APPLICATIONS NOTE

HunterLab
The Color Management Company

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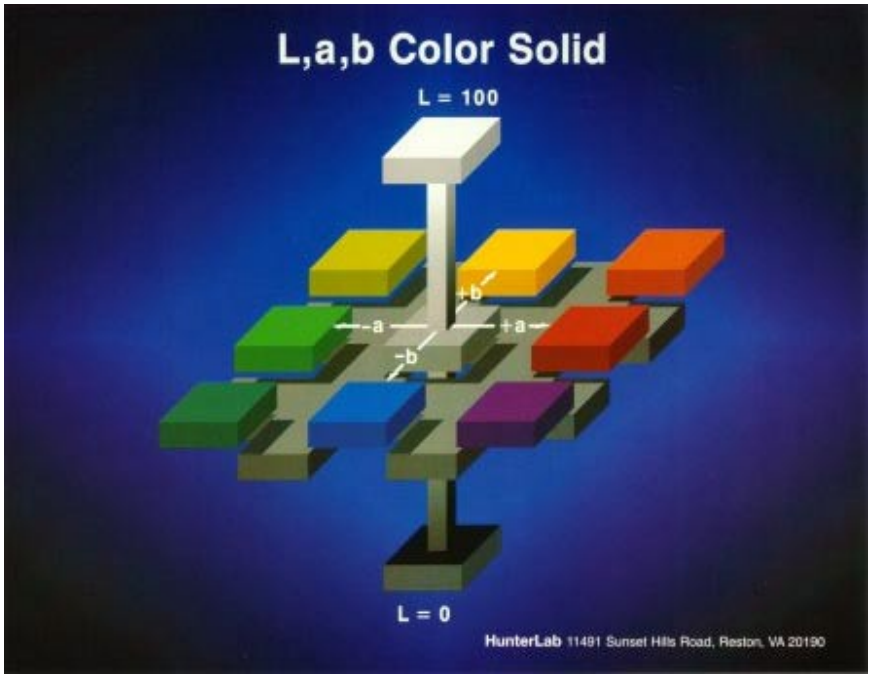
# Hunter L, a, b Versus CIE 1976 L*a*b*

## How Do They Compare?

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

- Light-dark
- Red-green
- Yellow-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.

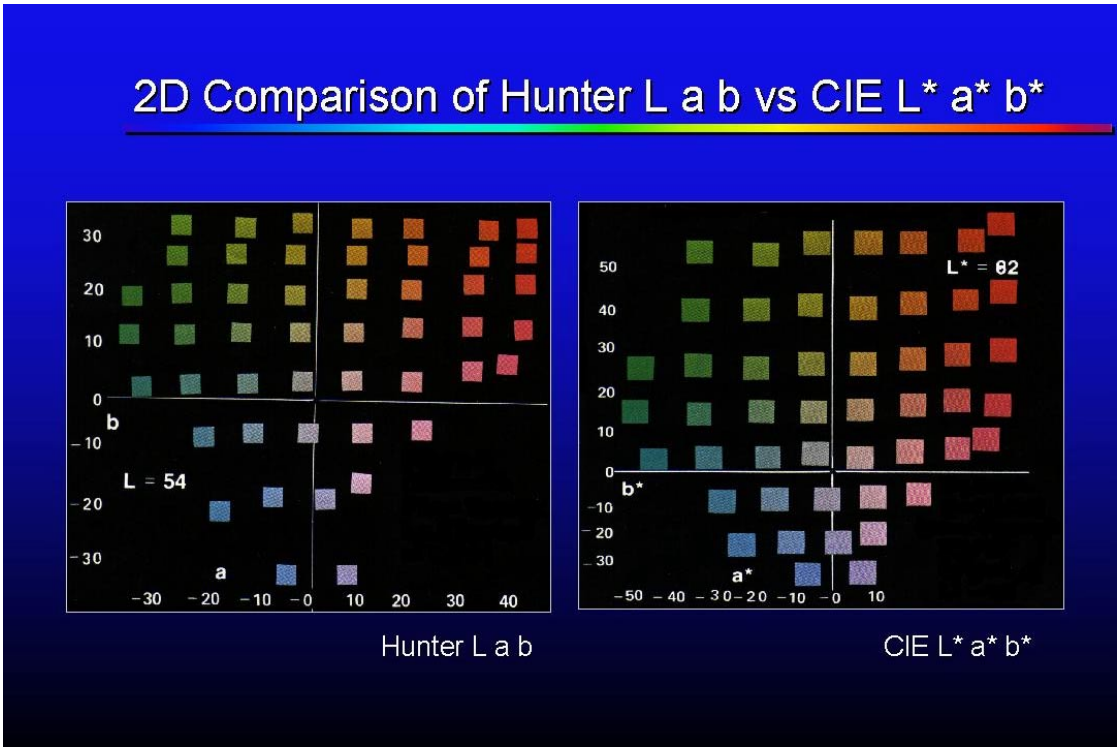


Both the Hunter L, a, b scale and the CIELAB scale are visually meaningful; the three values can be easily understood and translated into color. They are, however, calculated differently. The formulas for Hunter L, a, and b are square roots using CIE XYZ, whereas CIELAB is calculated using cube roots of XYZ. See the July 1-15, 1996 and August 1-15, 1996 *Applications Notes* for the formulas and more specific information about the two scales.

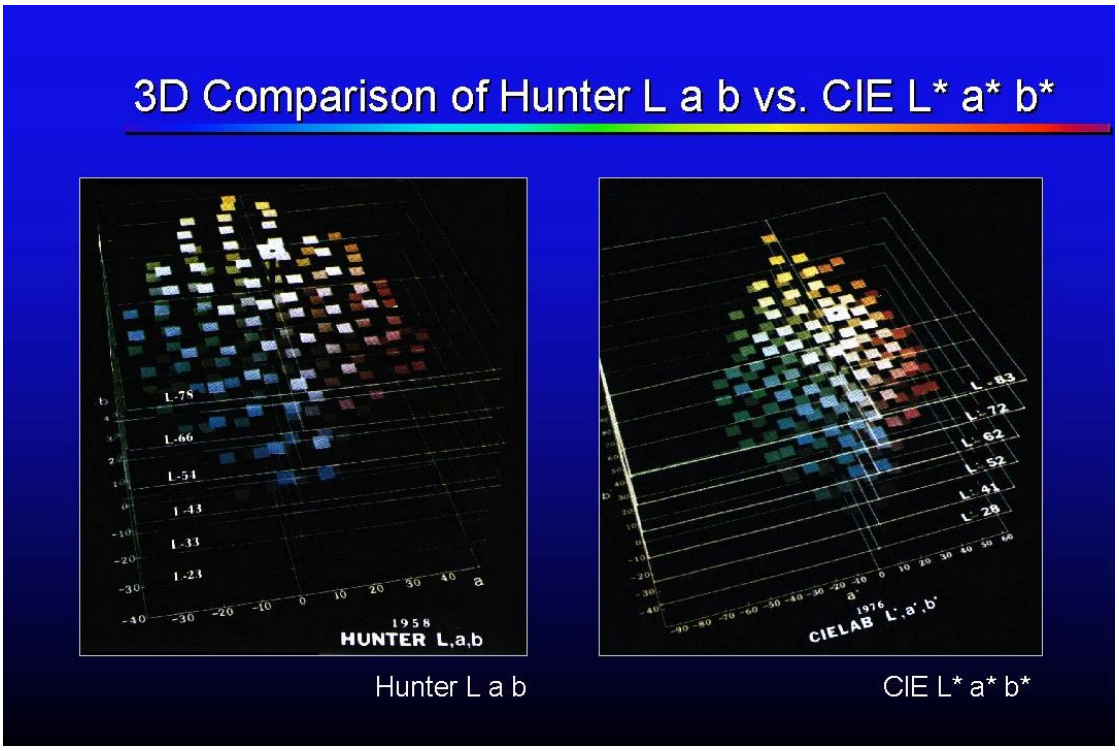
## Which Scale Should I Use?

So, which scale is best for you to use? Well, the CIE recommended the CIE 1976 L*a*b* scale in 1976 (Supplement No. 2 to CIE Publication No. 15, *Colorimetry*) as a improvement to the final version of Hunter L, a, b that was published in 1966, so if you wish to conform to this recommendation, use CIELAB, but as far as accuracy and descriptive value, neither Hunter L, a, b nor CIELAB clearly wins out as the better scale. Ideally, the scale used would be perfectly 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. However, 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 overexpands in the blue region. On the other hand, the CIELAB scale, although designed specifically to be more uniform, is still a bit over-expanded in the yellow region. This is a problem particularly 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, though, because its equations are cube roots.




**The colored squares are more evenly spaced on the CIELAB charts above and on the next page.**




Specific recommendations are outlined in the table below.

| Use Hunter L, a, b when: | Use CIELAB when: |
|---|---|
| Pre-established specifications indicate Hunter L, a, b or measurements will be compared to ones made using the Hunter L, a, b scale. In this case, the scale you use is less important than being consistent in using the same scale for all the measurements being shared. (The food industry, for example, often specifies Hunter L, a, b, so most communication of results within this industry will be done using this scale.) | Pre-established specifications indicate CIELAB or measurements will be compared to ones made using the CIELAB scale. In this case, the scale you use is less important than being consistent in using the same scale for all the measurements being shared. |
| Historical color data was recorded in Hunter L, a, b. | Historical color data was recorded in CIELAB. |
| | You wish to conform to CIE's color scale recommendation. |
| | The best possible uniformity across color space is desired. |
| | You are measuring very dark colors. |

| Use Hunter L, a, b when: | Use CIELAB when: |
|---|---|
| | You are establishing a new measurement procedure, including indicating the color scale, and neither of the "Use Hunter L, a, b when" factors apply. |

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