



The color of ideas.™

**PANTONE® huey™**

## **USER GUIDE for huey™ software & huey™PRO software**

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## Table of Contents

Key Features of huey	2
What You Get	2
System Requirements	3
What's what on huey?	3
Before You Begin	4
Software Installation	5
Step-by-Step Instructions	6
Step 1	6
Step 2	7
Step 3	8
Step 4	9
Step 5	10
Step 6	11
Step 7	12
Step 8	13
Step 9	14
Step 10 – hueyPRO software	15
Step 10 – huey software	17
Step 11	18
Step 12 – Multiple Monitors	19
huey/hueyPRO Preferences	20
Advanced Help Section	24
Basic Color Management - Questions	25
Monitor Calibration - Questions	26
After calibrating the monitor - Questions	29
Printing after the Monitor is Calibrated - Questions	32
Technical Support	37
How to Contact Us	38
Glossary	39
References	43

## Monitor Color Correction

Every monitor is different – they each have their own unique “fingerprint.” As monitors age, their performance degrades due to phosphors fading and liquid crystals wearing out. As a result, the colors on the monitor look different. The single biggest cause of poor visuals on a monitor is the lack of color correction.

With more than 25 million people expected to own digital cameras by the end of year 2007, users are embracing the convenience of self-correcting and re-touching images with easy-to-use software and photo printers, according to a September 2005 Info Trends/CAP Ventures report. Pantone, Inc. recognizes that people are often disappointed in the appearance of their images both on-screen and in print. You wonder if your screen is to blame and if you can really trust what you see on-screen. PANTONE **huey**™ is designed to automatically adjust and correct the way your monitor displays color and in the end, provide you a monitor color you can trust.

Two leaders in the world of color, Pantone and X-Rite have partnered and created **huey** to deliver professional – quality monitor calibration tools that make it easy for *anyone* to get the best possible color fidelity. **huey** is the first product that will automatically adjust color and contrast settings on your display if the lighting in your room should change. By first measuring the color produced by your display, and then adjusting the color settings to a common industry standard, **huey** provides improved color accuracy for digital images, publishing, online gaming, e-commerce and Web surfing.

## Key Features of huey

- Innovative design, lightweight, ultra-portable device – smaller than a pen
- The only calibration device at the breakthrough price that continually adapts a monitor for changing room lighting. A special sensor detects changes in room lighting and automatically adjusts the monitor for optimal viewing. **huey** knows that as room light gets brighter, more details get “washed out” in dark areas
- Provides fast measurements for quick profiling
- Applies users’ personal preferences for viewing accurate color
- Intuitive software interface
- USB powered

## What You Get

1. **huey** colorimeter
2. Desktop cradle
3. USB extension cable
4. Klear Screen monitor-cleaning packet and 4x4 Micro-Chamois cloth
5. Software CD
6. **huey** Quick Start Guide

## System Requirements

**Windows®:** Windows 2000, Windows XP, & Windows Vista™ operating systems

**Macintosh:** G4 or faster PowerPC; Intel Mac. Mac OS X 10.3.9 or later,

## What's what on huey?



## Before You Begin

In preparation for using **huey**, you will need to ensure that you have a clean monitor surface. Use the cleaning pads included in your package to wipe clean the surface of the monitor you will be calibrating.

- Remove moist Klear Screen cloth from packet and gently wipe entire screen.
- Then immediately polish the screen with the 4x4 blue Micro-Chamois cloth until screen is dry and clear.
- Wipe and polish in straight lines only – side-to-side and top-to-bottom.

The suction cups on **huey** pick up lint and dirt easily. Simply wipe them with the same cleaning pad used on your monitor. If the suction cups are not clean, **huey** may fall off your monitor. If the sensor should slip during a measurement, simply click Cancel and then restart the program.

**Note:** Throughout this document you will find the following terms being used:

- **huey** – refers to the device itself
- **huey software** – refers to the **huey** software (versions 1.0.x) with the red packaging and icon
- **hueyPRO software** – refers to the new software (versions 1.5.x) with the green packaging and icon

## Software Installation

### 1. Installing the software (be sure that **huey** is not plugged into your computer)

Place the software installation CD into your CD-ROM drive and follow the step-by-step instructions to install the software. If the software was downloaded, click on the installer and follow the instructions. (For Mac users just drag the **huey** icon onto your hard-drive.)



### 2. Plugging in the sensor

**Note:** The sensor measures your display's color with its three light sensors, one each for red, green and blue. Plug the sensor into any available USB port on your computer. Use the extender cable if necessary.



## Step-by-Step Instructions

**Note:** Your monitor should be turned on for at least 30 minutes before you begin profiling. For best results, be sure there is no direct sunlight or room light shining on your monitor.

### Step 1

Start the **huey/hueyPRO** software. When you first launch the software you will see a small window on the right hand side which is the help section to guide you with each step. If this window is closed, click on the “?” to open it.

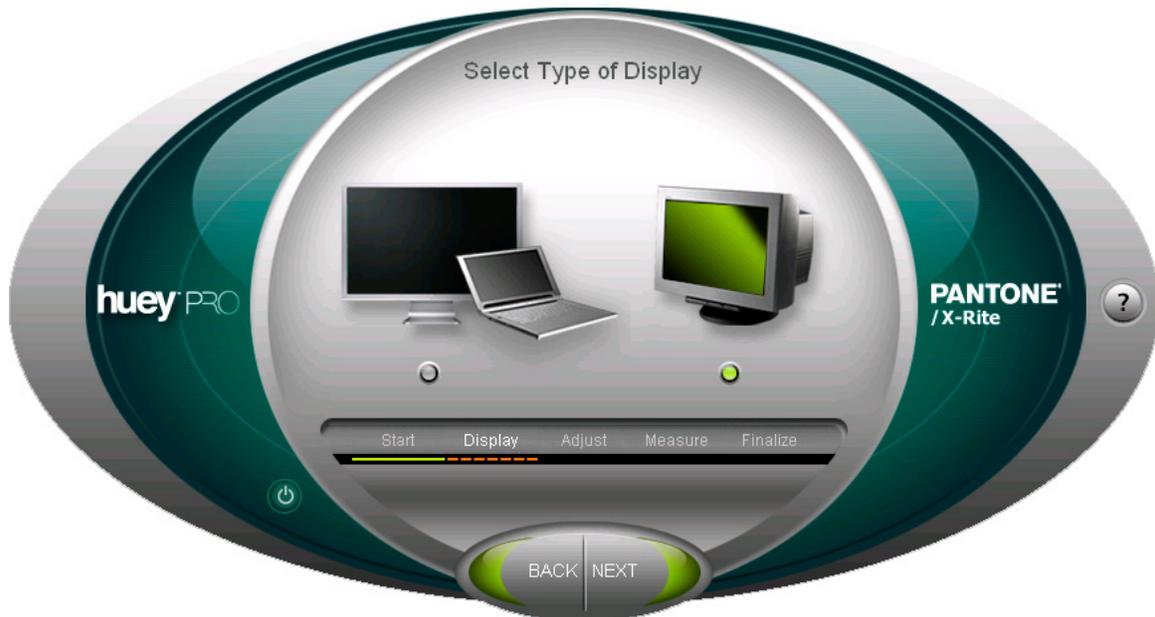
Click on “**START**”



## Step 2

Select what type of monitor you have by clicking on the small circle under the appropriate image, when the circle is selected it will light up.

Your options are: LCD/Laptop or a CRT and then click **“NEXT.”**



### Step 3

Place the sensor into the cradle for ambient light measurement and click “**NEXT**.” Place the sensor in the cradle so that the LEDs are facing you. **huey** will measure the ambient light to prepare the system for calibration.

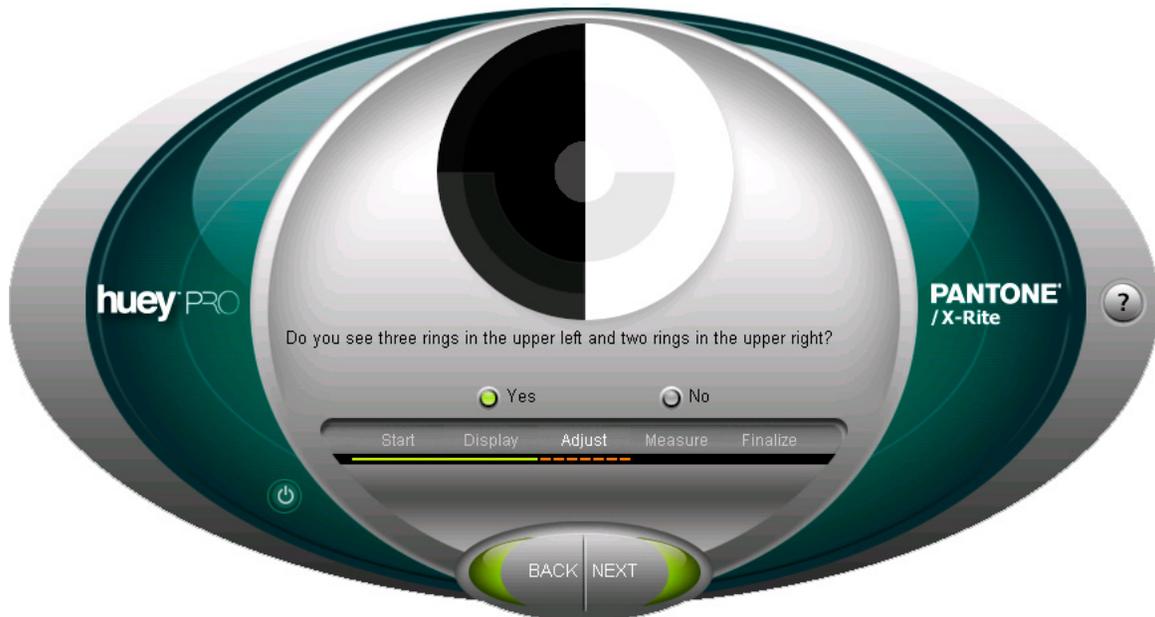


**Note:** The *ambient light sensor* is for adjusting your monitor’s contrast according to the room lighting conditions. This helps the display look the same as light changes throughout the day. The sensor measures the ambient light before profiling.

## Step 4

This step is different for **huey** software and **hueyPRO** software.

**hueyPRO** software - You will be asked to do a small contrast and brightness measurement. If you see 3 rings in the upper left quarter of the circle and 2 rings in the upper right quarter of the circle, select “**Yes**” and “**NEXT**”. If you do not see the rings select “**No**” and “**NEXT**” and follow the instructions to set your contrast and brightness.



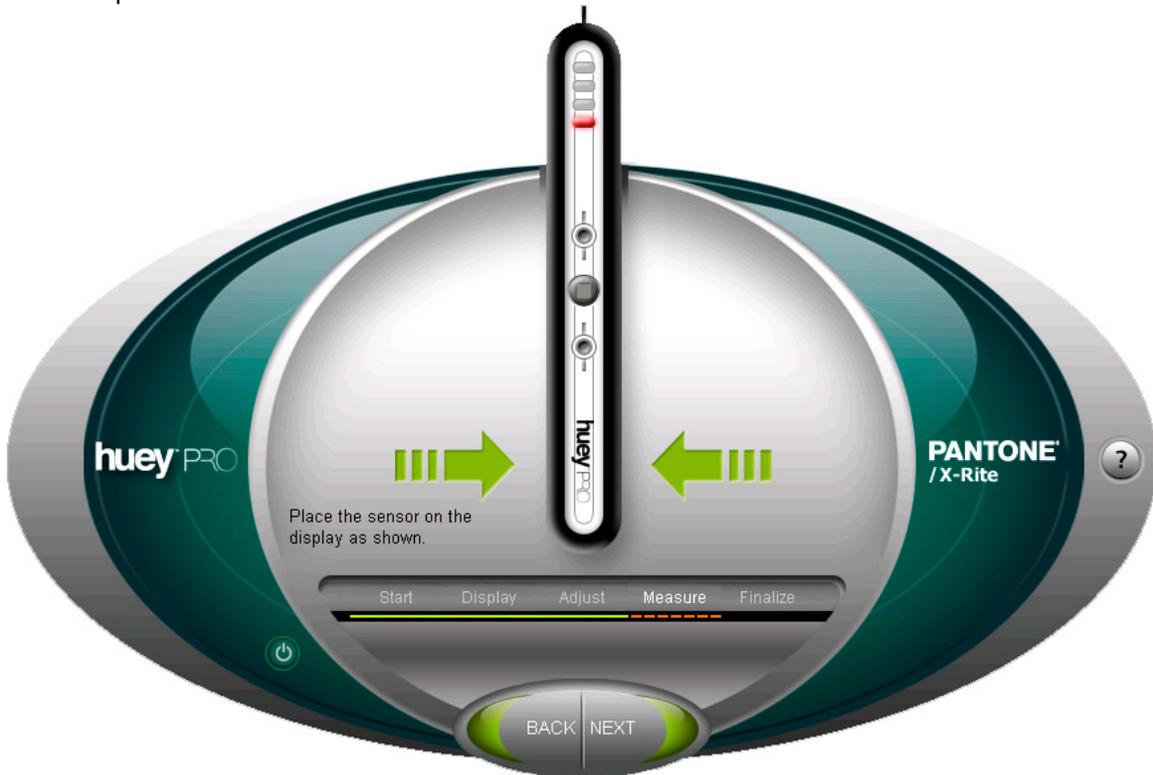
**Note:** **huey** software: If you have a CRT monitor you will be asked to perform this step.

If you have a LCD monitor or a laptop please go to **Step 5**. This feature is only available for CRT monitors.

## Step 5

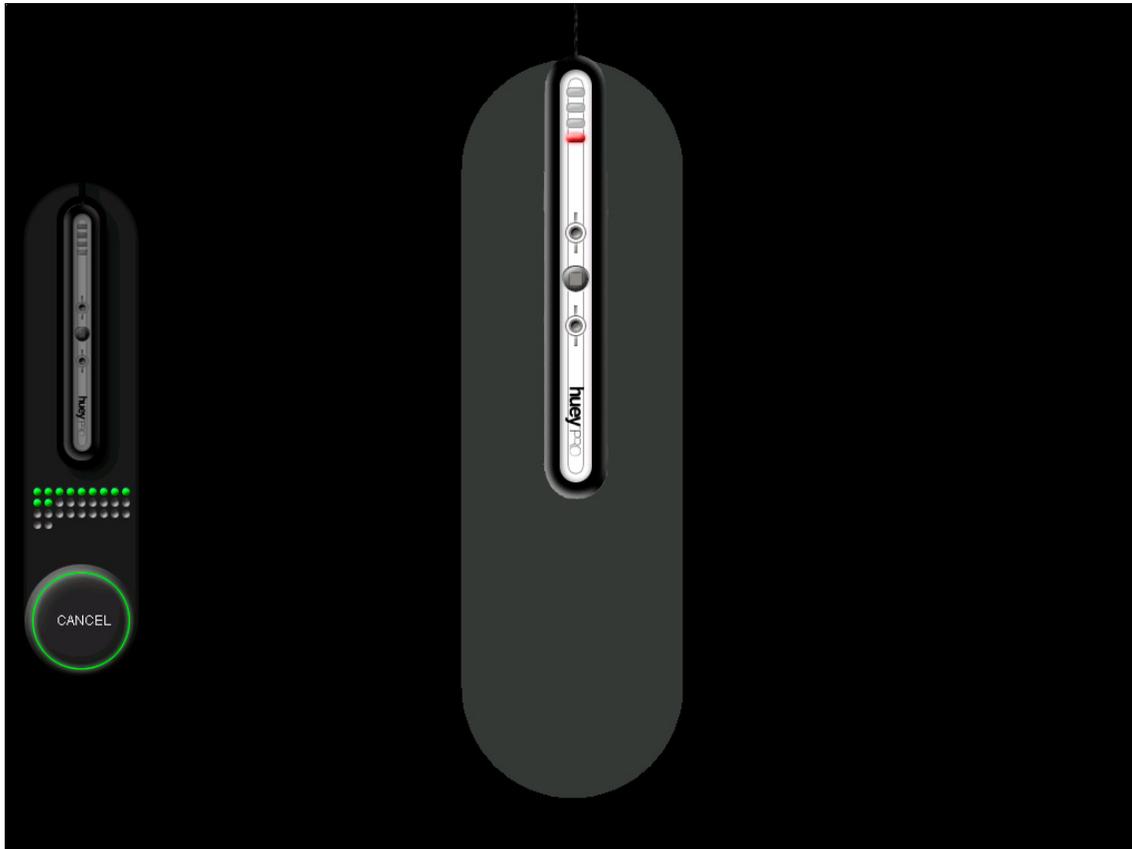
Place **huey** on the display as shown below and click “**NEXT**”. For LCD monitors and laptops gently press **huey** onto the screen so the suction cups stick to your screen as shown in the display below.

**Note:** The suction cups will not harm your LCD or laptop display. They do, however, easily attract dust and lint that will keep them from adhering to your display. If this happens and **huey** falls off your monitor, simply wipe the suction cups with a wet cloth or cleaner.



## Step 6

**hueyPRO** software will measure 29 different color patches (**huey** software measures only 26 patches). You can see the measurement progress on the left. The measurements will take less than two minutes.

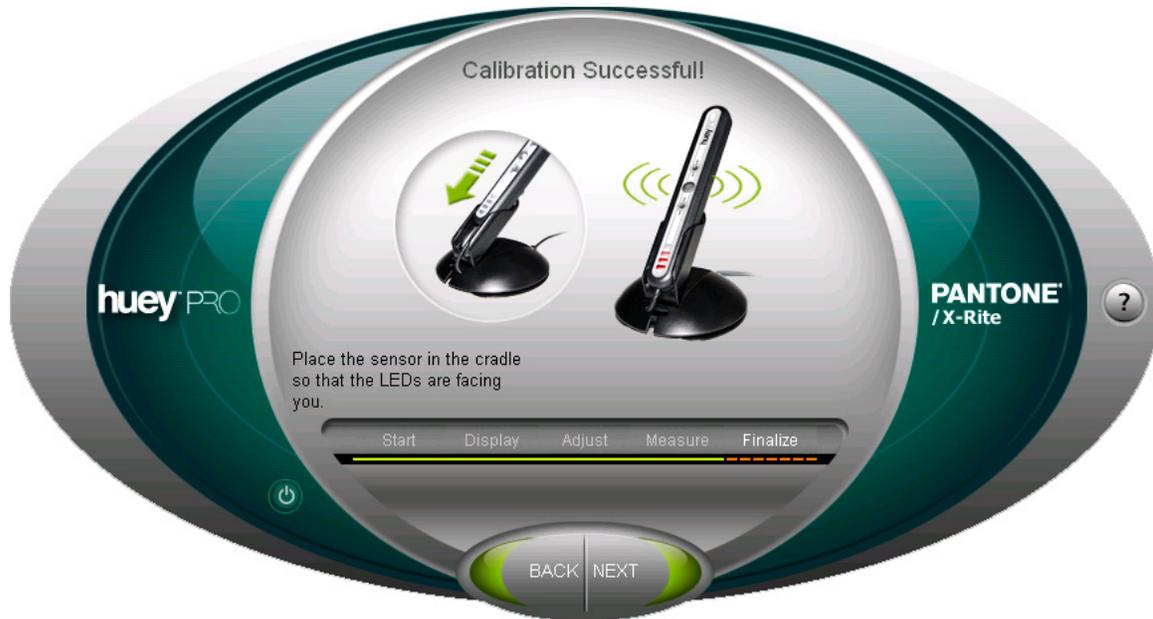


## Step 7

When the measurement process is complete, return **huey** to its desktop cradle.

Click “Next.”

Note: When **huey** is not in use, always place it in the desktop cradle. This will help keep the suction cups lint free and the ambient light sensor facing the same direction as the monitor to adjust for room light changes. When inserting **huey** into the cradle, be sure to insert the cable end first. Extra cable can be wrapped in the base. Inserting **huey** into the cradle with the sensor side down might damage the padding surrounding the sensors. Wrapping with the sensor up and then reclining the sensor may result in pulling the cable out of the sensor.



## Step 8

After successfully calibrating your monitor you can see the before and after by simply switching between “**Show corrected**” and “**Show uncorrected**”. Click “**NEXT**” once you have studied the differences.



## Step 9

For **hueyPRO** software, input a profile name to easily locate the profile on your system. The software will automatically store the profile in its appropriate location on your system as follows:

- **Windows operating system:** C:\WINDOWS\system32\spool\drivers\color
- **Mac operating system:** Your Home Folder/Library/ColorSync/Profiles



**Note:** For **huey** software, the profile will be stored automatically with a default name, for example "hueyViewSonicG810.icc".

## Step 10

This step is different for **huey** software and **hueyPRO** software.

For **hueyPRO** software:

Before you are finished, the **hueyPRO** software will prompt you to select your color settings.

“Color Temperature” and “Gamma” settings are independently changeable with separate pull-down menus as below:



continued on the next page...

## Step 10 - continued



### Color Setting Choices

The settings you choose depend on how you use your computer and monitor.

- Temperature Setting:** Warm (5000 K), Neutral (6500 K), and Cool (7500 K) - Color setting/ balance refers to the "shade" of white displayed on the screen. Color temperature is measured on the Kelvin scale. This describes the color of light emitted by a glowing element heated to the specified temperature. The higher the color temperature, the cooler (bluer) the light. The lower the color temperature, the warmer (redder) the light.
- Contrast Setting:** Low (gamma 1.8), Medium (gamma 2.2), and High (gamma 2.4) - Contrast refers to the difference between light and dark objects on-screen. Technically, contrast is measured by gamma, the relationship between input and output signals. Higher gamma settings will result in a darker screen with more contrast. The lower settings will provide a brighter screen with less contrast.

Suggested setting for use	Illuminate (color temperature)	Gamma
Gaming	6500 K	1.8
Web Browsing & Photo Editing	6500 K	2.2
Graphic Design & Video Editing	6500 K	2.4

## Step 10 - continued

This step is different for **huey** software and **hueyPRO** software.

For **huey** software:

Before you are finished, the **huey** software will prompt you to select your color settings according to your primary viewing activity such as looking at photos, playing games, browsing the Web, etc. Your monitor will be adjusted based on your choice.



### Color Setting Choices

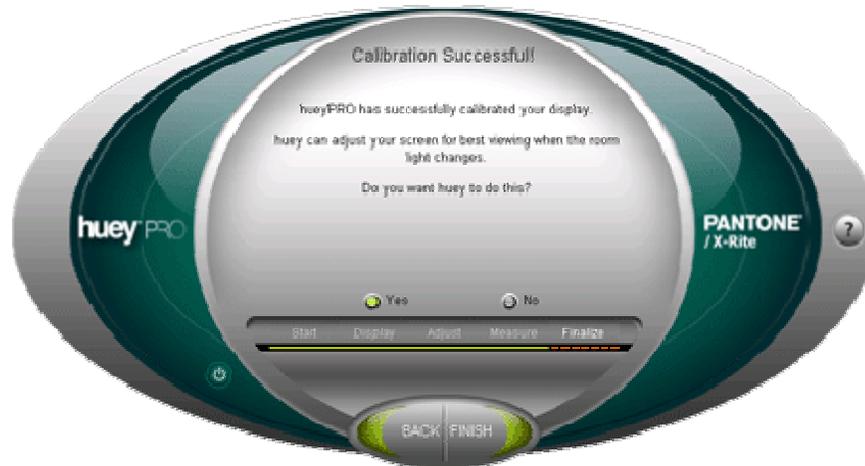
You can choose one of nine pre-defined settings that control your monitor's contrast and color balance. The settings you choose depend on how you use your computer and monitor.

- Temperature Setting:** Warm (5000 K), Neutral (6500 K), and Cool (7500 K) - Color setting/ balance refers to the "shade" of white displayed on the screen. Color temperature is measured on the Kelvin scale. This describes the color of light emitted by a glowing element heated to the specified temperature. The higher the color temperature, the cooler (bluer) the light. The lower the color temperature, the warmer (redder) the light.
- Contrast Setting:** Low (gamma 1.8), Medium (gamma 2.2), and High (gamma 2.4) - Contrast refers to the difference between light and dark objects on-screen. Technically, contrast is measured by gamma, the relationship between input and output signals. Higher gamma settings will result in a darker screen with more contrast. The lower settings will provide a brighter screen with less contrast.

Color Setting Choice	Illuminate (color temperature)	Gamma
Gaming	6500 K	1.8
Web Browsing & Photo Editing	6500 K	2.2
Graphic Design & Video Editing	6500 K	2.4
Special: Warm, Low Contrast	5000 K	1.8
Special: Warm, Medium Contrast	5000 K	2.2
Special: Warm, High Contrast	5000 K	2.4
Special: Cool, Low Contrast	7500 K	1.8
Special: Cool, Medium Contrast	7500 K	2.2
Special: Cool, High Contrast	7500 K	2.4

## Step 11

You will be prompted to select if you would like **huey** to adjust your monitor for room light changes. Select “**Yes**” or “**No**” and click “**FINISH**.”

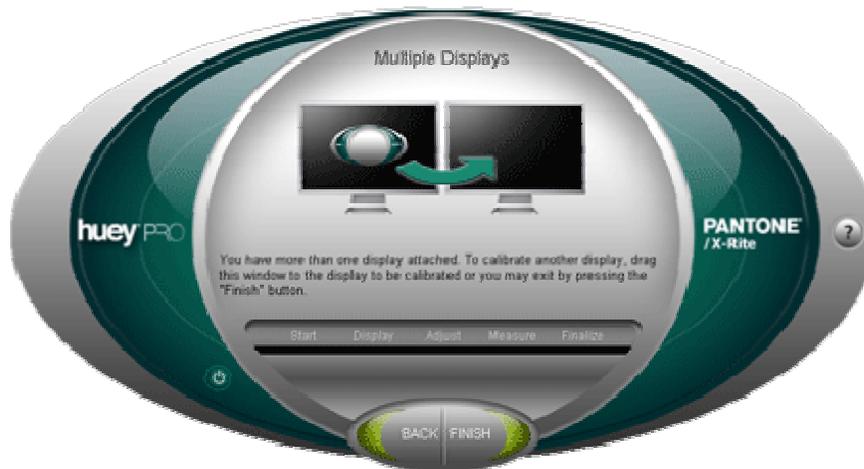


**Note:** hueyPRO software users if you have multiple monitors, continue to the next step.

## Step 12

### Multiple Monitors

This feature is only available in **hueyPRO**. If you have multiple monitors you will be asked if you would like additional monitors calibrated and if so, drag the **hueyPRO** application window to the other monitor and follow the same steps to calibrate your additional monitors.



**Note:** All monitors will be set to the same 'Color Temperature' and 'Gamma' settings for increased consistency.

## huey/hueyPRO Preferences

Your settings can easily be changed after you have completed the color calibration process through the Preferences menus (available from the **huey/hueyPRO** icon in the system tray on Windows or on the menu bar on a Mac) without re-measuring your monitor.

Click on the **huey/hueyPRO** icon.

- Red icon for **huey** software
- Green icon for **hueyPRO** software



Select “**huey/hueyPRO** Preferences.”



**huey/hueyPRO** Preferences window will be displayed on your monitor.

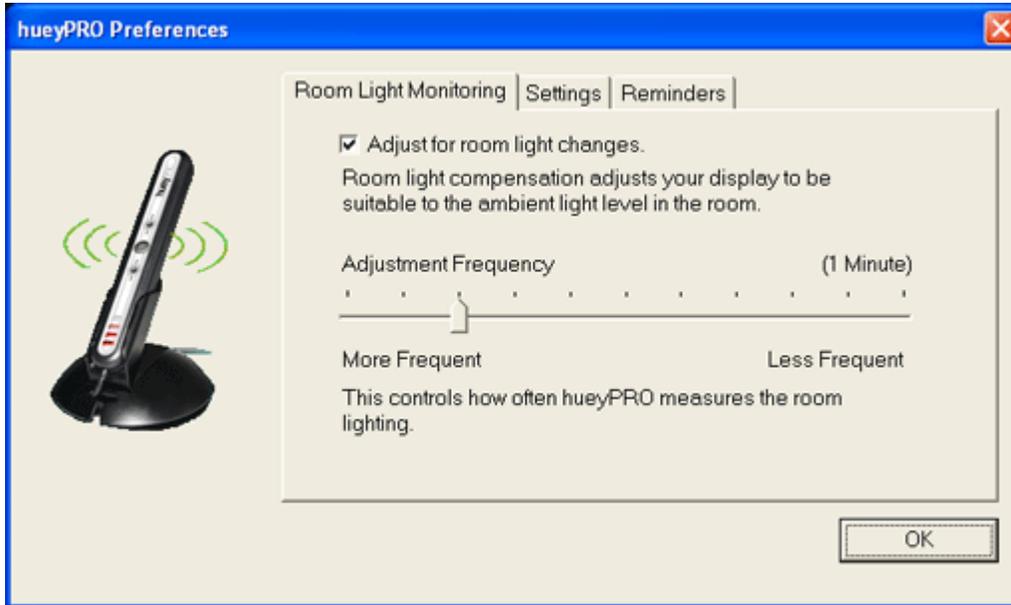
The next few pages have additional information about “Room Light Monitoring”, “Settings” and “Reminders.”

**Note:** **huey** software does not have some of the features that are discussed in section.

### Room Light Monitoring:

You can switch on/off the ambient light measurement feature.

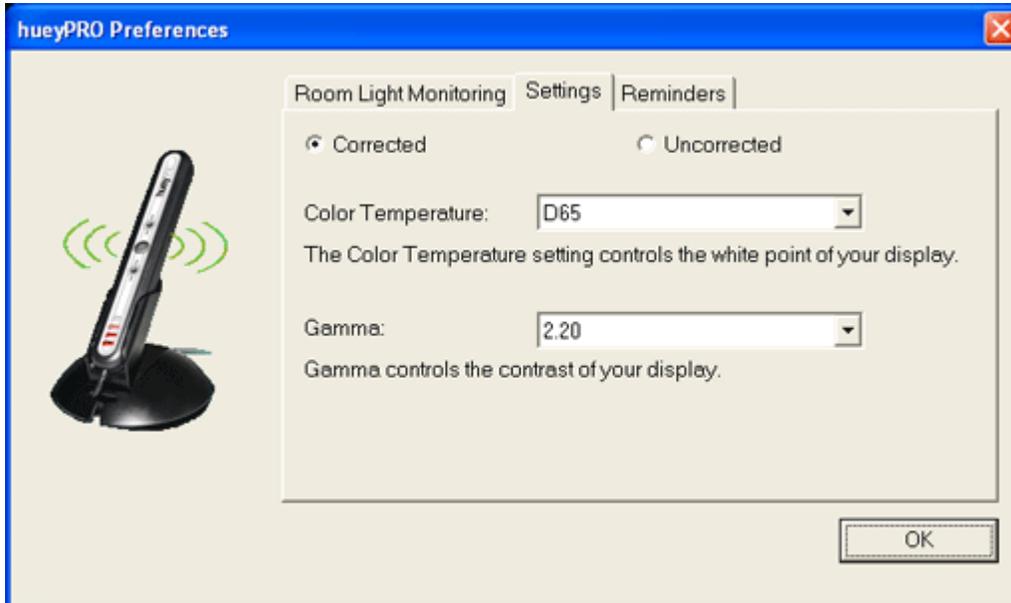
You can set the room lighting monitor to a desired interval from 10 seconds to 4 hours. For optimum ambient light adjustment, position **huey** in its cradle with the ambient light sensor facing in the same direction as the monitor screen. The ambient light sensor is on the same side as the indicator LEDs and logo.



**Settings:**

You can switch from “Corrected” to “Uncorrected”.

You can change your “Color Temperature” & “Gamma.”

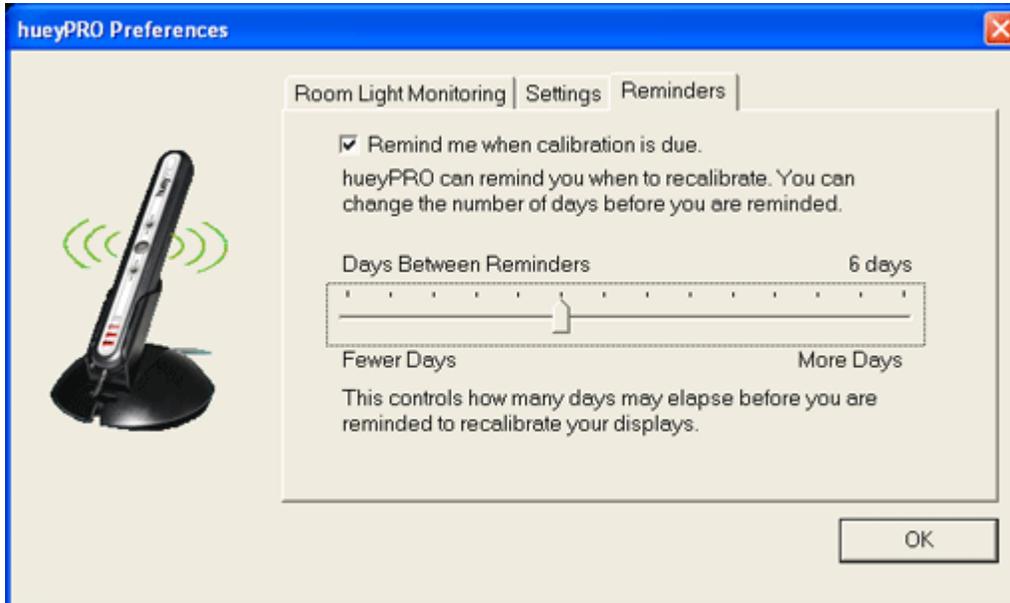


**Note:** huey software does not have separate “Color Temperature” and “Gamma” controls. However similar settings are available under the predefined settings in the pull down for “Color Settings.” Also see Step 10 for more information on “Color Settings.”

**Reminders:**

Turn on/off the reminder to re-calibrate your monitor as well as setting the reminder to recalibrate your display.

Note: This feature is ONLY available for **huey/hueyPRO** software.



**Note:** huey software does not have this feature.

## Advanced Help Section

The following section will help you better understand some important questions you may have about your monitor, different characteristics of your monitor profile, what you have to do once you have calibrated and profiled your monitor, etc. We have designed this section in the form of questions and answers. All you have to do is click on your question and it will take you to the answer. If you still have additional questions and require further assistance, you can contact us at: [www.askpantone.com](http://www.askpantone.com).

Questions are sectioned into the following categories:

[Basic Color Management Questions](#)

[Monitor Calibration](#)

[After Calibrating](#)

[Printing](#)

## Basic Color Management Questions

1. What is Gamma?
2. What is Whitepoint?
3. What is the difference between luminance, contrast and brightness?
4. What is an ICC monitor profile?
5. What is a ColorSync profile?

### 1. What is Gamma?

Monitor gamma describes the relationship between the strength of a monitor's input signal and the brightness of the displayed image. The industry standard for the truest capable grayscale of a monitor is 2.2 Gamma. This is the gamma that is best for viewing color images and browsing the web.

### 2. What is Whitepoint?

The monitor's whitepoint is the temperature measured in Kelvin. The higher the whitepoint, 7500K – 9300K, the brighter and bluer or "cooler" the screen looks. The lower the whitepoint, 6000K – 5000K, the less bright and redder or "warmer" the screen looks. The ideal setting for most displays is 6500K when working with images, photographs or browsing the Web. However, often the settings for displays when they are "out-of-the-box" are very bright and bluish and we get used to seeing everything big and bright. In fact, this is one of the key reasons why your screen and print do not match. The mismatch between the brightness of colors on the monitor and color printed on your inkjet are worlds apart - it precisely is the reason that you need to calibrate and profile your monitor, to bring what you see and what you get closer together.

Color balance refers to the "shade" of white displayed on the screen. Technically, Color temperature is measured on the Kelvin scale. This describes the color of light emitted by a glowing element heated to the specified temperature. The higher the color temperature, the brighter and cooler (bluer) the monitor will appear. The lower the color temperature, the less bright and warmer (redder) will be the overall appearance of the monitor.

### 3. What is the difference between luminance, contrast and brightness?

Luminance is the luminous intensity projected on a given area and direction. Luminance is an objectively measurable attribute. The unit is 'Candela per Square Meter' (cd/m<sup>2</sup>). So, different monitors can be adjusted to the same luminous intensity by measuring the luminance in cd/m<sup>2</sup>.

To learn more about Luminance, visit: <http://www.crompton.com/wa3dsp/light/lumin.html> .

Brightness is a subjective attribute of light. The monitor can be adjusted to a level of light between very dim and very bright. Brightness is perceived and cannot be measured objectively (but it can be scaled, e.g., as a percentage).

Contrast refers to the difference between light and dark objects on-screen. Technically contrast is measured by gamma, the relationship between input and output signals.

### 4. What is an ICC monitor profile?

An ICC (International Color Consortium) profile describes how your monitor reproduces color and what colors it can or cannot produce and encodes this information. A profile can be used by any application that uses ICC profiles to compensate for a monitor's color-display limitations. Accurately calibrating and characterizing your monitor is the crucial first step in developing a color-managed workflow.

### 5. What is a ColorSync profile?

A ColorSync profile is an ICC profile used on the Macintosh Operating systems.

## Monitor Calibration

1. What is monitor calibration and why do I need it?
2. What does “calibration” mean?
3. Does huey calibrate and profile the monitor?
4. What if I’m not using a color-managed application? Does huey matter?
5. What does huey calibrate to?
6. Isn’t monitor calibration just for professionals?
7. I have calibrated my monitor online, or using Apple Display Calibrator or with Adobe Gamma. Why should I buy a sensor to calibrate and profile my monitor?
8. How often should I recalibrate my monitor?
9. Will the huey calibrate my laptop monitor?
10. Is it possible to calibrate/profile dual monitors with the huey™PRO software?
11. How should I position huey for ambient light measurement?
12. How does Adobe Gamma affect huey monitor calibration?
13. How do I disable Adobe Gamma on a Windows system?
14. Should I turn off the rooms’ lights before calibrating my monitor?
15. Are there graphic cards that will cause problems when I’m calibrating my monitor?

### 1. What is monitor calibration and why do I need it?

Every monitor is different – they each have their own unique “fingerprint” and change over time. As monitors age, they degrade due to phosphors fading, liquid crystals wearing out and the performance is just not the same. As a result, the colors on the monitor look different. One of the biggest reasons for poor color in your prints is failure to calibrate and profile the monitor. **huey’s** sensors will analyze how the monitor emits color and correct the display to show true color.

### 2. What does “calibration” mean?

Calibrating is the process of returning a device to known color conditions by manipulating brightness, contrast and color balance. Regular calibration is necessary for displays because they shift and may change over time – the phosphors in CRT monitors lose brightness and the dyes in LCD cells can wear out. In order to ensure that your monitor can reproduce the optimal color gamut, you must first calibrate your monitor before you profile it.

### 3. Does huey calibrate and profile the monitor?

Yes, **huey** will calibrate your monitor first and then will take the data to create an ICC profile specific to your monitor. **huey** performs 2 distinct functions - calibration and profiling. **huey** calibrates the monitor, adjusting it for the display standard for images and web browsing. **huey** then profiles the monitor taking it one step further by providing the fingerprint of your monitor that can be interpreted in color managed applications like Adobe Photoshop for the highest degree of visual and color precision.

### 4. What if I’m not using a color-managed application? Does huey matter?

The answer is YES because it will still ensure that the monitor is displaying color as accurately as possible. On a system level, your computer will use the profile that **huey** creates to control the display of color.

### 5. What does huey calibrate to?

**huey** builds an ICC profile of the monitor based on the brightness and contrast settings that are adjusted during the profiling process. **huey** is unique in that it provides color settings that allow you to dynamically change the whitepoint/gamma combination that is being used. This information is uploaded to your computer's video card independent of the profile. In addition, during the profile process **huey** projects a precise series of color patches and measures the monitor's interpretation of these colors to set the monitor's color balance properly.

## Monitor is Calibration - continued

### 6. Isn't monitor calibration just for professionals?

No. While it's true all professionals dealing with color-critical work do need to calibrate their displays on a regular basis, even if you are not a graphics professional, you may be frustrated that your printouts from your inkjet printer do not match your monitor and further, their quality is less than satisfactory. You will immediately begin seeing the benefits of a color-corrected monitor.

Anyone who fixes red-eye or edits images, prints at home, works in graphic design, or is just frustrated wasting time, paper and ink will get improved results and better color fidelity.

### 7. I have calibrated my monitor online, or using Apple Display Calibrator or with Adobe Gamma. Why should I buy a sensor to calibrate and profile my monitor?

Online adjustments and Adobe Gamma are based solely on a person's vision. The accuracy of someone's vision can vary and be affected by outside lighting. Using a sensor, which is calibrated specifically for monitor color correction, takes the guesswork out of getting the right colors on-screen and in print.

### 8. How often should I recalibrate my monitor?

How often to recalibrate your monitor with **huey** depends upon a number of variables:

- Stability of the monitor
- Type of files that you view
- Level of color matching required

A typical user calibrates every two weeks. However, you may want to recalibrate daily, weekly or monthly. If you notice a change in your monitor's appearance, it may be time to recalibrate. If you're demanding about color or your monitor doesn't hold calibration very long, you may want to recalibrate weekly or even daily. If your monitor is relatively stable or you view non-color critical documents, it may only be necessary to calibrate once per month.

### 9. Will the huey calibrate my laptop monitor?

Yes, **huey** will calibrate all CRT, LCD and laptop displays.

### 10. Is it possible to calibrate/profile dual monitors with the huey™PRO software?

Calibration of dual monitors is a feature of the **hueyPRO** software only.

### 11. How should I position huey for ambient light measurement?

**huey** has a sensor for adjusting your monitor's contrast according to ambient room lighting conditions. This helps the display look the same as light changes throughout the day. **huey** measures the ambient light before profiling. It can also adjust your monitor's contrast at specified intervals, from every 10 seconds to four (4) hours.

For optimum ambient light adjustment, position **huey** in its cradle with the ambient light sensor facing the same direction as your monitor screen is facing. The ambient light sensor is on the same side as the indicator LEDs and **huey** logo.

## Monitor is Calibration - continued

### 12. How does Adobe Gamma affect huey monitor calibration?

Adobe Gamma is a free, visually based monitor calibration program that is installed automatically when Adobe Photoshop® is installed on Windows computers. Adobe Gamma can interfere with the **huey** calibration, which can cause bad calibration results (color shifts, strange brightness, etc.).

Before calibrating your monitor with the **huey** software or **hueyPRO** software, you should disable Adobe Gamma.

To do so:

- Click on "START."
- Click on "Programs."
- Click on "Startup."
- Right-click on "Adobe Gamma" and choose "Delete."

For Mac OS, Adobe Gamma is not applicable.

### 13. How do I disable Adobe Gamma on a Windows system?

To disable Adobe Gamma on a Windows system, do the following:

1. Right-click the Start menu, and choose 'Open.'
2. Double-click Programs, then Startup.
3. Delete Adobe Gamma or Adobe Gamma Loader.exe if present.
4. For Windows 2000, XP only, repeat steps 1 - 3, choosing 'Open All Users' in Step 1.
5. Close the Startup window to return to the main screen.

**Note:** This procedure does not delete Adobe Gamma from your hard-drive. It merely removes the shortcut to the startup file to prevent Adobe Gamma from loading its calibration in place of the monitor calibration solution you are currently using.

### 14. Should I turn off the rooms' lights before calibrating my monitor?

It is not necessary to do this as **huey** is designed to block most of the room light during measurement. It is not affected much by room lighting, unless very bright light, such as direct sunlight, strikes the display.

Also, **huey** is designed to adjust your monitor for ambient lighting. When calibrating, you should set the light level as you normally would when viewing your monitor.

For viewing photos on-screen, we recommend that room lights have balanced color temperature and are dim enough to view the monitor comfortably. The graphic arts viewing standard specifies 5000 K lighting (however we suggest 6500 K in our settings), which is equivalent to noon daylight. Incandescent light bulbs, warm white fluorescent lamps, and cool white fluorescent lighting are not evenly balanced and may make prints look differently than they do on-screen.

### 15. Are there graphic cards that will cause problems when I'm calibrating my monitor?

Yes, some Radeon Series from ATI may deliver unexpected calibration results. The resulting gamma curve may contain strange peaks and the display may show a strange color shift. The reason is that the ATI Radeon card driver, version 4.1, has a bug. The monitor calibration software is not able to reset the gamma curve before starting the calibration process.

This bug has been fixed by ATI. If your video card is installed on a desktop computer, you can download the newest driver versions from [www.ati.com](http://www.ati.com). If you work on a notebook, please contact your dealer or the manufacturer of your notebook and request an appropriate driver update.

## After calibrating the monitor

1. What does huey do with the profile?
2. Which color settings in huey software and hueyPRO software should I choose?
3. How do I tell if my monitor calibration and profile are good?
4. How do I switch a monitor's calibration and profile on the fly without rebooting on Windows?
5. Why is my screen yellowish and dull looking after calibrating?
6. Why does my screen appear dim compared to the native setting?
7. Why do images look different in Web browsers than they do in Adobe Photoshop?
8. I have calibrated my monitor. When working with Adobe Photoshop which color settings (edit/color settings) should you choose?
9. Does an Embedded Profile Limit the Colors Within an Image?

### 1. What does huey do with the profile?

After **huey** software creates a profile, it is automatically stored and activated in the proper systems folder (Windows or Mac) so that it is ready to be used. For **hueyPRO** users, you will be prompted to name the profile and for **huey** users, the software will give the profile a default name.

**Windows:** C:\WINDOWS\system32\spool\drivers\color

**Macintosh:** Your Home Folder/Library/ColorSync/Profiles

### 2. Which color settings in huey software and hueyPRO software should I choose?

In **huey** software you can choose one of nine pre-defined settings that control your monitor's contrast and color balance. Higher gamma settings will result in a darker screen with more contrast. The lower settings will provide a brighter screen with less contrast.

- Color Setting (temperature): Warm (5000 K), Neutral (6500 K), and Cool (7500 K)
- Contrast Setting (gamma): Low (1.8), Medium (2.2), and High (2.4).

The settings you choose depend on how you use your computer and monitor, for example:

- Gaming (6500 K, 1.8)
- Web Browsing & Photo Editing (6500 K, 2.2)
- Graphic Design & Video Editing (6500 K, 2.4)
- Special: Warm, Low Contrast (5000 K, 1.8)
- Special: Warm, Medium Contrast (5000 K, 2.2)
- Special: Warm, High Contrast (5000 K, 2.4)
- Special: Cool, Low Contrast (7500 K, 1.8)
- Special: Cool, Medium Contrast (7500 K, 2.2)
- Special: Cool, High Contrast (7500 K, 2.4)

If you are playing computer games, you may want to choose different settings based on the type of game being viewed. For example, players of the relatively dark game, Doom™, may want to set color to "Warm" (5000 K) and contrast to "Low" (1.8) to better see the shadows of the dark scenery. A "Madden Football" player might set color to "Neutral" (6500 K) and contrast to "High" (2.4) to best see the game's light, blue and green scenery. A "Harry Potter" player might choose a color of "Warm" (5000 K) and contrast of "Medium" (2.2) to best see this game's light and dark scenery.

In **hueyPRO** software you can select your own color temperature and gamma that you prefer. We recommend you display an image in the background as you are switching through the different selections to see which combination works best for you.

## After calibrating the monitor – continued

### 3. How do I tell if my monitor calibration and profile are good?

After calibrating and profiling your monitor with **huey**, it should look essentially neutral in color and have smooth contrast. Depending on the type of file you are viewing, such as photographs, computer games or office documents, check light, medium and dark areas of the screen to make sure they look neutral and do not have a strong color cast. Examine gradients or blends if present to make sure they are smooth.

You can perform a more comprehensive test of your **huey** monitor profile if you have Adobe Photoshop or any other application that is able to display photos (bitmapped images) using ICC profiles. In the following steps, you can view the images with or without the monitor profile. To turn off the monitor profile in Adobe Photoshop, select **View > Proof Setup > Monitor RGB**. The monitor profile will be off if **View > Proof Colors** is checked. To turn the profile on and off, uncheck and then recheck **Proof Colors**.

1) Compare with an image. Open an image in Adobe Photoshop and compare it on-screen with a print. Select an image that you have printed with a printer profile you know is good. If the print is viewed in balanced illumination (daylight or 5000 K illumination), the image on-screen should look the same. If viewed in home incandescent, office fluorescent, or any other lighting that is not neutral, the printed image will be off and will not match the screen exactly.

2) Use the gradient tool in Adobe Photoshop to make a gradient from black (RGB = 0 0 0) to white (255 255 255). Examine the gradient with the monitor profile on and off (see above instructions). The gradient should be smooth from highlight to shadow.

3) Check shadow definition. Create a series of rectangles with RGB values of 0 0 0 (black), 8 8 8, and 12 12 12. If your monitor is properly calibrated and profiled, you should be able to see a difference between the three rectangles.

### 4. How do I switch a monitor's calibration and profile on the fly without rebooting on Windows?

Unlike Macintosh operating systems, Windows operating systems do not have 'dynamic profile loading,' therefore, you cannot instantly upload a different lookup table to your video card.

To switch between different calibrations and profiles on Windows, you need to use DisplayProfile utility. This freeware allows you to switch both the calibration and profile without having to reboot the computer. If you do not use this application and just switch the profile in the display's properties window, it will load the new profile, but not the new calibration. To download this DisplayProfile utility please [Click Here](#). Scroll to the bottom the page and you will find "DisplayProfile freeware for Windows."

### 5. Why is my screen yellowish and dull looking after calibrating?

If you picked the "Warm" color temperature (5000 K), your monitor may look yellowish compared to its native state that you have been used to viewing. The native color temperature of many monitors, particularly TV-tube monitors (CRTs), is much bluer than that of a calibrated monitor.

Both the **huey** software and the **hueyPRO** software have three settings for Color Temperature: Warm (5000 K), Neutral (6500 K), and Cool (7500 K). The higher the color temperature in Kelvin, the bluer the display; the lower, the warmer it is. If your display looks too yellow, you might want to choose a cooler setting.

The 5000 K "Neutral" setting was designed for graphic arts, where standard viewing conditions are specified as 5000 K. This specification was written for fluorescent light bulbs, however, which are much brighter than computer displays. You may find that the "Neutral" setting (6500 K) produces a more balanced color on-screen.

Likewise, if you picked the "Low" contrast setting, the screen will look duller than with the "Medium" or native settings. A setting of "Medium" may produce a more pleasing appearance.

Different settings will be appropriate for the way you are using your computer, including graphic arts, photography, video gaming, Internet viewing and document processing.

## After calibrating the monitor – continued

### 6. Why does my screen appear dim compared to the native setting?

During calibration, **huey/hueyPRO** software creates a set of correction curves that balance your monitor's red, green and blue signals to create a more neutral color balance and to set a numerically defined contrast. The calibrator cannot make the monitor brighter; it can only dim channels relative to one another. So, even though the monitor may appear dimmer than it did before calibration, it is still displaying balanced, repeatable color and contrast.

If your monitor looks too dim after calibrating, you might want to set a higher brightness level before calibrating.

### 7. Why do images look different in Web browsers than they do in Adobe Photoshop?

Adobe Photoshop reads the standard working space profile embedded in images, then converts from this profile to the monitor profile for accurate display. Some browser applications read neither the standard working space profile nor the monitor profile; therefore, they only benefit from the monitor calibration and not the profile.

### 8. I have calibrated my monitor. When working with Adobe Photoshop which color settings (edit/color settings) should you choose?

After calibration, the **huey** profile is stored in the operating system as the "Default Monitor Profile". When Adobe Photoshop is open/running the software automatically refers to the "Default Monitor Profile", in our case the **huey** profile. From the "Edit>Color Settings" menu users should mostly be using "**Adobe RGB 1998**" working space for the widest possible color gamut or "**sRGB**" working space if they want to simulate Web colors. The **huey** profile will appear above these selections in the drop-down menu; however this is just a reference to the user showing them that Adobe Photoshop recognizes and is using the default monitor profile already. The user does not have to change any settings in Adobe Photoshop after calibration for the **huey** profile to be "in-use."

### 9. Does an Embedded Profile Limit the Colors Within an Image?

An embedded color profile or an assignment of a profile in Adobe Photoshop does not actually change the data in the file; it merely tells the application how to interpret those color numbers. It describes what red, green and blue look like and how they appear in various combinations. This does not limit the adjustments you can make. **Note:** However, assigning different profiles to the same image data will produce different results. If you start off with an image that has an embedded profile or sRGB and then assign it Adobe RGB (1998), the image will become much more vivid. This is because the Adobe RGB (1998) color space is much larger than sRGB, so "red" is much "redder." If you want a full understanding of profiles and color management, refer to "**Real World Color Management**" by Bruce Fraser as it covers all the fundamentals as well as practical aspects and specific settings for various programs.

## Printing after the Monitor is Calibrated

1. I understand that huey can calibrate my monitor but how can I ensure that my prints are going to match what I see on-screen?
2. What are "canned" profiles?
3. How are custom profiles created?
4. Should I build an RGB or CMYK profile?
5. Where to place the profile on my system?
6. How to print using a printer profile?
7. What is soft proofing?

### 1. I understand that huey can calibrate my monitor but how can I ensure that my prints are going to match what I see on-screen?

**huey** and **hueyPRO** are monitor solutions only. In order to achieve 'screen-to-printer matching,' you would need to have a valid ICC profile for your printer as well, and ensure that the profile is properly assigned at the time of output. Many printer manufacturers make pre-made or "canned" ICC profiles available. These are often available on the manufacturers' Web sites or included with the printer driver software. A profile is made for a specific printer, ink and paper. Should you change any one of those three things, you will need a different profile.

Additionally, there are also services that will allow you to submit a printed target, and will make profiles for you, usually for a fee. (Pantone offers [ColorValet](#), the custom ICC printer profiling service from CHROMiX. It is fast and easy) Performing a Google™ search on 'ICC profiling' should provide you with contacts for profiling services.

If you are sending work to a lab or service bureau, you need not concern yourself with the output. Typically, you will embed a source profile into the image which contains the information about your monitor that is provided by the profile which would be made with **huey**. It is the lab's responsibility to color-manage the file to their output system.

### 2. What are "canned" profiles?

Every printer manufacturer supplies ICC color profiles that are specifically designed for the papers that the printer manufacturer sells. For example on Seiko Epson Corporation's website you will find ICC profiles for the specific printer and a specific media type, i.e., EPSON PRO4000 using EPSON Premium Luster Photo Paper. These profiles are designed to correctly print color onto this same kind of paper from your printer. If you are printing with EPSON Premium Luster Paper, then you would choose this profile when you print.

If you are using Moab, Arches Infinity, Red River, or any other paper manufacturers' media you can find profiles for their paper types on the paper manufacturers' Website. Many times the "canned profiles" will not give you the best color since the profiles are more "generic" and not specifically built for your printer, its environment and your media types. Also, there can be minor differences in consistency between different printers even if they are of the same model. So, despite manufacturer-supplied profiles with manufacturer paper, a precise color match might not be achievable.

If you are using EPSON printers and printing with PANTONE® **ColorVANTAGE®** Inks, you will find ICC profiles at [www.pantone.com](http://www.pantone.com).

If you are using

- [Canon Printers](#)
- [EPSON Printers](#)
- [Hewlett-Packard Printers](#)
- [RedRiver Paper](#)
- [Moab Paper](#)
- [Arches Infinity Paper](#)
- [Hahnemuehle Paper](#)

## Printing after the Monitor is Calibrated - continued

### 3. How are custom profiles created?

Custom profiles are made specifically for your printer. Using your printer, your printers' ink set, your specified media type and with a specific printer driver setting. Custom-created profiles present the highest level of accuracy that can be achieved with printer profiles.

There are many software and hardware packages available for custom profiling. Users can build their own profiles by printing a target provided in the package with instructions. Users can measure the targets on the hardware that comes with the package and then use the software to build the profile. The cost of these packages runs from \$600 to several thousand dollars depending on the quality and the extent of the features.

As an alternative to "doing-it-yourself", there are service providers who supply custom printer profiles over the Web. There is a cost advantage to using a service provider, especially if you only need a small number of profiles. In addition, many people find that allowing a service provider to do their profiling makes life simpler for them. Finally, it is possible to get a better profile from a competent profiling service than one can make oneself - without investing in several thousand dollar's worth of equipment.

The usual procedure is:

1. Download instructions and a profiling target image.
2. Print the profiling target image on your printer, following very specific instructions.
3. Mail the target print into the profiling service.
4. The service provider measures the target using their spectrophotometric equipment
5. The service provider uses the target measurement to create the profile, and emails the profile back to the customer.

If you are in need of custom profiles, Pantone offers [ColorValet](#), the custom ICC printer profiling service from CHROMiX. It is fast and easy. You will have to download a Web-based application program, which will guide you through the whole process and will also manage all of your profiles.

If you are interested in purchasing your own profiling solutions visit [www.x-rite.com](http://www.x-rite.com). You will find packages such as [Profile Maker 5 Photostudio](#), [Profile Maker 5 Publish Plus](#), [Eye-One® Design](#), [Eye-One Photo](#), etc.

### 4. Should I build an RGB or CMYK profile?

It is useful to know whether your printer will be considered an RGB device or a CMYK device. This cannot be determined merely by reading the color names of the print cartridges, or by counting the cartridges. Most inkjet printers will use at least four standard inks: Cyan, Magenta, Yellow, and Black - yet most inkjet printers will need to be profiled as RGB devices. Generally, if a driver is used to submit images directly to the printer, then it should be profiled as an RGB device. If you are printing through a RIP, then you might be looking at a true CMYK process.

### 5. Where to place the profile on my system?

- **For Windows operating systems:** C:\WINDOWS\system32\spool\drivers\color
- **For Macintosh operating systems:** User/Library/ColorSync/Profiles

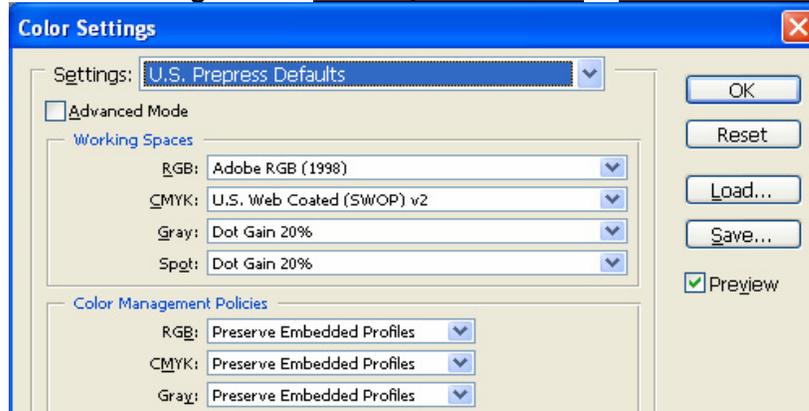
## Printing after the Monitor is Calibrated - continued

### 6. How to print using a printer profile?

When you are ready to print your image in Adobe Photoshop CS2:

#### Step 1: Check your “Color Settings”

1. Launch **Adobe Photoshop CS2** (Adobe Photoshop CS (Mac) or older the steps below may differ)
2. Go to **Edit** → “**Color Settings...**”
3. Under “**Settings**” select: **U.S. Prepress Defaults** or **North American Prepress 2**

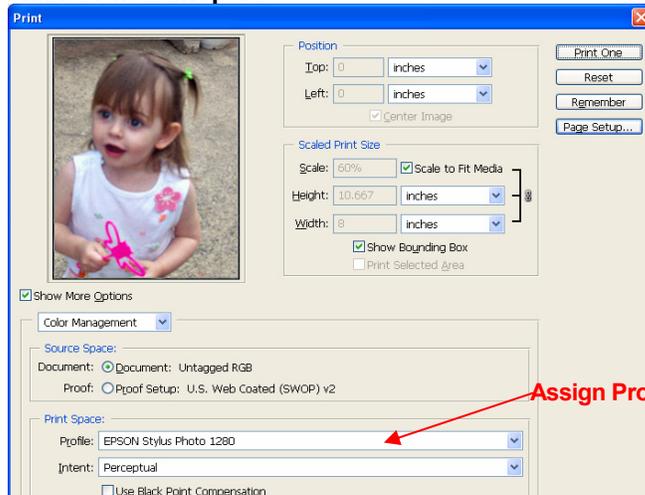


4. Click “**OK.**” Now you are ready to print your image, the next few pages have instructions on assigning printer profiles.

Once you have configured your “**Color Settings,**” open an image in Adobe Photoshop and follow the steps below:

1. File → “**Print with Preview...**” assign your profile as shown below.

#### Adobe Photoshop CS



**Profile:** use the pull-down to assign your profile  
**Intent:** “**Perceptual**”

## Adobe Photoshop CS2



**Color Handling:** "Let Photoshop Determine Colors"  
**Printer Profile:** use the pull-down to assign your profile  
**Rendering Intent:** "Perceptual"

2. Click on **"Print"** this will bring you to another dialog box to select your settings within your printer driver.
3. Click on **"Properties."**
4. Select the appropriate media settings and dpi for which your profile was created.
5. Ensure that you select **"No Color Adjustment"** in the printer driver under **"Color Management."**
6. It is recommended that you save these settings as a preset as you will use these driver settings with printing images using the profile.
7. Click on **"Print."**

## Printing after the Monitor is Calibrated - continued

### 7. What is soft proofing?

You have a monitor profile for your recently-calibrated monitor. You also now have a well-made printer profile that you are printing through. Your profiled monitor is presenting to you your image as accurately as it can, given the limitations of the color gamut of the monitor. Your printer profile is printing your image in an intelligent way so that it looks as good as it can, given your intent, and the limitations of the printer. Monitors are capable of showing colors that printers cannot print (like saturated reds, blues and greens.) And printers can produce colors that are out-of-gamut for most monitors (like some cyans.) Soft Proofing allows you to look at your image in Photoshop through the printer profile so you can see what your image will look like when it is printed through the profile.

1. Open the image in Adobe Photoshop.
2. Choose "**View**→ **Proof Setup**→**Custom**."
3. **Profile:** *Select your new, custom profile.*
4. Intent: "**Perceptual**."
5. Check "**Black Point Compensation**."
6. Simulate: Paper White (unchecked), Ink Black (checked).
7. Leave "**Preserve Color Numbers**" unchecked.
8. Click "**OK**."

The monitor now shows what the image will look like when it gets printed, with all of the limitations and color adjustments that the printer and its profile will accomplish. This "soft-proof" should match fairly closely to what is printed through the same profile.

You can also save this whole setup as a "proof setup file" with a name you choose. You can quickly view an image through this soft proofing any time you want to see what your image will look like when printed.

## **Technical Support**

Pantone is committed to offering you immediate and polite technical support. Technical support is provided at no charge to registered users of our products. Please be sure to provide a concise description of your problem including your system specifics.

You can reach Pantone Technical Support several ways:

1. Telephone: 201-935-5500, Monday - Friday, 8:00 a.m. to 6:00 p.m., Eastern Standard Time
2. Fax: 201-896-0242 please ensure that you indicate whether you want a reply by telephone, fax or e-mail. Please do not forget to include your telephone, fax number or e-mail address.
3. Online: <http://www.askpantone.com>

## **How to Contact Us**

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## Glossary

[A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#)

### A

**Additive Primaries:** Red, green, and blue light. When all three additive primaries are combined at 100% intensity, white light is produced. When these three are combined at varying intensities, a gamut of different colors is produced. Combining two primaries at 100% produces a subtractive primary, cyan, magenta, or yellow: 100% red + 100% green = yellow; 100% red + 100% blue = magenta; 100% green + 100% blue = cyan. See *Subtractive Primaries*.

**Appearance:** Manifestation of the nature of objects and materials through visual attributes such as size, shape, color, texture, glossiness, transparency, opacity, etc.

**Attribute:** Distinguishing characteristic of a sensation, perception or mode of appearance. Colors are often described by their attributes of hue, saturation or chroma, and lightness.

### B

**Black:** The absence of all reflected light; the color that is produced when an object absorbs all wavelengths from the light source. When 100% cyan, magenta, and yellow colorants are combined, the resulting color theoretically- is black. In real-world applications, this combination produces a muddy gray or brown. In four-color process printing, black is one of the process inks. The letter “K” is used to represent Black in the CMYK acronym to avoid confusion with Blue’s “B” in RGB.

**Brightness:** The attribute of visual perception in accordance with which an area appears to emit or reflect more or less light (this attribute of color is used in the color model HSB—Hue, Saturation, Brightness). See *Lightness*.

### C

**Calibration:** To check, adjust, or systematically standardize the performance of a device.

**Characterize:** To specify the parameters or performance of an instrument or method of measurement.

**Characterization:** The process of learning the color character of a monitor so that a profile can be created to describe it.

**CIE (Commission Internationale de l’Eclairage):** A French name that translates to International Commission on Illumination, the main international organization concerned with color and color measurement.

**CMC (Color Measurement Committee):** Of the Society of Dyes and Colorists in Great Britain. Developed a more logical, ellipse-based equation for computing  $\Delta E$  values as an alternative to the spherical regions of the CIELAB color space.

**Color Management:** Matching colors between an original image, scanner, monitor, color printer and final press sheet.

**Color Model:** A color measurement scale or system that numerically specifies the perceived attributes of color. Used in computer graphics applications and by color measurement instruments.

**Color Separation:** The conversion of the red, green, and blue color information used in a computer into cyan, magenta, yellow, and black channels that are used to make printing plates.

**Color Space:** A three-dimensional geometric representation of the colors that can be seen and/or generated using a certain color model.

**Color Specification:** Tristimulus values, chromaticity coordinates and luminance value, or other color-scale values, used to designate a color numerically in a specified color system.

**Color Temperature:** A measurement of the color of light radiated by an object while it is being heated. This measurement is expressed in terms of absolute scale, or degrees Kelvin. Lower Kelvin temperatures such as 2400 K are red; higher temperatures such as 9300 K are blue. Neutral temperature is gray, at 6504 K.

**A B C D E F G H I J K L M N O P Q R S T U V W X Y Z**

**Color Wheel:** The visible spectrum's continuum of colors arranged into a circle, where complementary colors such as red and green are located directly across from each other.

**ColorSync®:** Built-in color management architecture for Apple Macintosh computers. Third-party vendors utilize the ColorSync framework to provide device calibration, device characterization, and device profile-building methods.

**Colorimeter:** An optical measurement instrument that responds to color in a manner similar to the human eye - by filtering reflected light into its dominant regions of red, green, and blue.

**Colorimetric:** Of or relating to values giving the amounts of three-colored lights or receptors - red, green, and blue.

**Contrast:** The level of variation between light and dark areas in an image.

**Control Limits:** The amount of acceptable variation in press capabilities over the course of a press run.

**D**

**D50:** The CIE Standard Illuminant that represents a color temperature of 5000 K. This is the color temperature that is most widely used in graphic arts industry viewing booths. See *Illuminants*.

**D65:** The CIE Standard Illuminant that represents a color temperature of 6504 K.

**Density:** Refers to a computed number representing the ability of a transmissive material to block light, or the ability of a reflective surface to absorb light. The more light blocked or absorbed, the higher the density.

**Device-Dependent:** Describes a color space that can be defined only by using information on the color-rendering capabilities of a specific device. For example, the RGB color space must be generated by a monitor, a device which has specific capabilities and limitations for achieving its gamut of colors. In addition, all monitors have different capabilities and limitations, as do different scanners, printers, and printing presses.

**Device-Independent:** Describes a color space that can be defined using the full gamut of human vision, as defined by a standard observer, independent of the color-rendering capabilities of any specific device.

**Device Profile:** Device-specific color information that is a characterization of a device's color rendering and reproduction capabilities. Monitor profiles, scanner profiles, and printer profiles are utilized in a color management system such as Apple ColorSync to help the devices communicate color information with each other. Profiles are created by calibration and/or characterization method.

**E**

**Emissive Object:** An object that emits light. Usually some sort of chemical reaction, such as the burning gasses of the sun or the heated filament of a light bulb.

**F**

**Fluorescent Lamp:** A glass tube filled with mercury gas and coated on its inner surface with phosphors. When the gas is charged with an electrical current, radiation is produced which in turn energizes the phosphors, causing the phosphors to glow.

**Four-Color Process:** Depositing combinations of the subtractive primaries cyan, magenta, yellow, and black on paper to achieve dots of different sizes, shapes, and angles to create the illusion of different colors.

**G**

**Gamut:** The range of different colors that can be interpreted by a color model or generated by a specific device.

**Gamut Compression:** Or tonal range compression. The color space coordinates of a color space with a larger gamut are reduced to accommodate the smaller gamut of a destination color space. For example, the gamut of photographic film is compressed for representation in the smaller CMYK gamut used for four-color process printing. See *Gamut*.

**Gamut Mapping:** Converting the coordinates of two or more color spaces into a common color space. Often results in tonal range compression. See *Gamut Compression*.

[A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#)

**H**

**HiFi Printing:** Process printing that expands the conventional four-color process gamut using additional, special ink colors.

**Hue:** The basic color of an object, such as “red,” “green,” “purple,” etc. Defined by its angular position in a cylindrical color space, or on a Color Wheel.

**I**

**ICC (International Color Consortium):** A group of hardware and software companies dedicated to the development of a specification that is OS independent and provides the digital imaging, printing and related industries with a data format for defining the color and reproduction characteristics of devices and their related media.

**ICM:** Built-in color management architecture for computers running the Windows operating system, third-party vendors utilize the ICM framework to provide device calibration, device characterization, and device profile-building methods.

**Illuminant:** Incident luminous energy specified by its spectral distribution.

**Intensity:** Saturation or reflective energy as related to visible wavelengths of light. Reflectance of wavelengths at high intensity generates high saturation, or chroma.

**K**

**Kelvin (K):** Unit of measurement for color temperature. The Kelvin scale starts from absolute zero, which is -273° Celsius.

**L**

**L\*C\*H:** A color space that is similar to CIELAB, except uses cylindrical coordinates of lightness, chroma, and hue angle instead of rectangular coordinates.

**Light:** Electromagnetic radiation in the spectral range detectable by the human eye (approx. 380 to 720nm).

**Lightness:** The attribute of visual perception in accordance with which an area appears to emit or reflect more or less light. Also refers to the perception by which white objects are distinguished from gray objects and light from dark-colored objects.

**M**

**Monitor RGB:** Same as RGB; monitor RGB simply refers specifically to the color space that can be achieved by a particular monitor using combinations of red, green, and blue light.

**N**

**Nanometer (nm):** Unit of length equal to 10<sup>-9</sup> meter, or one millionth of a milli-meter. Wavelengths are measured in nanometers.

**P**

**Phosphors:** Materials that emit light when irradiated by cathode rays, or when placed in an electric field. The quantity of visible light is proportional to the amount of excitation energy present.

**Photoelectric:** Pertaining to the electrical effects of light or other radiation—for example, emission of electrons.

**Photoreceptor:** The cone- and rod-shaped neurons that cover the retina of the eye. Photoreceptors are excited by visible wavelengths, then send signals to the brain where the sensation of color is perceived.

**Pixel:** A tiny picture element that contains red, green, and blue information for color rendering on a monitor or a scanner. When generating colors, pixels are similar to dots of ink on paper. A monitor resolution description in terms of pixels-per-inch (ppi) is similar to a printer resolution description in terms of dots-per-inch (dpi).

**Prism:** Triangular-shaped glass or other transparent material. When light is passed through a prism, its wavelengths refract into a rainbow of colors. This demonstrates that light is composed of color, and indicates the arrangement of colors in the visible spectrum.

**A B C D E F G H I J K L M N O P Q R S T U V W X Y Z**

**R**

**RGB:** The additive primaries red, green, and blue. See *Additive Primaries*.

**S**

**Saturation:** The attribute of color perception that expresses the amount of departure from the neutral gray of the same lightness. Also referred to as chroma.

**Spectrophotometer:** An instrument that measures the characteristics of light reflected from or transmitted through an object, which is interpreted as spectral data.

**Spectrum:** Spatial arrangement of electromagnetic energy in order of wavelength size.

**Standard:** An established, approved reference against which instrument measurements of samples are evaluated.

**Subtractive Primaries:** Cyan, magenta, and yellow. Theoretically, when all three subtractive primaries are combined at 100% on white paper, black is produced. When these three are combined at varying intensities, a gamut of different colors is produced. Combining two primaries at 100% produces an additive primary, either red, green, or blue: 100% cyan + 100% magenta = blue; 100% cyan + 100% yellow = green; 100% magenta + 100% yellow = red.

**T**

**Transmissive Object:** An object that allows light to pass through from one side to the other. The color of a transmissive object results from the manipulation of wavelengths of light as they pass through.

**Tristimulus:** A method for communicating or generating a color using three stimuli—either additive or subtractive colorants (such as RGB or CMY), or three attributes (such as lightness, chroma, and hue).

**V**

**Viewing Booth:** An enclosed area with controlled lighting that is used in graphic arts studios, service bureaus, and printing companies as a stable environment for evaluating proofs and press sheets. Viewing booths are generally illuminated using graphic arts industry-standard D65 lighting, and are surfaced in neutral gray colors. See *D65*.

**Visible Spectrum:** The region of the electromagnetic spectrum between 380 and 720 nanometers. Wavelengths inside this span create the sensation of color when they are viewed by the human eye. The shorter wavelengths create the sensation of violets, purples, and blues; the longer wavelengths create the sensation of oranges and reds.

**W**

**White Light:** Theoretically, light that emits all wavelengths of the visible spectrum at uniform intensity. In reality, most light sources cannot achieve such perfection.

## References

X-rite: [www.xrite.com](http://www.xrite.com)

Chromix: [www.chromix.com](http://www.chromix.com)

X-rite: The Color Guide and Glossary, copyright © 2006 X-rite Incorporated.

Pantone, Inc.: [www.pantone.com](http://www.pantone.com)