



Designation: D1535 – 14 (Reapproved 2023)

## Standard Practice for Specifying Color by the Munsell System<sup>1</sup>

This standard is issued under the fixed designation D1535; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

### 1. Scope

1.1 This practice provides a means of specifying the colors of objects in terms of the Munsell color order system, a system based on the color-perception attributes hue, lightness, and chroma. The practice is limited to opaque objects, such as painted surfaces viewed in daylight by an observer having normal color vision. This practice provides a simple visual method as an alternative to the more precise and more complex method based on spectrophotometry and the CIE system (see Practices E308 and E1164). Provision is made for conversion of CIE data to Munsell notation.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

D1729 Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials

D3134 Practice for Establishing Color and Gloss Tolerances

E284 Terminology of Appearance

E308 Practice for Computing the Colors of Objects by Using the CIE System

E1164 Practice for Obtaining Spectrometric Data for Object-Color Evaluation

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee E12 on Color and Appearance and is the direct responsibility of Subcommittee E12.07 on Color Order Systems.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

### 3. Terminology

3.1 Terms and definitions in Terminology E284 are applicable to this practice.

#### 3.2 Definitions:

3.2.1 *Munsell notation, n*—(1) the Munsell hue, value, and chroma assigned to the color of a specimen by visually comparing the specimen to the chips in the *Munsell Book of Color*;<sup>3</sup> (2) a notation in the Munsell color system, derived from luminous reflectance factor  $Y$  and chromaticity coordinates  $x$  and  $y$ , in the CIE system for standard illuminant  $C$ , by the use of scales defined by the Optical Society of America Subcommittee on the Spacing of the Munsell Colors (1).<sup>4</sup>

3.2.1.1 *Discussion*—The Munsell notation is written as a combination of letters and numbers by which the color of an opaque object may be specified with respect to Munsell hue  $H$ , Munsell value  $V$ , and Munsell chroma  $C$ , written in the form  $HVC$ .

3.2.2 *hue, n*—the attribute of color perception by means of which a color is judged to be red, orange, yellow, green, blue, purple, or intermediate between adjacent pairs of these, considered in a closed ring (red and purple being an adjacent pair).

3.2.3 *Munsell hue, n*—an attribute of color used in the Munsell color system to indicate the hue of a specimen viewed in daylight.

3.2.3.1 *Discussion*—Two systems of designating Munsell hue are shown in Fig. 1, a letter-number system and an all-number system. The two systems are equivalent, but the letter-number system is preferred, because it requires no prior knowledge or memory of the correspondence of numbers to hues. The hue circle is graduated in steps judged visually to be approximately equal.

3.2.4 *lightness, n*—the attribute of color perception by which a non-self-luminous body is judged to reflect more or less light.

3.2.5 *Munsell value, n*—an attribute of color used in the Munsell color system to indicate the lightness of a specimen

<sup>3</sup> Available from Munsell, 4300 44th Street SE, Grand Rapids, MI 49512, [www.munsell.com](http://www.munsell.com).

<sup>4</sup> The boldface numbers in parentheses refer to a list of references at the end of this standard.

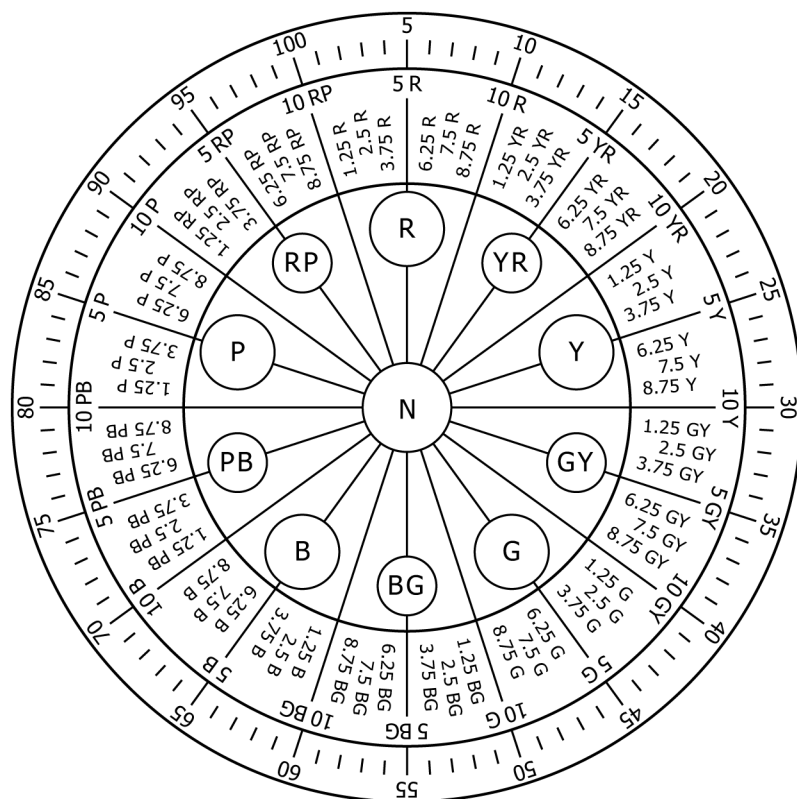


FIG. 1 Designation Systems for Munsell Hue

viewed in daylight, on a scale extending from 0 for ideal black to 10 for ideal white, in steps that are visually approximately equal in magnitude.

3.2.5.1 *Discussion*—Achromatic or neutral colors are designated *N* followed by the value notation, thus: *N* 5.61/.

3.2.6 *chroma, n*—the attribute of color used to indicate the degree of departure of the color from a neutral color of the same lightness.

3.2.7 *Munsell chroma, n*—an attribute of color used in the Munsell color system to indicate the degree of departure of a color from a gray of the same Munsell value, in steps that are visually approximately equal in magnitude.

### 3.3 Definitions of Terms Specific to This Standard:

3.3.1 *Munsell surface-color perception solid, n*—a spatial representation of colors in the form of a cylindrical coordinate system based on the three perceptual attributes: hue, lightness and chroma.

3.3.1.1 *Discussion*—(1) This solid (see Fig. 2 (2)) forms the basis of the Munsell notation in which Munsell hue corresponds to hue, Munsell value corresponds to lightness, and Munsell chroma corresponds to chroma. The central, vertical axis dimension represents neutral colors, ranging from black at the bottom, through a gradation of grays, to white at the top. The lightness of a color perceived as chromatic (not gray) is represented by the distance above the base plane. Hue is represented by the angular position about this axis (see Discussion (2)). Chroma is represented by the perpendicular distance from the central axis. If the observer has normal color vision, is adapted to daylight, and views the specimen illumi-

nated by CIE source *C* or *D65*, against a medium gray to white background, the Munsell value of the specimen correlates well with the observer's perception of the lightness of the color. Under the same conditions, the Munsell hue correlates well with the observer's perception of hue and the Munsell chroma with the perception of chroma.

3.3.1.2 *Discussion*—(2) Although the original system proposed by Munsell was a left-handed coordinate system, the system is often represented as a right-handed system because it facilitates comparison to the CIE chromaticity diagram, taken to be right-handed.

3.3.2 *Munsell hue circle, n*—a spatial representation of the Munsell hue sectors on a circle, where the angular spacing represents a uniform scaling of hue; see Fig. 2.

## 4. Significance and Use

4.1 This practice is used by artists, designers, scientists, engineers, and government regulators, to specify an existing or desired color. It is used in the natural sciences to record the colors of specimens, or identify specimens, such as human complexion, flowers, foliage, soils, and minerals. It is used to specify colors for commerce and for control of color-production processes, when instrumental color measurement is not economical. The Munsell system is widely used for color tolerancing, even when instrumentation is employed (see Practice D3134). It is common practice to have color chips made to illustrate an aim color and the just tolerable deviations from that color in hue, value, and chroma, such a set of chips being called a *Color Tolerance Set*. A color tolerance set