish a separate absolute color specification for each instrument/site by reading acceptable, borderline, and out-of-spec samples of your product (as established visually) on each instrument.

If you absolutely must see measurements in absolute values and must use the same specification at all sites, you can use the hitching feature available on all HunterLab systems *as a last resort* after aligning all of the six parameters as closely as possible. Note that hitching is not recommended for instruments with different geometries.

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