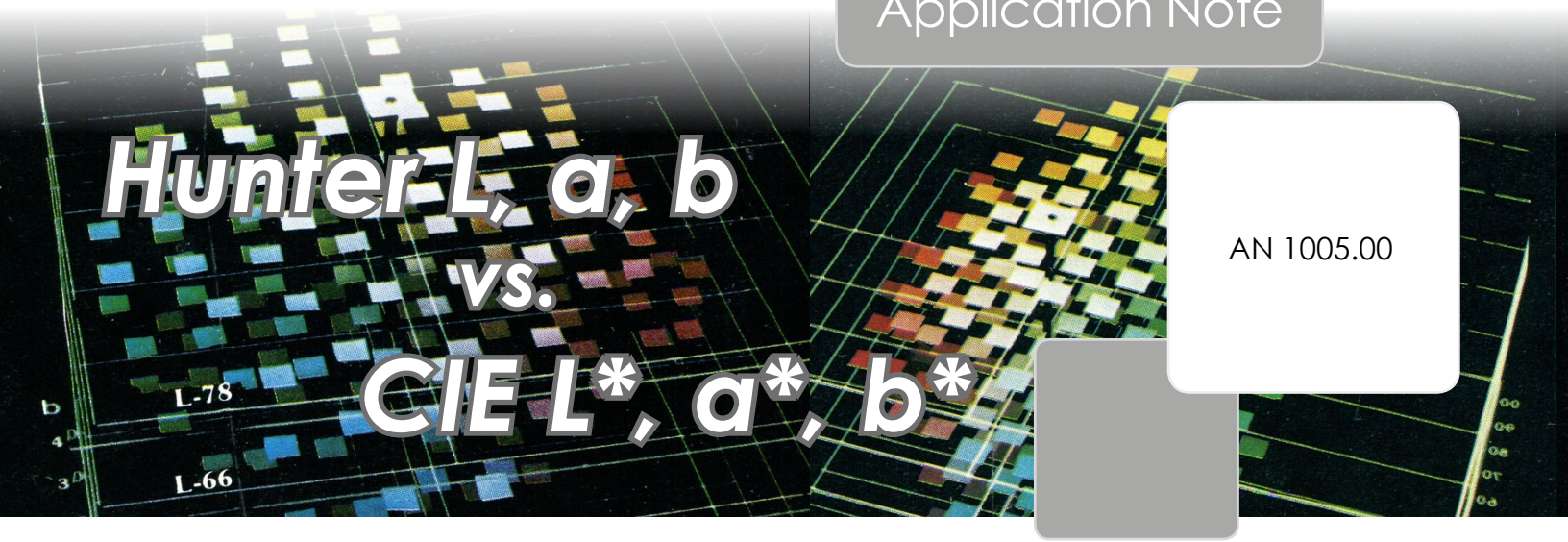


Application Note

Hunter L, a, b vs. CIE L*, a*, b*

AN 1005.00

Measuring Color using Hunter L, a, b versus CIE 1976 L*a*b*

"The L,a,b scales rise above language barriers enabling companies to easily communicate color and color differences."

ABSTRACT

Both the Hunter L, a, b scale and the CIELAB scales are intuitive. The use of these color scales with practice can easily lead to understanding and communication of color values.

This application note discusses the advantages of each scale so that the user may choose the best one to use.

The world's true measure of color

HunterLab

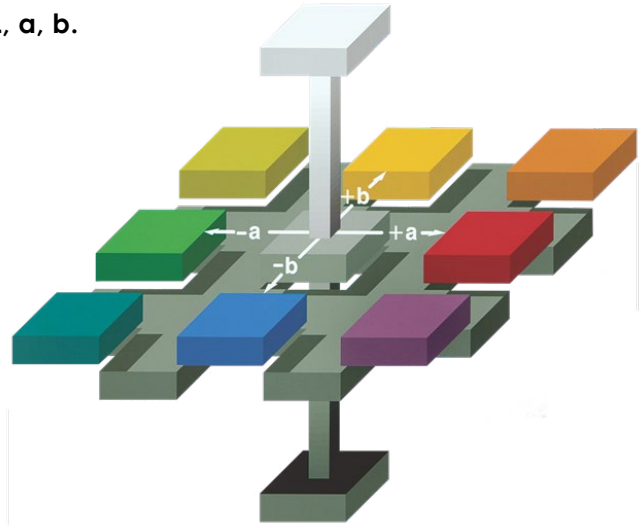
CHALLENGE: To choose the best color scale for the measurement.

Hunter L, a, b and CIE 1976 L*a*b* (CIELAB) are both color scales based on the Opponent-Color Theory. This theory assumes that the receptors in the human eye perceive color as the following pairs of opposites.

- L scale: Light vs. dark where a low number (0-50) indicates dark and a high number (51-100) indicates light.
- a scale: Red vs. green where a positive number indicates red and a negative number indicates green.
- b scale: Yellow vs. blue where a positive number indicates yellow and a negative number indicates blue.

The L value for each scale therefore indicates the level of light or dark, the a value redness or greenness, and the b value yellowness or blueness. All three values are required to completely describe an object's color. A three-dimensional representation of L, a, b color space is shown below.

Figure 1. Opponent Color Scales of L, a, b.



HUNTER LAB

The Hunter L, a, b color scale evolved during the 1950s and 1960s when many scientists involved with color measurement were working on uniform color scales. There were several permutations of the Hunter L, a, b color scale before the current formulas were released in 1966.

The Hunter L, a, b color scale is more visually uniform than the CIE XYZ color scale making it more easily understood and communicated. Below is a diagram of the Hunter L, a, b color space.

The delta values (ΔL, Δa, and Δb) indicate how much a standard and sample differ from one another in L, a, and b. The ΔL, Δa, and Δb values are often used for quality control or formula adjustment. Tolerances may be set for the delta values. Delta values that are out of tolerance indicate that there is too much difference between the standard and the sample.

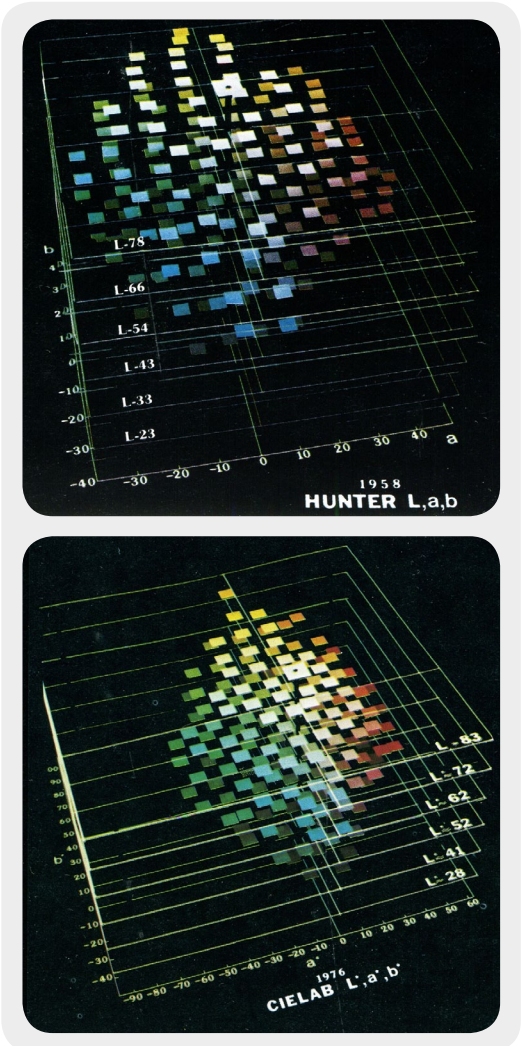


Figure 2. 3D Comparison of Hunter L, a, b vs. CIE L*a*b*.

The type of correction needed may be determined by which delta value is out of tolerance. For example, if Δa is out of tolerance, the redness/greenness needs to be adjusted. Whether the sample is redder or greener than the standard is indicated by the sign of the delta value. For example, if Δa is positive, the sample is more red than the standard.

The total color difference, ΔE, may also be calculated. ΔE is a single value that takes into account the differences between the L, a, and b of the sample and standard. It does not indicate which parameter is out of tolerance if ΔE is out of tolerance. It may also be misleading in some cases where ΔL, Δa, or Δb is out of tolerance, but ΔE is still within the tolerance.

The Hunter L, a, b color scale can be used on any object whose color may be measured. It is not used as frequently today as it was in the past because the CIE L*a*b* scale, which was released in 1976, has gained popularity.

CIELAB

The CIELAB color scale is another uniform color scale recommended by the CIE in 1976 to improve on the 1966 version of the Hunter L, a, b. It is in wide spread use today in many industries.

As with HunterLab, this color scale can be used to determine color differences (sample minus standard) for ΔL, Δa, Δb and ΔE.

WHICH SCALE SHOULD I USE?

The formulas are calculated differently with Hunter L, a, and b using square roots and using CIELAB is calculated using cube roots of CIE XYZ.

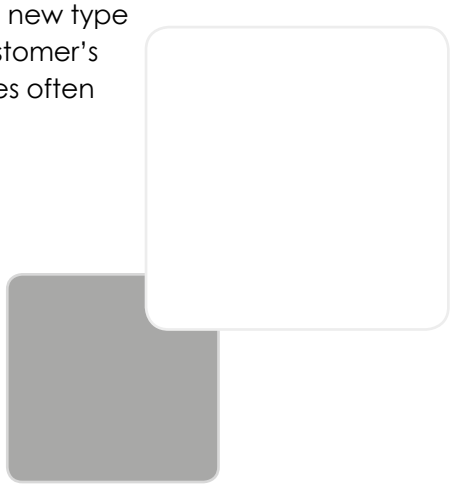
The perfect color scale would be uniform throughout color space, meaning that a one unit difference between two colors would appear to be visually different by the same amount whether red, purple, orange, or blue. In truth, neither Hunter L, a, b nor CIELAB is perfectly uniform. The Hunter L, a, b scale contracts in the yellow region of color space and expands in the blue region. The CIELAB scale, is a bit expands in the yellow region and this is more obvious when a sample's CIE Z value is less than one. The CIELAB scale generally gives better approximation to visual evaluation of color difference for very dark colors.

TABLE 1. CRITERIA FOR COMPARISON HUNTER L, A, B TO CIE L*A*B*

Criteria	Hunter L, a, b	CIE L*a*b*
Mathematical Function	Square root function of CIE XYZ	Cube root function of CIE XYZ
Specifications or Methods	Color specifications or methods indicate Hunter L, a, b such as in the food industry	Color specifications or methods indicate CIELAB
Frequency of Use	Used less frequently	Widespread use
Comparison to Previous Data	Historical color data was recorded in Hunter L, a, b	Historical color data was recorded in CIELAB
Color Space Sensitivity	Measuring blues more than yellows	Measuring yellows more than blues and dark colors

CONCLUSION

Both color scales are good selections when looking for a new method for a new type of sample. If a color measuring instrument is being requested to meet a customer's requirement, then the customer may have a preference of scales. Industries often have specific requirements as spelled out in ASTM methods and more.



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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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