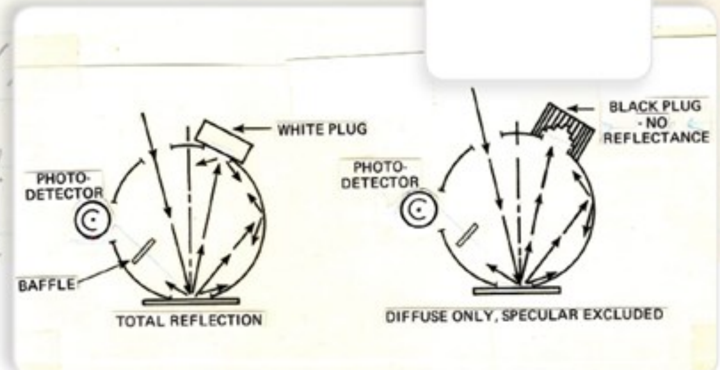
Applications Note

AN 1077



Using Tint Indices

. . . application of the tint indices is restricted to samples that are called "white". . .

Abstract

Tint indices are biased in the red-green dimension and describe the amount of greenish or reddish tint in products that are close to perfect white. Negative tint values indicate a reddish cast (slightly positive a*), while positive tint values indicate a greenish cast (slightly negative a*). The tint indices are highly sensitive to color change, and make it easy to quantify very small lot-to-lot differences between white materials. There are three types of tint available using HunterLab instruments: CIE Tint, ASTM E313 Tint, and Ganz Tint. These indices are companion indices to the CIE Whiteness, ASTM E313 Whiteness, and Ganz Whiteness indices, respectively.

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Background

By definition, the theoretical "perfect white" has reflectance values of 100% across the visible spectrum with corresponding colorimetric values of L* = 100.00, a* = 0.00, and b* = 0.00. If a white item is near, but not perfectly, white, it may be darker (have a lower L* value), and possibly be slightly chromatic, either in the red-green dimension (a*) or in the yellow-blue dimension (b*).

The whiteness indices (described in the *Applications Note* entitled "Whiteness Index") are biased in the blue-yellow dimension, such that higher whiteness index values are obtained if the white material is lighter or slightly bluer than the perfect white, and lower whiteness index values are obtained if the white material is darker or slightly yellower than the perfect white.

As a supplement, tint indices are biased in the red-green dimension and describe the amount of greenish or reddish tint in products that are close to perfect white. Negative tint values indicate a reddish cast (slightly positive a*), while positive tint values indicate a greenish cast (slightly negative a*). The tint indices are highly sensitive to color change, and make it easy to quantify very small lot-to-lot differences between white materials. There are three types of tint available using HunterLab instruments: CIE Tint, Tint Ganz and ASTM E313 Tint.. These indices are companion indices to the CIE Whiteness, ASTM E313 Whiteness, and Ganz Whiteness indices, respectively.

Conditions for Measurement

Instrumental: All HunterLab Instruments. Tint GANZ available only for Agera, UltraScan PRO, and UltraScan VIS with the UV control option installed);

Illuminant/Observer Combinations (as available in HunterLab software and firmware): The combination that is common to all test organizations is D65/10° and this combination is recommended if there are no conflicting requirements

ASTM E313 Tint: D65/10°, D65/2°, C/10°, C/2°, D50/10°, D50/2°

CIE Tint: D65/10°, D65/2°, C/2°

Ganz Tint: D65/10°

Transmittance and/or Reflectance: Reflectance

Formulas

The three tint indices are defined below.

CIE Tint and ASTM E313 Tint are calculated using the same equation, given below, but are available for different illuminant/observer combinations, as described above. Refer to CIE Publication 15:2004, *Colorimetry*, for more information on CIE Tint. Refer to ASTM E313, "Standard Practice for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates," for more information on ASTM E313 Tint.

$$\text{Tint E313} = T_x\,(x_n - x) - 650\,(y_n - y) = \text{Tint CIE}$$

Where, x and y are the chromaticity coordinates of the specimen and x_n and y_n are the chromaticity coordinates for the CIE standard illuminant used. These values are provided in the table below based on the illuminant and observer used. The T_x coefficient is also given in the table. The tint value is not calculated for any other illuminant/observer combinations.

Value	C/2°	D50/2°	D65/2°	C/10°	D50/10°	D65/10°
T_x	1000	1000	1000	900	900	900
X_n	0.3101	0.3457	0.3127	0.3104	0.3477	0.3138
Y_n	0.3161	0.3585	0.3290	0.3191	0.3595	0.3310

Tint GANZ = mx + ny + k

Where,

$$m = \frac{-\cos(\alpha)}{BW} = -937.588$$

$$n = \frac{\sin(\alpha)}{BW} = 826.697$$

$$k = -m\bar{x} - n\bar{y} = 21.352$$

x and y are the CIE chromaticity coordinates.

Typical Applications

Products that can be considered white, such as paint, plastics, paper, and textiles.

A few caveats regarding measurement of tint:

- The application of the tint indices is restricted to samples that are called "white" commercially, that are similar to each other in color and fluorescence, and that are measured on the same instrument at the same time. Under these conditions, their use should give relative, but not absolute, evaluations of tint that are adequate for commercial use.
- The more positive the value of tint, the greater is the indicated greenish tint of the sample. The more negative the value of tint, the greater is its reddish tint. Lines of equal tint are approximately parallel to the line of dominant wavelength 466 nm. For perfect white, tint = 0.
- Equal differences in tint values do not always represent equal perceptual differences in tint.
- Tint index should only be used for samples having tint values between -3 and +3. Outside this range, the chromatic content is considered to be beyond where tint can be used effectively and L*a*b* should be reported instead.

References

AATCC Test Method 110, "Whiteness of Textiles," AATCC, Research Triangle Park, North Carolina, www.aatcc.org.

ASTM E313, "Standard Practice for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates," ASTM, West Conshohocken, Pennsylvania, www.astm.org.

CIE Publication 15:2004, *Colorimetry*, 3rd ed., CIE, Wien, Austria, www.cie.co.at.

Griesser, Rolf, "Assessment of Whiteness and Tint of Fluorescent Substrates with Good Interinstrument Correlation," *Color Research and Application*, **19**:6, 1994.

About HunterLab

HunterLab is the technology leader in color measurement solutions, providing instruments, software, knowledge and service to a wide variety of industries.
With over 5 decades of experience in more than 65 countries, HunterLab applies our leading edge technology to your products helping you measure and communicate color simply and effectively.

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