

# ABOUT MUNSELL

Munsell® produces a broad range of color specification books and color standards for selecting, communicating, identifying, managing and controlling color. These products are used worldwide in industry, art and science.

The Munsell Books of Color are color reference guides used for color selection and communication. For an exact match to the color of your products, logos or packaging, Munsell can develop custom color standards, plastic standards and texture standards. Munsell can also develop special purpose standards, such as gray scales and calibration targets to meet your specific application. Other products from Munsell include the ColorChecker® color rendition chart used in photographic, graphic arts and television and the Farnsworth-Munsell 100 Hue Test for color vision and color discrimination testing.

The Munsell Color Laboratory is located at GretagMacbeth Worldwide Headquarters in New Windsor, New York. The Munsell lab is equipped with GretagMacbeth's latest computerized color matching software, color measurement instrumentation and lighting systems. Backed by the most sophisticated technology plus more than ninety years of experience, Munsell can guarantee effective solutions to even the most challenging color communication and color control problems.

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## The Munsell System of Color Notation

The Munsell color-order system is a way of precisely specifying colors and showing the relationships among colors. Every color has three qualities or attributes: hue, value and chroma. Munsell established numerical scales with visually uniform steps for each of these attributes. The Munsell Book of Color displays a collection of colored chips arranged according to these scales. Each chip is identified numerically using these scales. The color of any surface can be identified by comparing it to the chips, under proper illumination and viewing conditions. The color is then identified by its hue, value and chroma. These attributes are given the symbols H,V, and C and are written in a form H V/C, which is called the Munsell notation.

Utilizing Munsell notations, each color has a logical relationship to all other colors. This opens up endless creative possibilities in color choices, as well as the ability to communicate those color choices precisely.

### Hue

Hue is that attribute of a color by which we distinguish red from green, blue from yellow, etc. There is a natural order of hues: red, yellow, green, blue, purple. One can mix paints of adjacent colors in this series and obtain a continuous variation from one color to the other. For example, red and yellow may be mixed in any proportion to obtain all the hues from red through orange to yellow. The same may be said of yellow and green, green and blue, blue and purple, and purple and red. This series returns to the starting point, so it can be arranged in a circle. Munsell called red, yellow, green, blue, and purple principal hues and placed them at equal intervals around this circle.

He inserted five intermediate hues: yellow-red, green-yellow, blue-green, purple-blue and red-purple, making ten hues in all. For simplicity, he used the initials as symbols to designate the ten hue sectors: R, YR, Y, GY, G, BG, B, PB, P and RP. The hue circle is illustrated in Figure 1.



Figure 1: Munsell Hue

Munsell arbitrarily divided the hue circle into 100 steps, of equal visual change in hue, with the zero point at the beginning of the red sector, as shown in Figure 2.

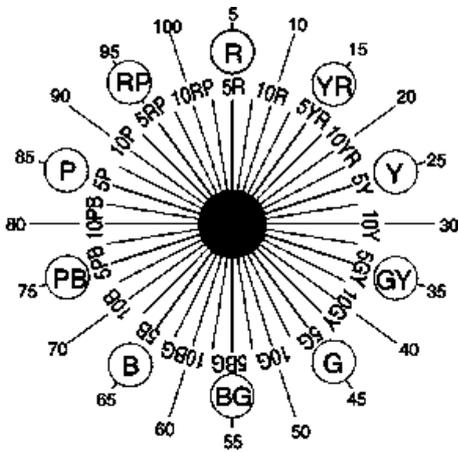


Figure 2: Hue Designations

Hue may be identified by a number from 0 to 100, as shown in the outer circle. This may be useful for statistical records, cataloging and computer programming. However, the meaning is more obvious when the hue is identified by the hue sector and a step, based on a scale of ten, within that sector. For example, the hue in the middle of the red sector is called five red, and is written 5R. (The zero step is not used, so there is a 10R hue, but no 0 YR.) This method of identifying hue is shown on the inner circle.

## Value

Value indicates the lightness of a color. The scale of value ranges from 0 for pure black to 10 for pure white. Black, white and the grays between them are called neutral colors. They have no hue. Colors that have a hue are called chromatic colors. The value scale applies to chromatic as well

as neutral colors. The value scale is illustrated for a series of neutral colors in Figure 3.

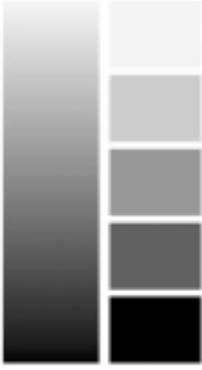


Figure 3: Munsell Value

## Chroma

Chroma is the degree of departure of a color from the neutral color of the same value. Colors of low chroma are sometimes called weak, while those of high chroma are said to be highly saturated, strong or vivid. Imagine mixing a vivid yellow paint, a little at a time, with a gray paint of the same value. If you started with gray and gradually added yellow until the vivid yellow color was obtained, you would develop a series of gradually changing colors that increase in chroma. The scaling of chroma is intended to be visually uniform and is very nearly so. The units are arbitrary. The scale starts at zero, for neutral colors, but there is no arbitrary end to the scale. As new pigments have become available, Munsell color chips of higher chroma have been made for many hues and values. The chroma scale for normal reflecting materials extends beyond 20 in some cases. Fluorescent materials may have chromas as high as 30. A scale of chroma is illustrated in Figure 4.

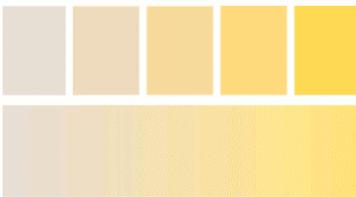


Figure 4: Munsell Chroma

## Munsell Notation

The complete Munsell notation for a chromatic color is written symbolically: H V/C. For a vivid red having a hue of 5R, a value of 6 and a chroma of 14, the complete notation is 5R 6/14. When a finer division is needed for any of the attributes, decimals are used. For example, 5.3R 6.1/14.4.

The notation for a neutral color is written: N V/. (The chroma of a neutral color is zero, but it is customary to omit the zero in the notation.) The notation N 1/ denotes a black, a very dark neutral, while N 9/ denotes a white, a very light neutral. The notation for a middle gray is N 5/.

## Munsell Color Space

Munsell hue, value and chroma can be varied independently so all colors can be arranged according to the three attributes in a three-dimensional space. The neutral colors are placed along a vertical line, called the neutral axis with black at the bottom, white at the top and all grays

in between. The different hues are displayed at various angles around the neutral axis. The chroma scale is perpendicular to the axis, increasing outward. This three-dimensional arrangement of colors is called the Munsell color space. The relationship of the three scales in three-dimensional space is illustrated in Figure 5.

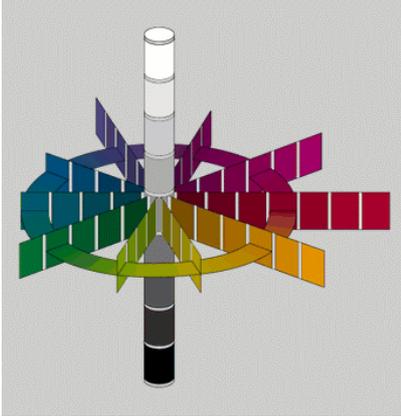


Figure 5: Munsell Color Space

## Munsell Color Solid

All colors lie within a specific region of Munsell color space called the Munsell color solid. Hue is limited to one turn of around the circle. The scale of value is limited on the lower end by pure black, which is as dark a color can be, and on the top by pure white, which is as light as a color can be. For a given value, there is a limit to the chroma that is possible, even with theoretically ideal coloring agents. Real coloring agents, with less than ideal characteristics, impose further limitations on physical representations of the color solid. The Munsell color-order system itself is applicable to all possible colors. The highest chroma yellow colors have rather high values, while the highest chroma blue colors have lower values. Thus the Munsell color solid has the irregular shape.

## The Munsell Primary Hue Circle

In 1993, Cal McCamy proposed a series of hue names for the hue circle, using the additive primaries - red, green and blue; the subtractive primaries - yellow, magenta and cyan; and four intermediate hues. The names are applied to the same set of hue sectors as the Munsell hues. This proposal corrects a well-known displacement of blue on the Munsell hue circle and it accommodates the thinking of the large number of people who work with color photography, color printing, color television, color copying and color computer monitors - technologies based on the additive and subtractive primaries. The correspondence between the Munsell hue circle and the primary hue circle is as follows:

- Red (R) is also Red (R) in the Primary Hue Circle
- Yellow-Red (YR) is also Yellow-Red (R) in the Primary Hue Circle
- Yellow (Y) is also Yellow (Y) in the Primary Hue Circle
- Green-Yellow (GY) is also Green-Yellow (GY) in the Primary Hue Circle
- Green (G) is also Green (G) in the Primary Hue Circle
- Blue-Green (BG) is Cyan (C) in the Primary Hue Circle
- Blue (B) is Blue-Cyan (BC) in the Primary Hue Circle
- Purple-Blue (PB) is Blue Prime (Blue') in the Primary Hue Circle
- Purple (P) is Magenta-Blue (MB) in the Primary Hue Circle
- Red-Purple (RP) is Magenta (M) in the Primary Hue Circle

Blue is the only instance where the same name has a different meaning (resulting from the deliberate use of that name for a different sector). In this case, the new word and symbol are distinguished from the old, when necessary, by the prime mark (Blue' and B').

The addition of this set of hue names does not involve any changes whatsoever in the colors in The Munsell Book of Color or any Munsell color standards. It is merely an alternate way of designating the same hues, in those fields in which it is found useful.

## Munsell Standard Viewing Conditions

The observed color of a surface depends on the spectral quality of the illumination, the direction of illumination, the direction of viewing, the surround or background, the nature of any light that might be reflected from the surface and the nature and state of adaptation of the eyes of the observer.

It is standard practice to view specimens illuminated by daylight from a lightly overcast north sky (south sky in the southern hemisphere) or the artificial equivalent of this illumination (D65 daylight source). Viewing booths that provide controlled artificial daylight and other common illuminants, such as the [SpectraLight® III](#), The [Judge® II](#) and [Sol-Source®](#), are available from GretagMacbeth. Their use is recommended because the light is much more reproducible than natural daylight, they provide standard viewing conditions at any hour and in interior rooms, they provide a neutral ambient surround and they exclude extraneous light. Specimens should be viewed along their normal (the line of sight perpendicular to the surface) and to illuminated at 45 degrees to the normal. Equivalent results can be obtained with the reversed geometric arrangement - illuminating normally and viewing at 45 degrees. These conditions are described in a standard from the American Society for Testing and Materials (ASTM): D 1729 Standard Practice for Visual Evaluation of Color Differences of Opaque Materials.

Before anyone is required to judge colors, they should be tested to assure that they have normal color vision. About one man in twenty and one woman in fifty have defective color vision, commonly called color blindness. Even among normal observers, there is variation in aptitude for judging colors. Normally this capability gradually diminishes with age. Even among normal expert observers, differences in judgments, due to normal variation in the human eye, are not uncommon. Color vision can be evaluated by the use of the Farnsworth-Munsell [100 Hue Test](#), which is available from GretagMacbeth.

## Development of the Munsell System

Professor A.H. Munsell, an artist and art teacher, developed the basic principles of the system and published them in a small book, A Color Notation, in 1905. In 1915, he published The Munsell Atlas of Color, displaying colored specimens of a range of values and chromas for ten hues. He formed the Munsell Color Company to produce color standards in 1918, but died the same year. His son sponsored studies at the National Bureau of Standards and in the Munsell Color Laboratory, which led to the improved color scales in the 1929 edition of The Munsell Book of Color, which displayed 20 hues.

A subcommittee of the Optical Society of America studied the visual spacing of the scales and published recommended changes in 1943. Those recommendations are called the Munsell renotation. The recommended spacing was specified by the system of color measurement standardized by the International Commission on Illumination (identified by the initials, CIE, of its name in French), using CIE Illuminant C and CIE 1931 (2 degree) Standard Observer. The renotation provides a method of converting color measurement data to Munsell notations and

provides the specifications for producing Munsell color standards. The Munsell renotation was standardized by the American Society for Testing and Materials in D 1535 Standard Test Method for Specifying Color by the Munsell System.

About 1950, the number of hues in The Munsell Book of Color was doubled, from 20 to 40 hues. In the early editions of The Munsell Book of Color, the chips had a matte surface. In 1958, a glossy version was introduced, to improve the reliability of comparisons of the standards to paints, plastics and other materials with glossy surfaces. Both matte and glossy versions are in widespread use today. The Nearly Neutrals Collection, introduced in 1990, provides a number of pale colors often used for cosmetics, interior design and computer hardware.

The Munsell color-order system has gained international acceptance. It is described in unabridged dictionaries and encyclopedias as well as in specialized publications on art, design, color photography, television, printing, paint, textiles and plastics. It is recognized as a standard system of color specification in standard Z138.2 of the American National Standards Institute, Japanese Industrial Standard for Color JIS Z 8721, the German Standard Color System, DIN 6164 and several British national standards. The Munsell color-order system has been widely used in many fields of color science, most notably as a model of uniformity for colorimetric spaces and has, itself, been the subject of many scientific studies.

- [Color Communication Products](#)
- [Custom Color Standards](#)
- [Color Vision Tests](#)
- [Educational Products](#)
- [Specialty Color Charts](#)
- [Ordering Information](#)
- [White Reflectance Products](#)

## Munsell Color Communication Products

Unlock the full potential of color choices with Munsell® Color Communication Products. These color collections serve a wide range of applications including art and design, package/product design, color specification and color quality control.

- The Munsell Book of Color, [Glossy Collection](#)
- The Munsell Book of Color, [Matte Collection](#)
- The Munsell Book of Color, [Nearly Neutrals Collection](#)
- Individual [Color Standards](#)
- Neutral [Value Scales](#)

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### The Munsell Book of Color, Glossy Collection

The Munsell Book of Color is the classic that turns color theory into a practical tool for color selection and specification. This two volume set features 1600 removable color chips arranged on 40 constant hue charts (2.5, 5, 7.5 and 10 positions of each hue) plus 4 Munsell Gray charts and 3 supplementary color charts. Values range from 2 to 9 in whole steps, with a value of 8.5 added to Y charts. Chromas range from 2 to maximum achievable in equal steps of 2. A 37-step Neutral Value Scale Chart page is also included. Chart size: 9.75" x 11". Chip size: 3/4" x 1 5/8".

Part Number: 40115

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### The Munsell Book of Color, Matte Collection

For projects that require color without surface gloss, we provide this collection of over 1270 color chips mounted on 40 constant hue charts (2.5, 5, 7.5 and 10 positions of the 10 Munsell hues).

Values range from 2.5 to 9 in whole steps, with a value of 8.5 added to Y and GY charts. Chromas range from 2 to maximum achievable, in equal steps of 2, with /1 added to 5 and 10 hues. A 31-step Neutral Value Scale Chart page is included. Chart size: 8.5" x 11". Chip size: 5/8" x 7/8".

Part Number: 40291

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### **The Munsell Nearly Neutrals Book**

This collection of over 1100 pastel colors meets the needs of projects that require very neutral, subtle colors. The matte color samples are mounted on 20 constant hue pages (5 and 10 positions for each hue) plus one Nearly Whites page. Values range from 6 to 9 in half steps. Chromas range from 0 to 4 in half steps. Chart size: 8.5" x 11". Chip size: 5/8" x 7/8".

Part Number: 40328

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### **Nearly Neutrals Individual Fan Deck**

Nearly Whites Fan Deck, Part Number: 40346

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### **Individual Color Standards**

Colors from the Munsell collections are available in full sheets, making it easy to provide standards to your suppliers. To order, simply specify the Munsell notation and finish (matte, glossy or Nearly Neutral).

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### **Neutral Value Scale, Glossy Finish**

This 37 step scale displays neutral grays with a value range of 0.5 to 9.5 in quarter-step intervals. The Munsell notation and percent reflectance for CIE Illuminant C is printed for each color.

Part Number: 50130

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### **Neutral Value Scale, Matte Finish**

This 31 step scale displays neutral grays with a value range of 0.5 to 9.5 in quarter-step intervals. The Munsell notation and percent reflectance for CIE Illuminant C is printed for each color.

Part Number: 50135

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## **Munsell Color Vision Tests**

Munsell® provides special color vision tests used in medical and psychological testing, as well as in industries where visual color discrimination is important.

- Farnsworth-Munsell [100 Hue Test](#)
  - Farnsworth-Munsell [Dichotomous D-15 Test](#)
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### Farnsworth-Munsell 100 Hue Test

This simple and effective method for determining color vision abnormalities and testing color discrimination yields reliable data which can be applied to many psychological and industrial color vision problems. Used by government and industry for over 40 years, the set consists of four trays containing a total of 85 removable reference caps. The color caps have incremental hue variation on one side and are numbered on the reverse. Color vision anomalies and color aptitude are detected by the ability of the testee to place the color caps in hue order. A score sheet yields numerical and graphical results. Consists of four 20" x 1.75" x 1.25" trays, housed in a 21.5" x 6.12" x 2.5" carrying case. Color reference size is 7/16" diameter.

Part Number: 80000

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### Farnsworth-Munsell 100 Hue Test Replacement Caps

Replacement caps are available for the Farnsworth-Munsell 100 Hue Test. They are available in sets which correspond to the trays in the test. Due to soiling from usage, it is recommended that the caps in the 100 Hue Test be replaced every two to four years.

FM 100 Hue Test Replacement Caps 22-42, Part Number: 80212

FM 100 Hue Test Replacement Caps 43-63, Part Number: 80213

FM 100 Hue Test Replacement Caps 64-84, Part Number: 80214

FM 100 Hue Test Replacement Caps 85-21, Part Number: 80215

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### Farnsworth-Munsell Dichotomous D-15 Test

A modification of the 100 Hue Test intended for screening color vision defects. Contains a reference cap and 15 numbered disks with all different hues.

Part Number: 20103

## Munsell Educational Products

Teaching aids and instructional materials from Munsell® are used in schools and on the job. They make the complexities of color understandable by giving color appearance and color relationships a logical order and common language.

- Munsell [Student Color Set](#)
  - Munsell HVC [Color Charts](#)
  - Munsell [Color Tree](#)
  - Hue, Value, Chroma [Poster](#)
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### Munsell Student Color Set

New Munsell Student Set published by Fairchild Books and Visuals. Designed to teach the Munsell System and the concept of three-dimensional color space. Students learn by arranging color chips on blank charts. Set includes 11 charts, one for each hue (5R, 5YR, 5Y, 5GY, 5G, 5BG, 5B, 5PB, 5P, 5RP) plus one hue, value/chroma chart showing hue circle, value scale and chroma scale. Also includes Munsell: A Language of Color text with classroom exercises and binder.

Part Number: 91010

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## Munsell HVC Color Charts

Blank hue value/chroma chart showing hue circle, value scale and chroma scale and color chips from the Munsell Student Color Set (Part Number 91010). Package of 10.

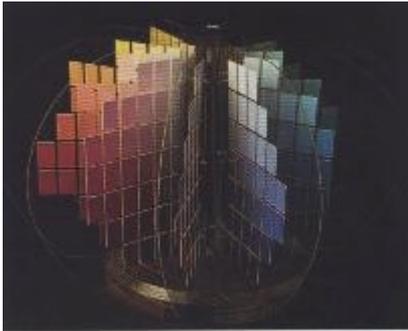
Part Number: 91011

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## Munsell Color Tree

A practical and attractive 3-dimensional model of Munsell Color space, illustrating the attributes of hue, value and chroma. 309 glossy chips for ten constant hues displayed on clear acrylic panels assembled on wooden base. Chart size: 10.5" x 12". Base size: 12" diameter. Height: 12.5". Chip size: 1" x .75". New 1995 edition.

Part Number: 70115



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## Hue, Value, Chroma Poster

Enlarged hue, value, chroma chart displaying 10-step hue circle, 8-step value scale, and 6-step red chroma scale. Color samples: 3.13" x 2.25". Chart size: 25" x 38".

Part Number: 70085

## Munsell Specialty Color Charts

Munsell® offers unique color reference materials that play a vital role in many industrial and scientific fields.

- GretagMacbeth [ColorChecker](#)
  - Munsell [Soil and Plant](#) Tissue Color Charts
  - Munsell Color Charts for [Color Coding](#)
  - Munsell USDA [French Fry Standards](#)
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## GretagMacbeth ColorChecker®

One of the most photographed images in the world, the ColorChecker is a unique test pattern scientifically designed to help determine the true color balance of any color rendition system. It allows you to avoid costly mistakes by checking for potential problems.

Some of its applications include:

- Photography: Check films, lights, filters and paper.
- Graphic Arts: Check any printing or proofing process.

- Electronic Publishing: Check scanners, monitors and proofing devices.
- Television: Check cameras, monitors, lights and film.

The ultimate goal of any process of photography, electronic publishing, printing or television is to reproduce all colors perfectly. To help make meaningful judgments about color rendition, a totally non-subjective standard of comparison is needed. That is why the GretagMacbeth ColorChecker chart was developed. It provides the needed standard with which to compare, measure and analyze differences in color reproduction in various processes.

The ColorChecker is a checkerboard array of 24 scientifically prepared colored squares in a wide range of colors. Many of these squares represent natural objects of special interest, such as human skin, foliage and blue sky. These squares are not only the same color as their counterparts, but also reflect light the same way in all parts of the visible spectrum. Because of this unique feature, the squares will match the colors of natural objects under any illumination and with any color reproduction process.

The ColorChecker chart provides an easy way to recognize and evaluate the many factors that can affect color reproduction. To evaluate the effect of varying any given factor, simply compare the chart's color image (photograph, television picture, computer monitor or printed sample) with the actual ColorChecker. This comparison may be made visually or through optical density measurements.

The ColorChecker chart is produced in the Munsell Color Lab at GretagMacbeth.

Part Number: 50105



## Munsell Soil and Plant Tissue Color Charts

### Munsell Soil Color Charts

These charts were developed by Munsell and the U.S.D.A. Soil Conservation Service for classifying the color of soils. They are also used for judging rocks, hydric soils, archeological samples and many natural products in this range. They help agronomists, biologists, archeologists, geologists, zoologists and other scientists record the color of specimens. 322 color chips are mounted on nine charts: seven (7) hues (10R, 2.5YR, 5YR, 7.5YR, 10YR, 2.5Y and 5Y) and two Gley (blue and green colors, and gray scale for submerged soils). Apertures between chips facilitate observations. Contained in loose leaf binders with color name diagrams and masks. 1994 Revised edition. Chart size: 4.25" x 7.25". Chip size: 1/2" x 5/8".

Part Number: 50215

## **Supplementary 5R Soil Color Chart**

Used for Australian and Southeast Asian soils.

Part Number: 50221

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## **Supplementary 7.5R Soil Color Chart**

Used for tropical and semi-tropical soils.

Part Number: 50222

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## **Individual Soil Color Chart Components**

Individual components from the Soil Color charts are available. They are:

- Soil Book Binder, Part Number: 50209
  - Individual Soil Chart, 10R, Part Number: 50223
  - Individual Soil Chart, 2.5YR, Part Number: 50224
  - Individual Soil Chart, 5YR, Part Number: 50225
  - Individual Soil Chart, 7.5YR, Part Number: 50226
  - Individual Soil Chart, 10YR, Part Number: 50227
  - Individual Soil Chart, 2.5Y, Part Number: 50228
  - Individual Soil Chart, 5Y, Part Number: 50229
  - Individual Soil Chart, Gley Set, Part Number: 50230
  - Individual Soil Chart, Y-GY, Part Number: 50231
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## **Munsell Plant Tissue Color Charts**

These color charts provide a means for determining and recording the color of plant tissues. This information is important to scientists working with growth rates, nutrient deficiency, plant disease and other plant processes. Approximately 320 matte color chips are permanently mounted on charts of 17 hues (2.5R, 5R, 10R, 2.5YR, 5YR, 7.5YR, 2.5Y, 5Y, 2.5GY, 5GY, 7.5GY, 2.5G, 5G, 7.5G, 5BG, 2.5B and 5RP) in a loose leaf binder. Chart size 4.25" x 7.25". Chip size: 1/2" x 5/8". Mask included.

Part Number: 50150

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## **Munsell Color Charts for Color Coding**

Used for color coding of wire and cable insulation and by Electronics Industries Assoc. (Std. RS359-A) for use with electronics components. Ten color charts in binder: Red, Orange, Brown, Yellow, Green, Blue, Violet (Purple), White, Gray (Slate), and Black. Each chart defines the Centroid (ideal) color and the permissible tolerances. High gloss chips are permanently mounted on 8.5" x 11" chart. Includes 3" x 5" swatch of each Centroid and copy of STD. RS359-A. Minimum order of 10.

Part Number: 50110

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## USDA French Fry Standards

Printed color ranges meet specifications set by USDA for frozen french fry potatoes. Set of 5 identical reproductions in a folder with instructions.

Part Number: 60040

## Munsell White Reflectance Products

Munsell Color, located in New Windsor, New York, is proud to announce the acquisition of the White Reflectance Technology from Kodak Scientific Imaging Systems effective January 12, 1999. The transition from Kodak to Munsell Color has been a joint effort to ensure the continuation of the highest level of quality and customer satisfaction. [Munsell](#) currently produces a broad range of color specification books and color standards for selecting, communicating, identifying, managing, and controlling color. These products are used world wide in industry, art and science.

Our Munsell Color Lab is equipped with the latest computerized color matching software, color measurement instrumentation, and lighting systems. The addition of the White Reflectance Technology increases our color capabilities to meet the growing color needs of today.

### Munsell White Reflectance Products are:

- Ultra-pure and highly stable
- NIST-Referenced
- Excellent diffuse reflectance from 200 nm to 2,500 nm
- Can be applied on many surfaces

Munsell White Reflectance Products are available as powder or paint. Both are comprised of highly purified barium sulfate which gives extremely high diffuse reflectance of radiant energy and yield absolute reflectance values of up to 0.993 throughout the UV, visible and part of the near infrared regions.

Munsell White Reflectance Coating is a composition of barium sulfate, binder and solvent that is prepared to form a paint that can be applied by spraying or coating. It is ideal for use in integrating spheres and in reflectance spectrophotometers, color difference meters, sphere photometers and other instrumentation. The White Reflectance Standard is ultra-pure barium sulfate powder that is ideal for inter-laboratory comparisons of reflectance data.

[Specifications](#) for Munsell White Reflectance Products: Reflectance Curves and Absolute Reflectances

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