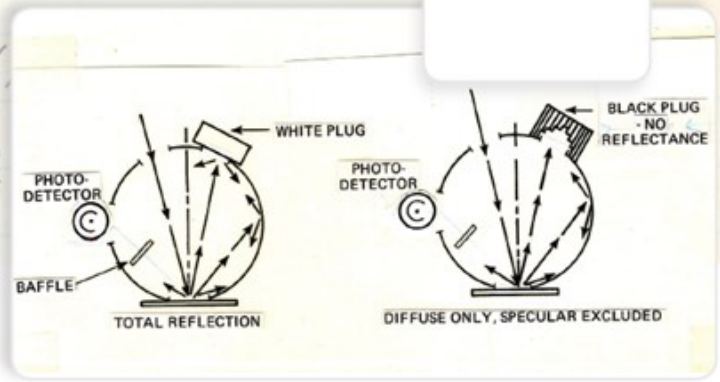
Applications Note

AN 1110



Human Color Vision Testing

1 in 12 men and 1 in 200 women are affected by 'color blindness'.

Abstract

A person with normal color perception equivalent to the CIE standard observer is called a normal trichromat, that is, a person with average red, green, and blue color perception. A person with defective or variant color vision is missing one of these three color sensitivities. Color deficient persons can be further subdivided into protans (red deficient), deutans (green deficient), and tritans (blue deficient). The more familiar term, *color blind*, is a misnomer, as few people perceive no color at all.

The world's true measure of color
HunterLab

Dichromats are those persons with only two of the three color sensitivities. The most common dichromatic deficiency (found in roughly eight percent of Caucasian males and one percent of females)[1] is an inability to discriminate between colors in the red-green region of the spectrum. The inability to discriminate between colors in the blue-green spectral region also occurs but is rare.

In addition to those persons with a deficient or missing color sensitivity, there are those people with *anomalous* color vision such that they have a red, green, and blue visual perception which is greater or less than that of the general population. For example, people with anomalous trichromatic vision may have a red color perception that is lower than normal. They still perceive red, but not to the degree of people with normal trichromatic vision. Anomalous trichromats are not easy to diagnose, as they often have developed adaptive visual techniques to compensate for their perceptual imbalance. In making judgments on fine color differences for some colors, their ratings may consistently differ from those with normal color vision.

Color Discrimination

Color discrimination is independent of color deficiency, so it is possible for some color normal persons to have poor color discrimination. Likewise, those with variant color vision can have good or poor color discrimination ability[2].

Color Vision Tests

Tests have been developed for diagnosing color deficiencies and for assessing color discrimination ability. Each of these tests was designed to examine a specific characteristic of color vision and the results are valid only if the test is conducted correctly. For a complete description of the color vision tests and their validation, there is a government document produced by National Research Council[3] entitled *Procedures for Testing Color Vision* that is recommended reading.

Source: U.S. Department of Commerce National Technical Information Service
5285 Port Royal Road, Springfield, VA 22161
TEL: (703) 487-4600.

Color Deficiency Tests

Pseudo-isochromatic plates, color vision lanterns, and anomaloscopes isolate certain factors indicative of color deficiency. The Dvorine Pseudo-Isochromatic Plates, the Farnsworth Dichotomous Test, the HRR Pseudoisochromatic Plates, and the Ishihara Color Plates Test are simple tests used for detecting color deficiencies based on differentiating a set of figure-ground relationships. For example, a red-green normal observer would see the number 48 in the picture below where the background is green and the number is red. A red-green deficient individual may not be able to discern the number.

The color deficiency tests described are readily available.

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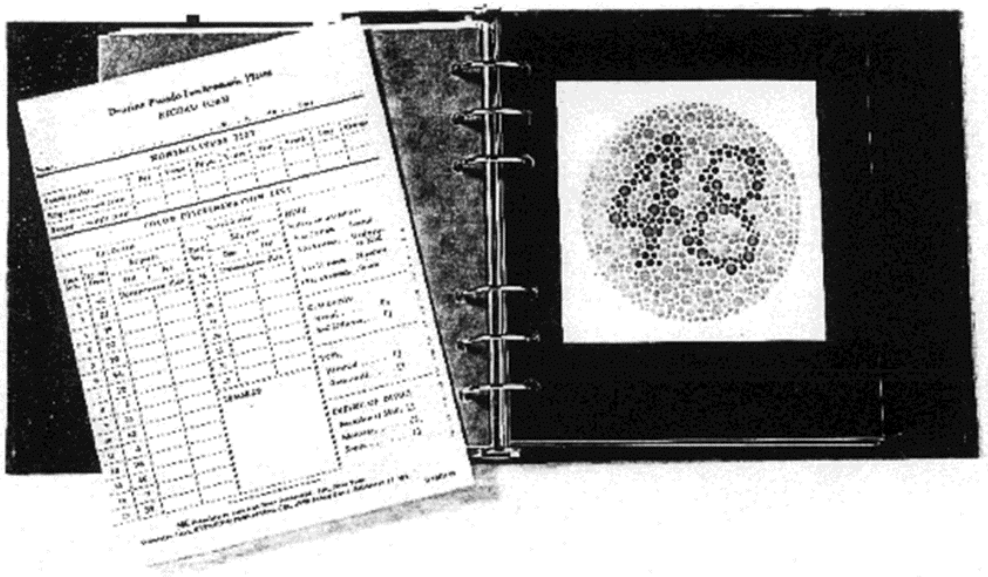
[1] Jeremy Nathans, "The Genes for Color Vision," *Scientific American*, (February 1989: 42-49).

[2] Dean Farnsworth, "The Farnsworth-Munsell 100 Hue and Dichotomous Tests for Color Vision," *Opt. Soc. Am*., **33** (1943: 568).

1. Dvorine Pseudo-Isochromatic Plates



Source: The Psychological Corporation 555 Academic Court, San Antonio, TX TEL: (512) 299-1061
Order Service Center, P.O. Box 839954
San Antonio, TX 78283-3954 TEL: (800) 228-0752.

2. Farnsworth Dichotomous

Source: Munsell Color, 617 Little Britain Road New Windsor, NY 12553
TEL: (914) 565-7660, (800) 622-2384
FAX: (914) 561-0267.

3. HRR Pseudoisochromatic Plates and Ishihara Plates

Source: Richmond Products, Suite 6, 1021 South Rogers Circle Boca Raton, FL 33847-2894
TEL: (407) 994-2112.

[3] National Research Council /National Academy of Sciences, *Procedures for Testing Color*, USDOC National Technical Information

Color Discrimination Tests

Color discrimination tests attempt to distinguish between normal and color anomalous observers, and assess the degree of the individual's color discrimination ability through tests involving the ranking of color chips. The following color discrimination tests are readily available.

The Farnsworth-Munsell 100-Hue Test separates observers with normal color vision into classes of superior, average, and low color discrimination ability. It also detects and measures the color confusion zones of observers with defective color vision. The F-M 100- Hue Test was not intended to distinguish fine degrees of differences between persons of superior color vision or to divide those persons with color deficiency into pass and fail classes (see the Dvorine Pseudo-Isochromatic Plates Test).

Source 1: Munsell Color, 617 Little Britain Road New Windsor, NY 12553
TEL: (914) 565-7660, (800) 622-2384
FAX: (914) 561-0267

Source 2: The Psychological Corporation
Order Service Center, P.O. Box 839954
TEL: (800) 228-0752.

Discrimination of Color Difference

The HVC Color Vision Skill Test was designed to assess the ability of individuals to discriminate between samples having small color differences in hue, value and chroma. The HVC Color Vision Skill Test[4] attempts to go beyond testing for the presence of color deficiency or color anomaly to focus on the natural ability of an individual to discriminate between samples having small differences in hue, value, and chroma. The discrimination of color differences is similar to the task of most color QA applications. The size of these color differences falls at or below the commonly accepted color difference tolerances for most industries. Older tests tended to use either larger differences in hue only (no variations in value or chroma) or smaller differences (similar to HVC) in chroma only. The test consists of thirty-six mounted chips (nine chips each for blue, red, green, and yellow). The thirty-six similar loose chips, presented in random order, must be compared in turn and the color matching decision made as to the nature of the difference.

Source: Lou Graham & Associates, 1207 Colonial Avenue, Greensboro, NC 27408
TEL: (910) 379-1809
FAX: (910) 370-9154.

[4] Louis A. Graham, "A New Color Vision Skill Test," *Die Farbe,* **39** (1993: Heft 1-6).

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.

 12/2023

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