Color management workflow in Adobe After Effects CS4

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PREVIOUS VERSION OF THIS DOCUMENT

This white paper describing color management workflows in Adobe After Effects CS4 is an update to the original "Color Management Workflows in Adobe After Effects CS3" white paper published with the release of Adobe After Effects CS3.

Use the link below to access the original white paper covering color management workflows in Adobe After Effects CS3.

http://www.adobe.com/designcenter/aftereffects/articles/aftereffectscs3_color_mgmt.pdf

Getting started

This guide is intended for professionals in the motion graphics, video, and film production industries who need a reliable approach to achieving accurate and consistent color in their workflows. Before we get started, let's first talk briefly about why accurate and consistent color is difficult to achieve, and how color management technology in Adobe After Effects CS4 can help.

What is color management?

Color management technology enables you to achieve more accurate and consistent color reproduction. To achieve this goal, color management technology performs two essential tasks:

- Identifying a specific color appearance for red, green, and blue (RGB) numbers in a digital file
- Attempting to maintain that color appearance by changing, if necessary, the color numbers needed by an output device to produce the specified color appearance

To perform these two tasks, the color management features in After Effects rely on ICC (International Color Consortium) color profiles and a color management system (CMS). Though you can read more about ICC profiles in After Effects Help, for now you simply need to know that profiles give the CMS the data needed to maintain color appearance when color values are sent to a device. For example, if the color represented by the numbers R235, G56, and B70 captured by a digital camera is tomato red but appears closer to brick red on a monitor, the CMS can translate the RGB numbers to those needed by the monitor to preserve the tomato red appearance. In this way, color management helps you produce consistent color—independent of the unique color characteristics of a particular device.

Adobe

Why use color management in your After Effects projects?

In addition to allowing correct representation of color appearance in your project and faithful reproduction on your computer display, use of a color management system also gives you the ability to do the following:

- ***View accurate color and tone when using linear light (gamma 1.0) for compositing.*** After Effects CS4 allows you to composite colors using a gamma of 1.0. This option allows for more photorealistic blending operations in your compositions. Color management allows you to view this linear light encoding accurately on your computer monitor.
- ***Repurpose material for different output conditions.*** In some cases, you may have content that has been composited but will be displayed on different output media. It may be necessary to change the color values for those different output media (for example, digital cinema, high-definition video, or a website). This can be done by selecting a specific output color space when it is time to render the composition.
- ***Work on projects using different computers.*** The ICC profile that defines the colors in your project is embedded in the project when the project is saved. Workstations with accurate monitor ICC profiles allow you to view colors consistently across these workstation displays. This includes workstations using different operating systems.
- ***Manage footage from multiple sources.*** When you import footage into your After Effects project, colors can be correctly interpreted based on the technology used to capture or create them.
- ***View color consistently in other applications.*** If you are using Adobe Photoshop® or other Adobe Creative Suite® components in your workflow, you will be able to view color consistently across these applications. Both Photoshop and Adobe Illustrator® will use ICC profiles embedded in your files. Currently, Adobe Premiere® Pro does not support color management.
- ***Simulate different output conditions without altering color values in your project.*** You may be working on a project that will be delivered in multiple formats (for example, Cineon files for film-out or QuickTime for high-definition video). You can simulate how colors will appear when output to these formats by simulating their appearance in After Effects.

Tips for accurate color viewing

Before moving on to the workflow chapters, here are a few tips to help set up a presentation environment that will work well with the color management features in After Effects CS4:

- ***Calibrate and profile your computer monitor.*** This is a very important step for achieving accurate and consistent color. There are several high-quality software and hardware packages available that will enable you to calibrate and profile your computer monitor. An accurate monitor profile allows the color management system used by After Effects to accurately adjust colors for display on your monitor.
- ***Work in a consistent environment.*** You may have an accurate profile for your monitor, but if that monitor is located next to a window that provides inconsistent lighting, the colors you view may not be as consistent as those viewed in a more controlled environment.
- ***Remove strongly colored objects in your field of vision.*** Your eyes are sensitive to ambient lighting and colors that surround your computer monitor. Reducing the amount of saturated colors in your field of vision will allow you to see colors more accurately. For this reason, it is also a good idea to use a relatively neutral desktop pattern when working in After Effects.

High-definition video workflow

This chapter provides detailed, step-by-step instructions for using Adobe After Effects CS4 and Adobe Photoshop CS4 to achieve more accurate color in a high-definition (HD) video workflow. Use this workflow to produce content for high-definition television or video/DVD distribution. This workflow can also be used by producers of content for standard-definition (SD) distribution. For these users, content can be edited in After Effects and Photoshop for high-definition output and colors converted for standard-definition, if necessary, when compositions are rendered for final output.

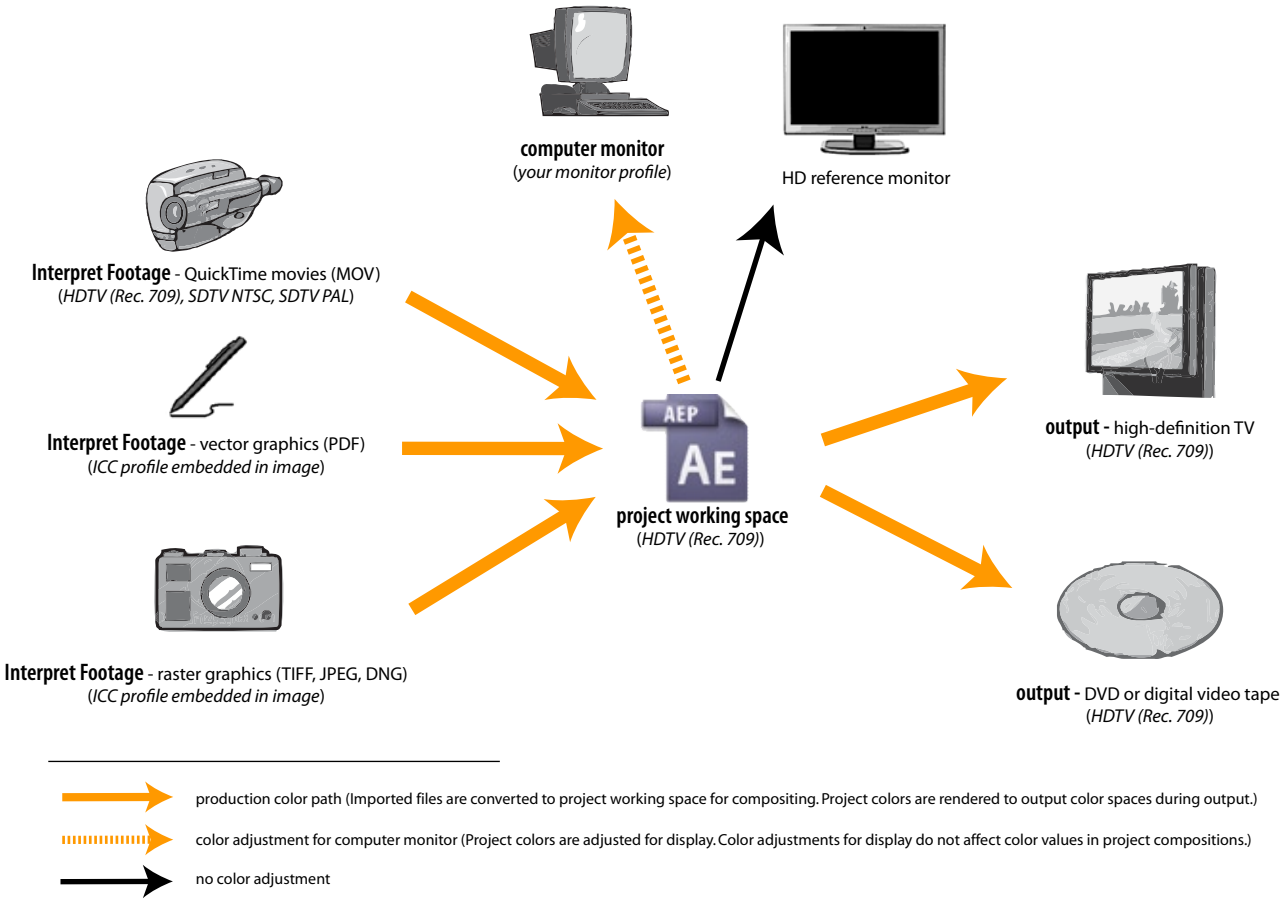

Figure 1 - High-definition video color workflow

This workflow uses the HDTV (Rec. 709) color space as the project working space, the common color space for compositing. Primary colors and gamma are based on those defined by the ITU (International Telecommunication Union) in Recommendation 709. On a calibrated and profiled computer monitor, you can accurately view colors defined in the HDTV (Rec. 709) color space.

In this workflow, it is common for footage to be brought into the project as high-definition video, composited in an HD TV color space, and output to an HD TV color space. In this scenario, the color values are not converted in the import→composite→output pipeline. This has an advantage of maintaining consistency between footage you are compositing in After Effects and footage that may not be color-managed in other parts of your workflow. However, colors are converted when sent to your computer monitor in order to view the HDTV (Rec. 709) color space accurately. It is normal in video production to use a reference video monitor to preview how colors will look when played back on the final viewer's video display. You can choose a reference video monitor using the Video Preview preferences (choose Preferences > Video Preview). After Effects does not convert colors from the project working space to this output device. Colors are converted only for your main computer display.

Workflow overview

This workflow takes you through the following steps:

1 Setting up the After Effects project.

2 Importing footage, including still images.

3 (Optional) Editing images in Photoshop CS4.

4 Outputting files.

Step 1: Set up the After Effects project

1 Start After Effects and create a new project (choose File > New > New Project).

2 Open the Project Settings dialog box (choose File > Project Settings). In the Project Settings dialog box, select the following options:

- ***Choose 16 Bits Per Channel from the Depth menu.*** Working with 16 bits per channel when compositing reduces artifacts and image degradation when pixels are altered in the After Effects project. Even though a project may be rendered and output to 8 bits per channel, the additional pixel information protects against unwanted and unnecessary quality loss in final output.

  If you are concerned about preserving overbrights, consider using the 32 Bits Per Channel (float) option. However, some After Effects effects will not work in 32 bpc mode, and render time will increase.

- ***Choose the HDTV (Rec. 709) ICC profile from the Working Space menu.*** Choosing a working color space for the project turns on color management for the project, allowing you to convert the colors of imported footage into a common color space for compositing. Compositing in a common color space allows for more consistent rendering of the effects that you apply in your After Effects project. The HDTV (Rec. 709) profile is a good choice for a project's working color space. The primary colors and gamma are a close match to those used in HDTV camera equipment, and the defined luminance is based on scene lighting, not the darker lighting found in presentation viewing environments.

- ***Check Compensate For Scene-referred Profiles.*** Checking this option allows After Effects to make necessary gamma and contrast adjustments to your footage. See the "Scene and presentation environment profiles" section of Appendix B for more details.

Step 2: Import footage, including graphics

After you have created your After Effects project, you are ready to import and work with footage, including movies, still raster images, and vector graphics from other sources. In some cases, files that you import will have ICC (International Color Consortium) color profiles embedded in them. Examples of this case may be still images created or edited using Photoshop. In these cases, you can import the footage confident that you will see colors as the producer of the footage originally intended. In other cases, footage will not have an ICC profile embedded; QuickTime video files and GIF still images are examples of this type of footage. In this case, you can assign an ICC profile in the Interpret Footage dialog box and bring that footage into the After Effects project for accurate color viewing and compositing.

1 Choose File > Import > File and select the footage you wish to import.

2 Choose File > Interpret Footage > Main and click the Color Management tab. This dialog box allows you to select an ICC profile to define the color appearance of your footage, independent from the color characteristics of your monitor.

- ***For DV files:*** After Effects will automatically select the correct color space for DV files and files using an uncompressed YCbCr format. You will not have an option to select a color space in the Interpret Footage dialog box. For formats that aren't handled automatically (e.g., third-party codecs), you can choose the color space in the Interpret Footage dialog box. For this case, if you know that a particular QuickTime DV file was created using standard-definition camera equipment, choose

LINEAR LIGHT COMPOSITING

After Effects allows you to composite footage and images using a gamma of 1.0 (linear light). You can use this feature by selecting the Linearize Working Space option in the Project Settings dialog box. This option allows you to apply effects and composite colors for a more natural rendering of colors and tone. A color depth of 16 or 32 bpc is recommended when using this feature.

NOTE: Because the video-out path for preview on reference monitors is not color-managed, colors defined using a gamma of 1.0 will not correctly render to the reference monitor screen. Colors will look excessively dark. If you would like to work using a linear light project working space, then view compositions, layers, and footage on your computer monitor instead of your reference monitor.

LINEAR BLENDING IN PHOTOSHOP

If you would like to use linear blending in Photoshop, specify linear blending in the Photoshop Color Settings dialog box (choose Edit > Color Settings). Click the More Options button and select Blend RGB Colors Using Gamma. Use the default value of 1.00.

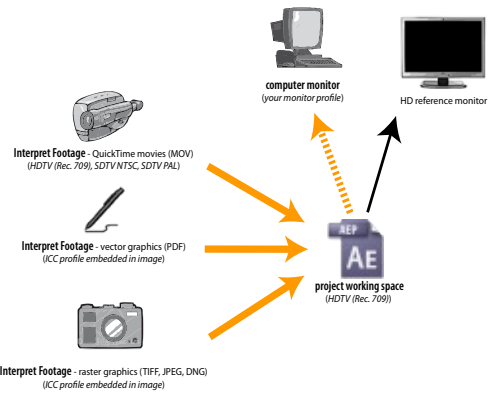

Figure 2 - Interpreting footage and assigning ICC profiles to footage. After Effects converts footage and image colors to the project working space for compositing.

the SDTV NTSC profile. If the QuickTime file was created using high-definition camera equipment, choose the HDTV (Rec. 709) profile. If your footage does not have an embedded profile, After Effects uses a text file (interpretation rules.txt) to define a "best guess" for a color profile appropriate for your imported footage. You can edit this file to better define rules used to determine how imported files are handled. The interpretation rules.txt file is located in the After Effects application folder. By interpreting footage using the same color profile as the one selected as the project working space (see step 1 of this workflow), color values will not be adjusted.

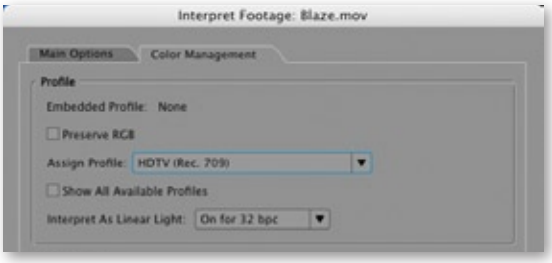

Figure 3 - Interpret Footage — QuickTime HD footage

- ***For 8-bpc and 16-bpc raster files:*** If the file has an embedded profile, After Effects uses it to define the color appearance of that file. If the file does not have an embedded profile, After Effects assigns the sRGB IEC61966-2.1 profile.

After you have imported video, raster image, and vector graphic files into your project, After Effects converts color values to your project's working color space for compositing.

Step 3: (Optional) Edit imported footage or graphics in Photoshop

In some cases, imported image files may require editing in Photoshop. Using color management allows you to maintain color appearance as you switch between Photoshop and After Effects. Follow these steps to preserve consistent appearance in Photoshop and After Effects CS4:

Select the image you would like to edit in the After Effects Project panel. Choose Edit > Edit Original, and do any of the following in Photoshop:

For 8-bpc or 16-bpc files

The default color settings file in Photoshop (North America General Purpose 2) enables Photoshop to automatically use embedded ICC profiles. If the file you're editing does not have an embedded profile, Photoshop uses the default sRGB IEC 61966-2.1 ICC profile to define the color appearance of the RGB values. This profile is an acceptable profile to use for HD TV work as it represents the color appearance of color values displayed on an HD TV monitor.

Note: *Photoshop color settings may not be in the default state on your computer.*

To specify the default, before opening the raster image, choose Edit > Color Settings, and choose North America General Purpose 2 from the Settings menu at the top of the dialog box.

1 Make edits to the 8-bpc or 16-bpc raster image.

2 Save your changes. Select the Embed Color Profile option in the Save dialog box if you are working with file formats that support embedded ICC profiles.

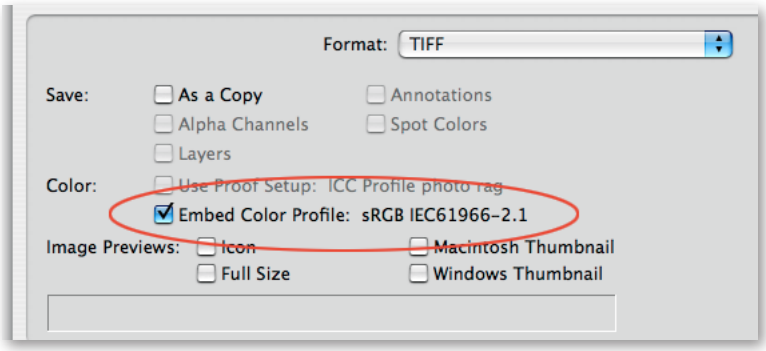

Figure 4 - Photoshop Save dialog box

USING THE HDTV (REC. 709) PROFILE IN PHOTOSHOP CS4

If you are editing high-definition stills/footage in Photoshop CS4, you may wish to assign the HDTV (Rec. 709) profile to those stills/footage, over-riding Photoshop's default sRGB profile. While the color appearance using this profile will match the color appearance produced by the sRGB profile, the embedded HDTV (Rec. 709) profile will provide information allowing those in your workflow to understand that this image/footage came from a high-definition camera.

To ensure a color match between Photoshop CS4 and After Effects CS4 when using the HDTV (Rec. 709), SDTV NTSC, and SDTV PAL profiles, make sure the "Compensate For Scene-referred Profiles" option is checked in the Color Settings dialog box in Photoshop.

See the *Image state adjustment in Adobe After Effects CS4 color workflows* white paper from Adobe for more information on the relationship between the HDTV (Rec. 709) and sRGB IEC 61966-2.1 profiles.

For HDR 32-bpc files

Photoshop CS4 recognizes ICC profiles embedded in 32-bpc (bits per channel) raster files and presents a consistent appearance match with After Effects CS4. Photoshop supports embedded profiles for 32-bpc TIFF and PSD files. (See the sidebar for information on gamma-encoded 32-bpc files).

If you are using formats that do not support embedding of ICC profiles, it may be difficult to create an appearance match with After Effects for those files.

1 Make edits to the 32-bpc image in Photoshop.

2 Save your changes. Select the Embed Color Profile option in the Save dialog box if you are working with file formats that support embedded ICC profiles.

NON-1.0 GAMMA, 32-BPC FILES IN PHOTOSHOP

Photoshop assumes an encoding using a 1.0 (linear) gamma for all 32-bpc files. Some applications that produce and process 32-bpc files do not encode 1.0 gamma, but use the monitor gamma to define the tone reproduction of the image. Files using non-1.0 gamma encoding and 32 bpc will not appear correctly when opened in Photoshop.

Step 4: Output files

After you have made compositions in After Effects, it's time to output files using the render queue. Before output, compositions use the color space defined in the Working Space menu in the Project Settings dialog box. You can convert colors to a different color space using an output module.

Follow these steps to output your compositions using color management:

1 Choose Composition > Add To Render Queue.

2 Click the highlighted text to the right of Output Module in the Render Queue panel to open the Output Module Settings dialog box.

3 Click the Color Management tab in the Output Module Settings dialog box, and choose the appropriate ICC color profile:

- For high-definition video output, choose the HDTV (Rec. 709) profile. After Effects will not alter color values in your project when you choose this profile, because the profile matches the project working space. Choose the HDTV (Rec. 709) profile instead of the default Working Space - HDTV (Rec. 709) to ensure that if you change the project working space at some point (not a recommended practice), the profile in the Output Module will not change as well. However, if you wish to maintain color values when outputting, then the Working Space - HDTV (Rec. 709) profile is a good choice. This choice will maintain color values even if you change your project working space before output.

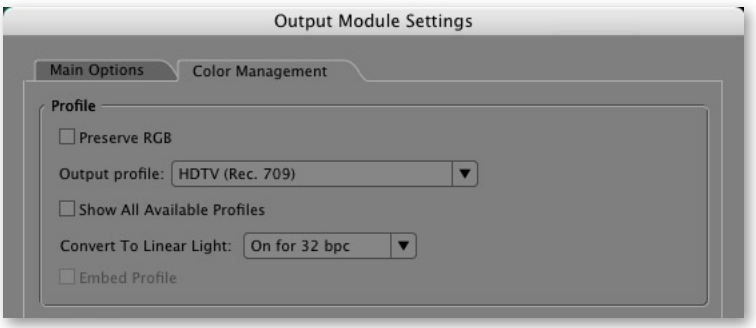

Figure 7 - Color management output settings for HD output

  In some cases, a luma level adjustment (to the 16-235 range from the full range of 0-255) is required to prepare files for final output for display on HD TV systems. If luma levels need to be adjusted, but are not adjusted by your codec or other software or hardware in your workflow, you may want to choose the HDTV (Rec. 709) 16-235 profile to compress luma levels.

- For standard-definition NTSC or standard-definition PAL output, choose the SDTV NTSC or SDTV PAL profile. In some cases, a luma level adjustment (to the 16-235 range from the full range of 0- 255) is required to prepare files for final output for display on SD TV systems. If luma levels need to be adjusted, but are not adjusted by your codec or other software or hardware in your workflow, you may want to choose the SDTV NTSC 16-235 profile or the SDTV PAL 16-235 profile to compress luma levels.

Digital cinema workflow

This chapter provides detailed, step-by-step instructions for using Adobe After Effects CS4 and Photoshop CS4 to achieve accurate and consistent color in a digital cinema workflow. This workflow is commonly used during production of content for motion picture distribution and presentation. Though the term "digital cinema" often refers to the display of digital content using digital projection systems, this workflow describes control of digital content in After Effects CS4 for output to formats appropriate for film-based distribution and projection as well as output to formats appropriate for digital distribution and projection.

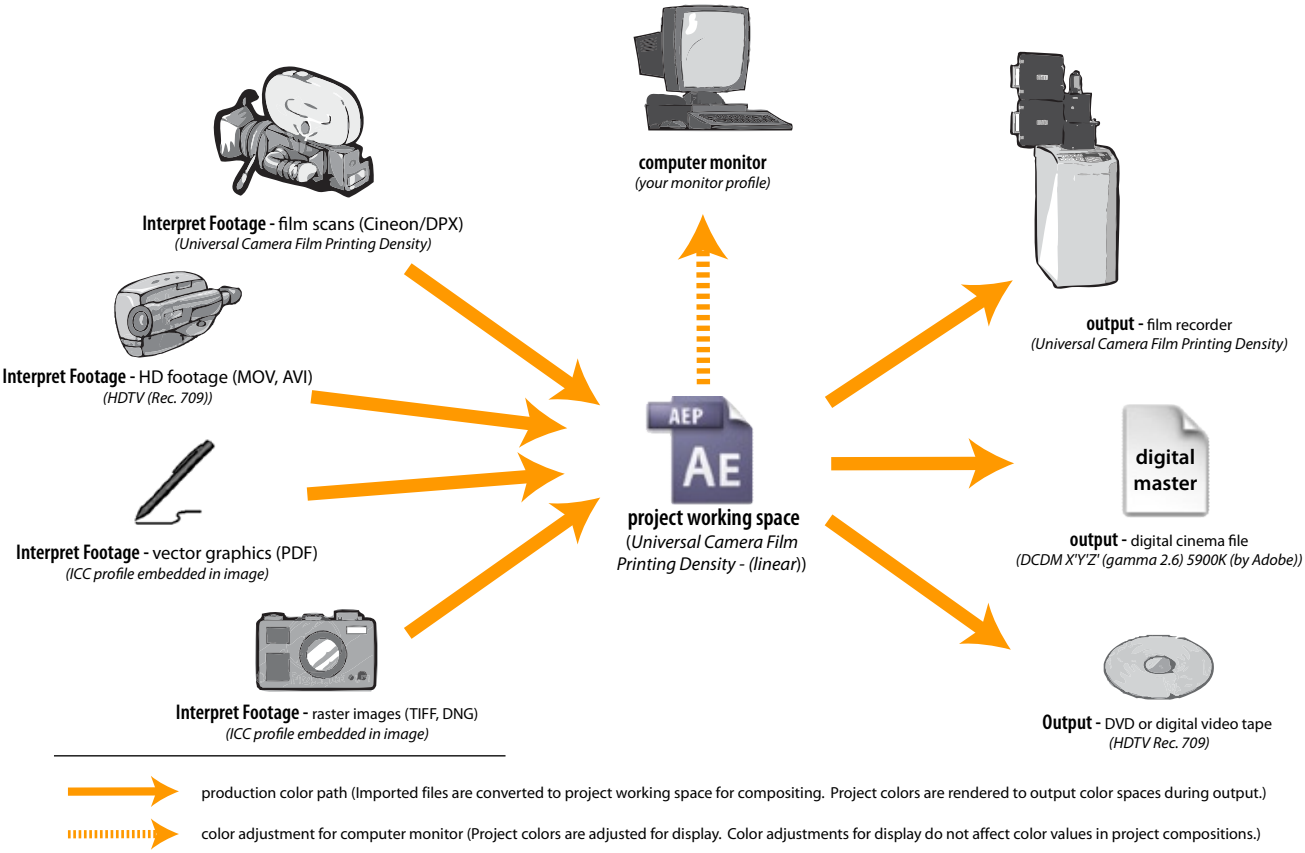

Figure 1 - Digital cinema color workflow

This workflow uses the Universal Camera Film Printing Density color space, converted to a linear gamma (1.0) using 32 bits per channel. On a calibrated and profiled monitor, you can view the linear-encoded color space accurately and preview the appearance of images after they have been filmed-out and printed to commonly used print stocks for theatrical distribution.

Workflow overview

This workflow takes you through the following steps:

1 Setting up the After Effects CS4 project.

2 Importing footage and graphics.

3 Simulating output for theater projection.

4 (Optional) Editing images in Photoshop CS4.

5 Outputting files.

6 Using the Color Profile Converter effect.

Step 1: Set up the After Effects project

1 Start After Effects CS4 and create a new After Effects project (choose File > New > New Project).

2 Open the Project Settings dialog box (choose File > Project Settings). In the Project Settings dialog box, select the following options:

- ***Choose 32 Bits Per Channel (float) from the Depth menu.*** The 32 bits per channel (float) option allows for over-range values to be used for compositing. This allows for preservation of highlight and shadow details in composited images. A color depth of 32 bpc also reduces quantization errors during calculations in your compositions, reducing the possibility of unwanted artifacts in the final rendered file.
- ***Choose Universal Camera Film Printing Density from the Working Space menu.*** Choosing a working space allows you to composite footage and graphics using a common color space that is different from the color characteristics of your monitor. The Universal Camera Film Printing Density color space is a simplified representation of common camera film stocks.
- ***Select Linearize Working Space.*** The Linearize Working Space option allows the project working space to have a tone response of 1.0 gamma, which provides more realistic compositing than the commonly used monitor gamma encodings (for example, 2.2 gamma or 2.6 gamma). This option is only recommended for 16-bpc or 32-bpc projects, as specified in the Depth menu. The Blend Colors Using 1.0 Gamma option is automatically selected if the working space is linearized; all compositing operations will be done using linear blending.
- ***Check Compensate For Scene-referred Profiles.*** Checking this option allows After Effects to make necessary gamma and contrast adjustments to your footage. See the "Scene and presentation environment profiles" section of Appendix B for more details.

You are now ready to import footage and create compositions using a color-managed project in After Effects.

Step 2: Import footage, including graphics

After you have created your After Effects project, you are ready to import and work with footage from other sources. In some cases, footage that you import will have embedded ICC color profiles. Examples of this case may be film sequences encoded in the TIFF format. In these cases, you can import the footage confident that you will see colors as the producer of the footage originally intended. In other cases, footage will not have an embedded ICC profile. In these cases, you can assign an ICC profile in the Interpret Footage dialog box to define the color and tone characteristics of the footage, and then bring that footage into the After Effects project for accurate color viewing and compositing. Cineon/DPX files are examples of this type of footage.

1 Choose File > Import > File and select the footage you wish to import.

2 Select the imported footage in the Project panel and choose File > Interpret Footage > Main. Click the Color Management tab. The Interpret Footage dialog box allows you to select an ICC profile to define the color and tone of your footage.

- ***For Cineon and DPX files:*** Choose the Universal Camera Film Printing Density profile from the Assign Profile menu. You may choose one of the film stock-specific profiles available in the Assign Profile menu. These profiles may provide a more accurate representation of colors captured on specific film stocks. However, color conversions from film stock–specific profiles may produce color-channel crosstalk and negative values.
- ***For non-Cineon raster and vector files:*** If the file has an embedded profile, that profile is the default profile used by After Effects when the file is imported into the After Effects project. If the file does not have an embedded profile, choose a profile that is appropriate for the image. A common choice for 8-bit images without embedded profiles is sRGB IEC61966-2.1. (For more information on color spaces, see Appendix A: "Color spaces and color management".)

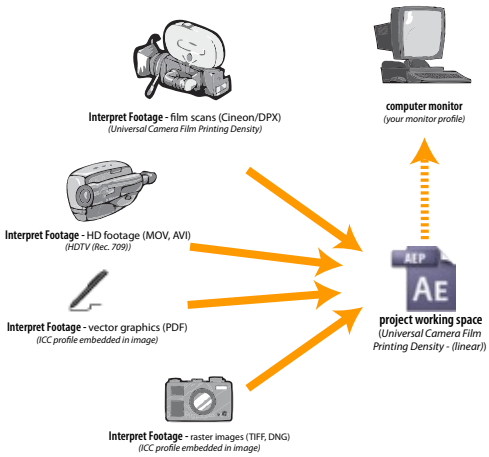

Figure 2 - Interpreting footage and assigning ICC profiles to footage. After Effects converts footage and image colors to the project working space for compositing.

After you've imported the footage into your project and assigned a profile, After Effects converts color values from the color space that you assign in the Interpret Footage dialog box to your linear project working space for compositing.

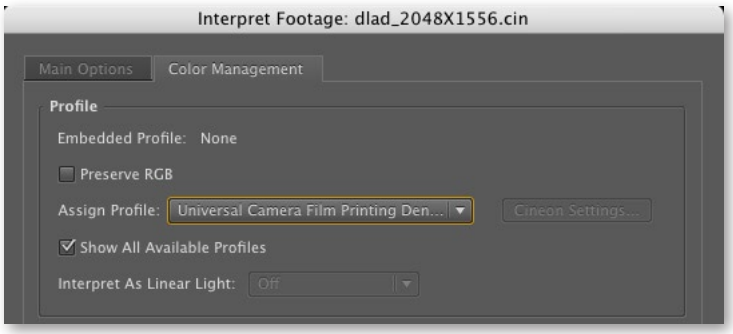

Figure 3 - Interpret Footage — Cineon files scanned from camera negative film stock

Step 3: Simulate output for theater projection

As mentioned above, After Effects uses color management to compensate for the unique color characteristics of your monitor, displaying the color values in your compositions accurately. Color management also allows you to preview how colors will appear when they reach their final presentation device. This kind of output simulation of final color can be executed using Simulate Output commands in the View menu.

Follow these steps to engage this preview mechanism:

1 Choose View > Simulate Output > Universal Camera Film To Kodak 2383. This preset reinterprets DPX values as color that would be shown after film-out on an ARRI recorder to Kodak intermediate stock 5242, which is then printed onto Kodak 2383 print stock in a Bell & Howell Model C film printer, and projected in a theater with a xenon light source.

Once you have selected Universal Camera Film to Kodak 2383 from the Simulate Output menu, After Effects uses this setting to adjust display colors to approximate colors as they will look when filmed out and projected.

ICC PROFILES SUPPLIED BY ADOBE

Adobe Photoshop CS4 and Adobe After Effects CS4 install ICC profiles for several commonly used camera negative film stocks and theater print stocks from Kodak and Fuji. For more information on Adobe-supplied ICC profiles, see Appendix B, "Adobe-supplied profiles".

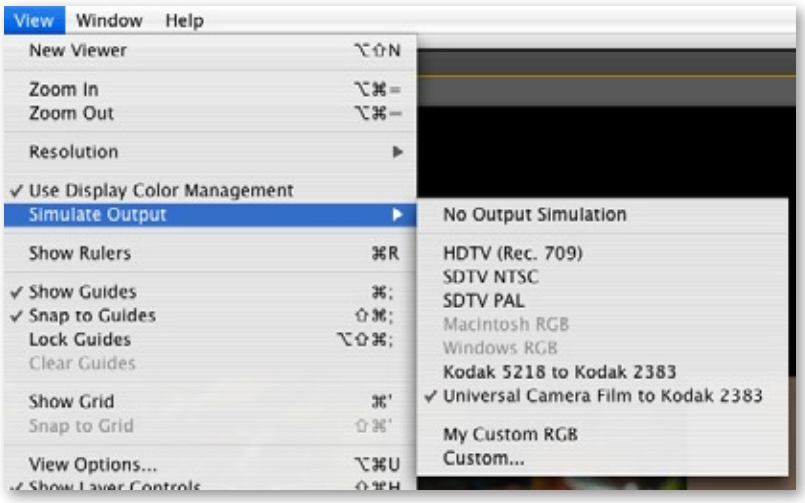

Figure 4 - Output simulation presets

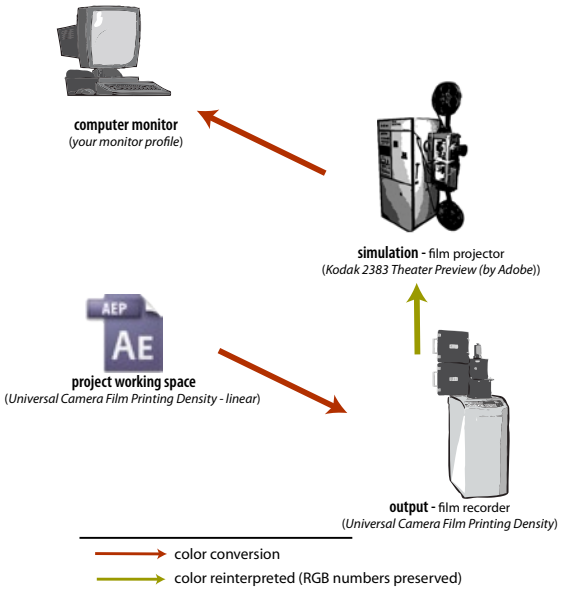

Figure 5 - Output simulation for film-out workflow

If you wish to use film stocks that are not represented in the presets list in the Simulate Output menu, choose View > Simulate Output > Custom. The Custom Output Simulation dialog box allows you to select a wider range of commonly-used film stocks to use for simulation.

Choose the camera negative film stock from the Output Profile menu that represents the film stock used to capture scenes. This film stock will be used as a basis for colors sent to the film recorder during film-out. Choose the print stock you will be using for final theatrical distribution from the Simulation Profile menu. Note that the Preserve RGB option is selected. Colors are not converted from the output profile to the simulation profile; output colors are reinterpreted using the simulation profile.

After choosing these film and print stocks, type a name appropriate for this setup in the Name box. The name of this custom output simulation setup appears above the Custom command in the Simulate Output menu.

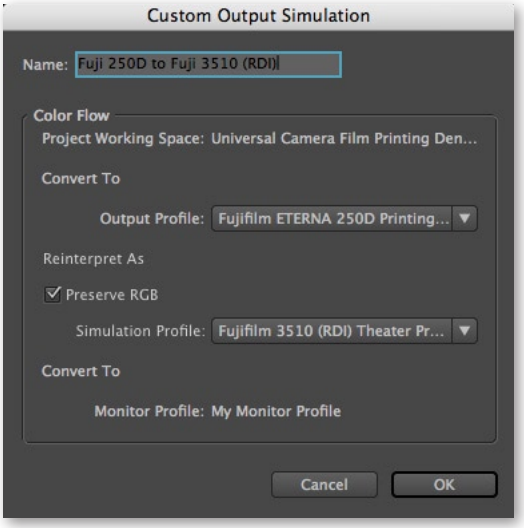

Figure 6 - Custom Output Simulation dialog box settings for film-out workflow

Step 4: (Optional) Edit imported footage and graphics in Photoshop

In some cases, imported graphics may require editing in Photoshop. Using color management allows you to maintain color appearance as you switch between After Effects CS4 and Photoshop CS4. Follow these steps to preserve consistent appearance in After Effects CS4 and Photoshop CS4.

Note: *If you have not selected a Color Settings file in Photoshop, choose Edit > Color Settings. Select North America General Purpose 2 from the Settings menu (this setting is the default, so it should be selected already). This Color Setting recognizes ICC profiles already embedded in images and embeds profiles when saving to file formats that support embedding ICC profiles. Cineon/DPX files do not support embedded profiles.*

Select the footage you would like to edit in the After Effects Project panel. Choose Edit > Edit Original and do the following:

For Cineon/DPX Files:

1 In Photoshop, choose Edit > Assign Profile and choose an appropriate profile that represents the film stock used to capture the original footage. This should be the same profile you selected in the After Effects Interpret Footage dialog box (see step 2 of this workflow, above).

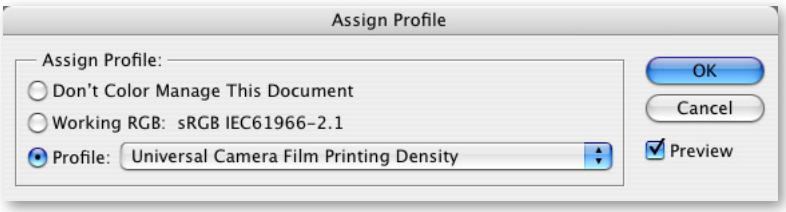

Figure 7- Photoshop Assign Profile dialog box

SETTING A PROFILE IN COLOR SETTINGS

If you are working with a large number of files in Photoshop, it will be helpful to choose the Universal Camera Film Printing Density profile as the RGB Working Space in the Color Settings dialog box in Photoshop (Edit > Color Settings). This allows you to use the Universal Camera Film Printing Density profile without the time-consuming step of assigning the profile to each file in your image sequence.

The image will appear very dark after assigning the camera negative film stock profile. This is expected. The maximum luminance in your Cineon image is being scaled to the maximum luminance value of your monitor, as defined by your monitor's ICC profile. This luminance scaling preserves highlight tones but makes non-overbright values relatively dark.

Use the Photoshop proofing controls to enable a more realistic and usable rendering of the image to screen.

2 Choose View > Proof Setup > Custom.

3 In the Customize Proof Condition dialog box, choose these options for a more realistic interpretation of the Cineon/DPX file:

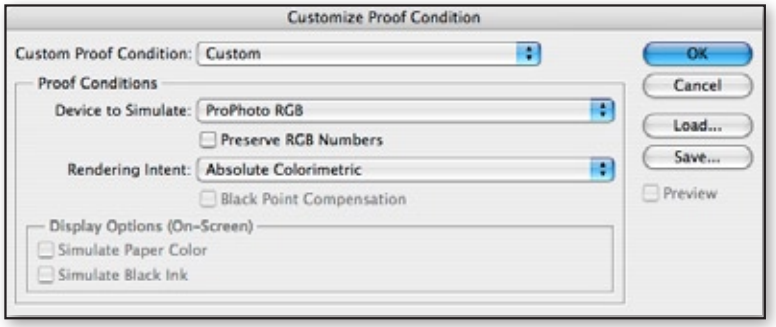

Figure 8- Photoshop Customize Proof Condition dialog box

- Choose ProPhoto RGB from the Device To Simulate menu.
- Deselect Preserve RGB Numbers.
- Choose Absolute Colorimetric from the Rendering Intent menu.

The absolute colorimetric rendering to the ProPhoto RGB color space will render mid-tone values more accurately. However, highlight values may be clipped to your monitor color space and may not appear as they will when printed back to camera negative film stock.

If you wish to save this proofing condition for later use, you can do so by clicking Save, naming the proof condition, and saving it to disk. This Proof Settings (PSF) file will then be accessible to you in Photoshop's View > Proof Setup menu for later use.

4 After making your edits in Photoshop, save and close the file.

For 8-bpc or 16-bpc raster or vector files:
Using the default Color Settings file in Photoshop (North America General Purpose 2) enables Photoshop to automatically use the embedded ICC profile in files opened in Photoshop. If the file you open in Photoshop does not have an embedded profile, Photoshop will use its working space (sRGB IEC 61966-1.2 for the North America General Purpose 2 color setting) to define the color appearance of the RGB values.

***Note:** If you assigned a profile to your image using the After Effects Interpret Footage dialog box prior to editing in Photoshop, use the Assign Profile dialog box (see the section above on Cineon/DPX files) to assign that profile to the image you are editing.*

1 Make edits to the 8-bpc or 16-bpc raster image.

2 Save changes to the image. Make sure that the Embed Color Profile option is selected in the Save dialog box.

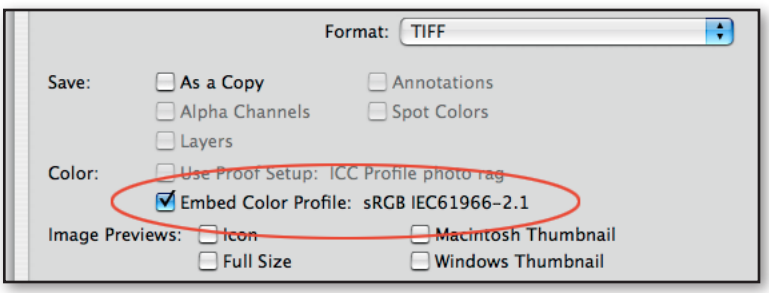

Figure 9- Photoshop Save dialog box

For HDR 32-bpc files:
Photoshop recognizes the ICC profile embedded in a 32-bpc (bits per channel) raster file and presents a consistent appearance match with After Effects.

Note: *If you are using formats that do not support embedded ICC profiles, it may be difficult to create an appearance match with After Effects for those files. See the sidebar for more details.*

1 Make edits to the HDR 32-bpc file in Photoshop.

2 Save changes to the image. Make sure that the Embed Color Profile option is selected in the Save dialog box.

Step 5: Output files

After you have made compositions in After Effects, it's time to output files using the render queue. The compositions are now in the linear-encoded working color space defined in the Project Settings dialog box. However, you probably don't want to output files with this linear encoding. You likely want to output to the log-encoded Cineon format for film-out or to high-definition TV colors for video dailies or video distribution.

1 Choose Composition > Add To Render Queue.

2 Open the Output Module Settings dialog box by clicking the underlined text to the right of Output Module in the Render Queue panel.

3 Click the Color Management tab in the Output Module Settings dialog box and choose the appropriate ICC color profile from the Output Profile menu.

- ***For Cineon output:*** Choose the Universal Camera Film Printing Density ICC profile. This will be the default. This will leave color values unchanged on output.

Figure 10 - Output Module Settings dialog box - Cineon

- ***For HD video dailies:*** Choose the HDTV (Rec. 709) ICC profile in the Output Profile menu in the Color Management tab of the Output Module Settings dialog box. For HD video dailies, use the Color Profile Converter effect to "bake in" film looks and convert colors for accurate playback of those film looks on HD monitors. (See "Step 6: Use the Color Profile Converter effect for color transforms" for a description of this workflow.)
- ***For DCDM (Digital Cinema Distribution Master) format output:*** Choose the DCDM X'Y'Z' (Gamma 2.6) 5900K (by Adobe) ICC profile in the Output Profile menu in the Color Management tab of the Output Module Settings dialog box. This format and color space have been specified by the DCI (Digital Cinema Initiative) for the distribution of digital content for digital projection. Use the Color Profile Converter effect to "bake in" film looks before outputting to the DCDM color space. (See "Step 6: Use the Color Profile Converter effect for color transforms" for a description of this workflow.)

NON-1.0 GAMMA-ENCODED 32-BPC FILES

For images files that do not support embedded ICC profiles, Photoshop assumes that files using 32-bpc encoding are encoded with a 1.0 (linear) gamma. Some applications that produce and process 32-bpc files do not encode 1.0 gamma but use the monitor gamma to define the tone reproduction of the image.

Step 6: Use the Color Profile Converter effect for color transforms

In some cases, you may want to apply color transforms to color values to render a look or feel to the files you are working with. An example of this kind of transform is adjusting Cineon files to colors that approximate the appearance of final filmed-out files that are printed and shown in the theater. It would be helpful to "bake" this type of look into files being used for high-definition (HD) digital dailies or the distribution of digital content for digital projection. These types of color transforms can be achieved using the Color Profile Converter effect in After Effects.

For HD video dailies and digital cinema projection

1) Add a new adjustment layer (choose Layer > New > Adjustment Layer) to the composition you have been working with. Apply the Color Profile Converter effect to the new adjustment layer. In the Color Profile Converter effect, choose these settings:

   Input Profile: Project Working Space
   Output Profile: Universal Camera Film Printing Density
   Rendering Intent: Absolute Colorimetric

2) Apply another instance of the Color Profile Converter effect to the new adjustment layer and use these settings:

   Input Profile: Kodak 2383 Theater Preview 2 (by Adobe)
   Output Profile: Project Working Space
   Rendering Intent: Relative Colorimetric

The first instance of the Color Profile Converter effect translates the linear project working space to printing density values. The second effect interprets these printing density values as they would appear printed on theatrical distribution film stock Kodak 2383 and converted back to your project working space. The appearance of the projected film in the theater is now baked into your footage.

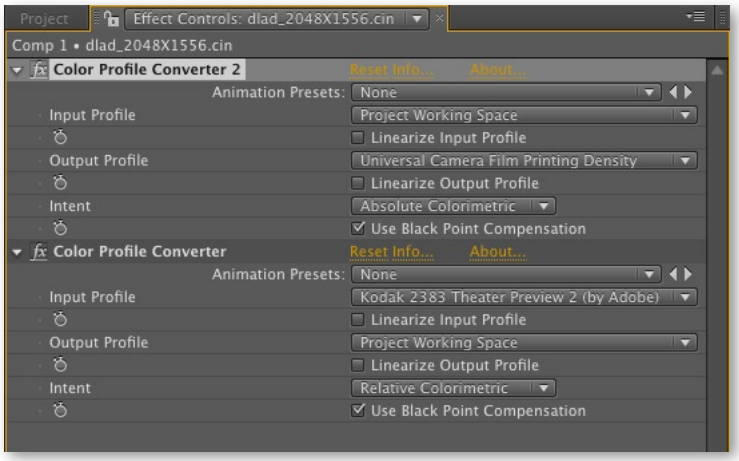

Figure 11 - Color Profile Converter effects for digital dailies

Animation/Flash export workflow

This chapter provides detailed, step-by-step instructions for using Adobe After Effects CS4 to achieve more accurate color in an animation workflow exporting to SWF files and FLV files. This workflow is commonly used when creating animated content for viewing within an HTML web page using Adobe Flash® Player. Compositions are also output as SWF or FLV files for distribution on DVD.

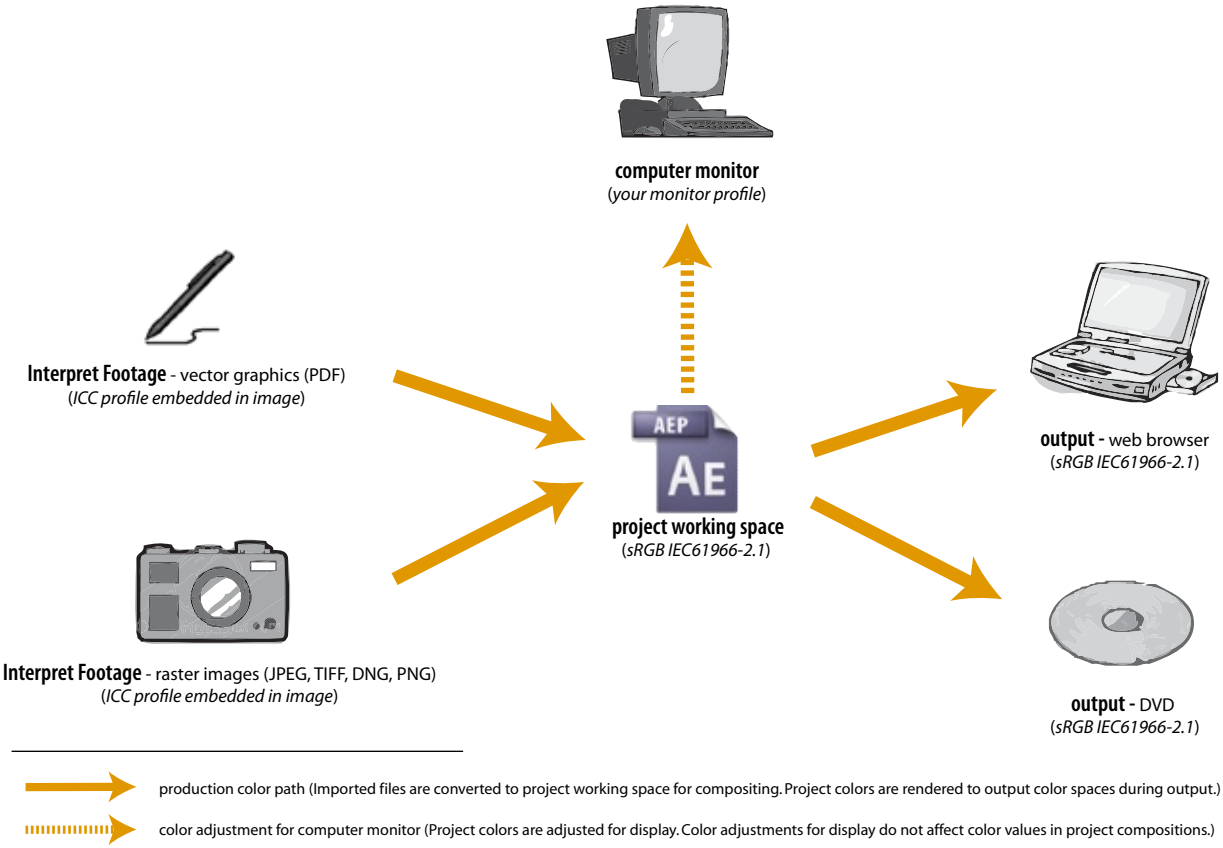

Figure 1 - Animation color workflow using Flash output formats

This workflow uses the sRGB IEC61966-2.1 color space as the common color space for compositing animated layers. The sRGB IEC61966-2.1 color space is recommended by the World Wide Web Consortium for colors published on the World Wide Web.

On a calibrated and profiled monitor, you can accurately view sRGB IEC61966-2.1 colors to ensure that colors are correctly rendered using the sRGB IEC61966-2.1 color space.

Workflow overview

This workflow takes you through the following steps:

1 Setting up the After Effects project.

2 Importing footage, including still graphics.

3 (Optional) Editing graphics in Photoshop CS4.

4 (Optional) Simulating output for more accurate viewing.

5 Outputting files.

Step 1: Set up the After Effects Project

1 Start After Effects and create a new After Effects CS4 project (Choose File > New > New Project).

2 Choose File > Project Settings. In the Project Settings dialog box, select the following options:

- ***Choose 16 Bits Per Channel from the Depth menu.*** Working with 16 bits per channel when compositing reduces artifacts and image degradation when pixels are altered in the After Effects project. Even though a project may be rendered and output to 8 bits per channel, the additional pixel information will protect against unwanted and unnecessary quality loss in final output.
- ***Choose the sRGB IEC61966-2.1 ICC profile from the Working Space menu.*** Choosing a working color space allows you to convert the colors of imported graphics into a common color space for compositing. In most cases, the imported graphics will have been created using the sRGB IEC61966-2.1 color space and have an embedded sRGB IEC61966-2.1 profile. In this case, the color values will not be converted into the working space, because they are already defined using the sRGB IEC61966-2.1 profile. In cases where the embedded color profile for an imported graphic differs from the project working space, colors will be converted from the color space of the embedded profile to the project working space. This preserves the color appearance of the imported graphic.
- ***Check Compensate For Scene-referred Profiles.*** Checking this option allows After Effects to make necessary gamma and contrast adjustments to your footage. See the "Scene and presentation environment profiles" section of Appendix B for more details.

You are now ready to import graphics and create compositions using a color-managed project in After Effects.

LINEAR BLENDING IN PHOTOSHOP

You may wish to use the Blend Colors Using 1.0 Gamma option in the Project Settings dialog box to produce blending that may appear more realistic. This option can also be set in the Color Settings dialog box in Photoshop to create an appearance match with After Effects. Choose Edit > Color Settings, click More Options, and then select Blend RGB Colors Using Gamma. Enter 1.0 in the box.

Step 2: Import footage, including graphics

After you have created your After Effects project, you are ready to import and work with raster images or vector graphics from other sources. In some cases, files that you import will have embedded ICC profiles; examples of this case may be still images created or edited using Photoshop. In these cases, you can import the graphics confident that you will see colors as the producer of the graphics originally intended. In other cases, graphics will not have an ICC profile embedded; BMP images are examples of this type of graphic. In these cases, you can assign an ICC profile in the Interpret Footage dialog box and bring that graphic into the After Effects project for accurate color viewing and compositing. After Effects will assign the sRGB IEC61966-2.1 profile to graphics that do not have an embedded profile, so direct assignment of the profile in the Interpret Footage dialog box is not necessary in this particular workflow.

1 Choose File > Import > File and select the graphic that you wish to import.

2 After importing the footage, choose File > Interpret Footage > Main, and click the Color Management tab. The Interpret Footage dialog box allows you to assign an ICC profile to define the color appearance of your footage, independent from the color characteristics of your monitor or working space.

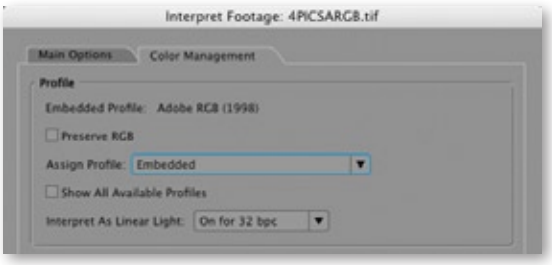

Figure 3 - Interpret Footage dialog box — embedded profile

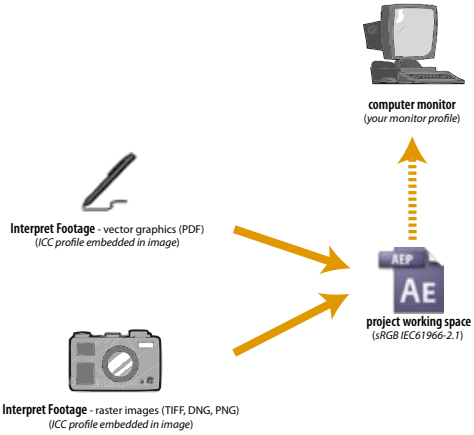

Figure 2 - Interpreting footage and assigning ICC profiles to footage. After Effects converts footage and image colors to the project working space for compositing.

- ***For 8-bpc or 16-bpc raster or vector files:*** If the file has an embedded profile, that profile is the profile used by After Effects. If the file does not have an embedded profile, After Effects assigns the sRGB IEC61966-2.1 ICC profile.

Step 3: (Optional) Edit imported images in Photoshop

In some cases, imported image files may require editing in Photoshop. Using color management allows you to maintain color appearance as you switch between After Effects and Photoshop. Follow these steps to preserve consistent appearance in After Effects CS4 and Photoshop CS4:

1 Select the footage you would like to edit in the After Effects Project panel. Choose Edit > Edit Original.

Note: *The default Color Settings file in Photoshop (North America General Purpose 2 enables Photoshop to use the embedded ICC profile in the footage opened in Photoshop. If the file you opened does not have an embedded profile, Photoshop CS4 uses the default sRGB IEC61966-2.1 ICC profile to define the color appearance of the RGB values.*

2 Make edits to the image in Photoshop.

3 Save changes to the image. Select the Embed Color Profile option in the Save dialog box if you are working with file formats that support embedded ICC profiles (such as TIFF, PSD, or JPEG).

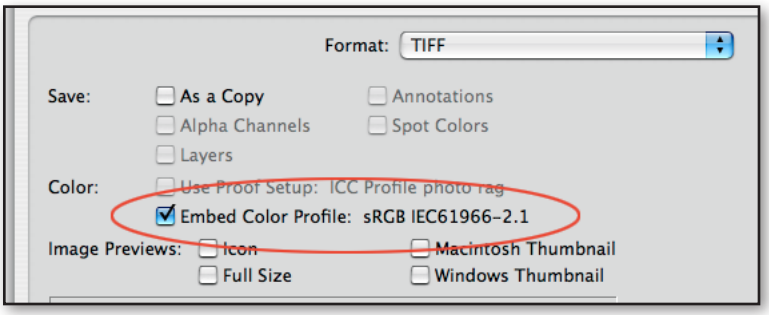

Figure 4 - Photoshop Save dialog box (with Embed Color Profile option selected)

Step 4: (Optional) Simulate final output

In some cases, you may want to create a Flash animation project and output to different types of display technologies, like standard-definition TV or computer monitors. Output simulation options allow you to preview colors as they will appear in these output conditions. In addition to previewing output to different display technologies, the output simulation options also allow you to preview how a composition will appear on Macintosh systems using a tone response (gamma) of 1.8, Windows systems using a tone response of 2.2, or when viewing uncorrected colors directly on your monitor to simulate how many web browsers display colors.

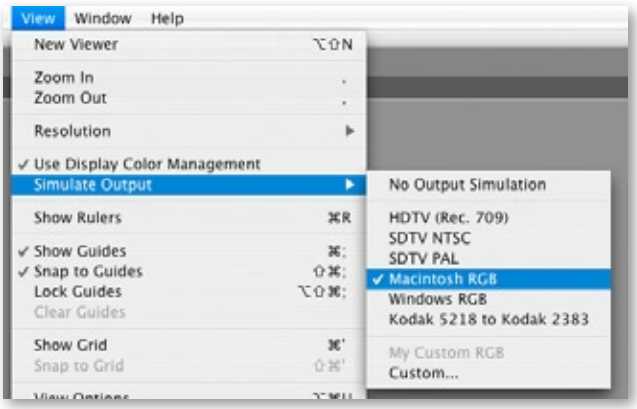

Figure 5 - Output simulation presets

1 Choose View > Simulate Output, and select an Output Simulation preset that is appropriate for your workflow.

PHOTOSHOP COLOR SETTINGS

The Photoshop CS4 color settings may not be in the default state on your computer. You can check by choosing Edit > Color Settings and viewing the Settings menu. The default setting is North America General Purpose 2.

These are the most common choices for output simulation for a Flash animation workflow:

- ***Macintosh RGB:*** Select Macintosh RGB from the View > Simulate Output menu. This preset is helpful if you wish to view how colors will appear in non-color-managed applications using a display with a 1.8 gamma. This is a common condition for web pages displayed on Macintosh computers.
- ***Windows RGB:*** Select Windows RGB from the View > Simulate Output menu. This preset is helpful if you wish to view how colors will appear in non-color-managed applications using a display with a 2.2 gamma. This is a common condition for web pages displayed on computers running Windows. You will not see much change if you choose this option. This workflow uses the sRGB IEC61966-2.1 working space, which has a gamma of 2.2 — the same gamma as the standard tone response of the standard computer running Windows.
- ***Monitor color:*** Deselect Use Display Color Management in the View menu. This option turns off color transformations from your working color space to your monitor. It is normally useful to have color management convert colors to your monitor color space; this conversion corrects for the unique characteristics of your display, allowing you to view color consistently with colleagues who may have monitors whose characteristics differ from your own. Turning this monitor compensation off does allow you to view colors as they would appear on your monitor using most web browsers and other non-color-managed applications.

Once you have selected one of the Simulate Output options, After Effects uses this setting to adjust display colors to approximate colors as they will look when finally output to the specified device or condition.

Step 5: Output files

After you have made compositions in After Effects, it's time to export files in the SWF or FLV format. Before export or output, compositions use the project working space (sRGB IEC61966-2.1) defined in the Project Settings dialog box to define the appearance of your color values.

Follow these steps to export your compositions using color management:

To export SWF

1 Choose File > Export.

2 Specify a name and location for the output file, and click Save.

- After Effects CS4 converts color values to the sRGB IEC61966-2.1 color space during export. Because in this workflow the project working space is sRGB IEC 61966-2.1, the color values do not change. However, if the project working space is not sRGB IEC 61966-2.1, After Effects will convert colors from that project working space to the sRGB IEC 61966-2.1 color space when they are exported.

To output to FLV

1 Choose Composition > Add To Render Queue.

2 In the Render Queue panel, click the text next to Output Module, click the Color Management tab in the Output Module Settings dialog box, and choose the appropriate ICC color profile from the Output Profile menu.

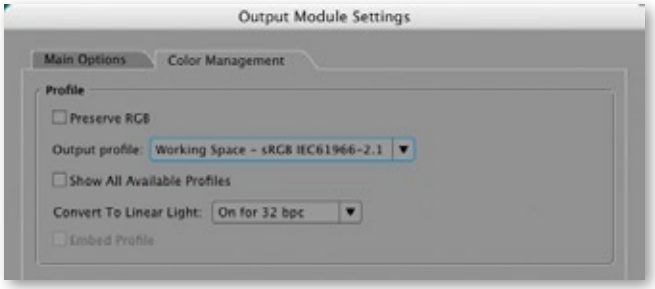

Figure 6 - Color management output settings for FLV

- For output for display in web browsers and other web-based environments, use the default profile in the Output Profile menu (Working Space - sRGB IEC61966-2.1). Since the output profile is the same as the profile used as the working space, no color conversion will take place when compositions are rendered and output.

Appendix A: Color spaces and color management

You've seen the term *color space* used extensively in this document. You probably now know that color spaces provide a reference for how RGB numbers are meant to appear to the viewer. This chapter provides more detailed information about color spaces and how they are used in color-managed workflows, like the workflows outlined for After Effects CS4 in chapters 2-4.

Device dependence

When you select RGB values in an Adobe application, like After Effects or Photoshop, you're specifying relative amounts of primary colors you want to use in the image or project. However, defining an amount of primary color does not provide enough information to describe what this value is supposed to look like to the viewer of that color. Let's look at an example. Let's create some red. We want this color to be as red as possible, so we define a value of R=255 G=0 B=0 in our file. We ask the application to provide maximum red and no green or blue. If the application presents these values to your computer monitor without any adjustment, the monitor will show its maximum red, and no green or blue. However, if you view the file with the 255,0,0 values on another monitor, you may see different colors because the monitor may use different material in the liquid crystal filters, or differs in the quality of light passing through the LCD filters. We see different colors on two displays even though the encoding in the digital file is the same (255,0,0). This is a case of device dependence. The color appearance of an RGB value is defined by the combination of 1) color values and 2) device characteristics.

Device independence — specifying color accurately

We know that simply specifying RGB values for our colors will not provide an accurate, unambiguous description of the color appearance of those values. Some color spaces, like CIE XYZ and CIE L*a*b*, define colors using a reference to human vision — the Standard Observer. The Standard Observer provides a standard understanding of how sensitive human eyes are to the three primary colors: red, green, and blue. By using this reference to human vision, color spaces like CIE XYZ and CIE L*a*b* are able to define colors using three values that correspond to a specific color appearance. That's very handy. In addition to the Standard Observer, CIE XYZ uses an understanding of the light source used to view an object as well as the reflective or transmissive qualities of an object. By understanding the qualities of these three elements that make up human visual response, we are able to encode device-independent color values in the CIE XYZ color space.

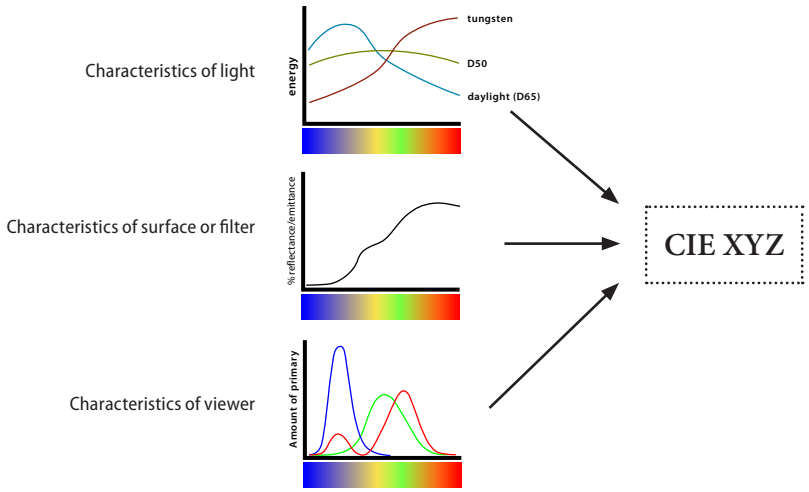

Figure 1 — Device-independent color using the CIE XYZ color space

In Figure 1, we can see the three elements of human vision on the left side of the diagram. By combining an understanding of these three elements, we are able to encode color values using the device-independent color space, CIE XYZ.

Showing accurate color on devices

Now that we are able to encode color appearance unambiguously using the CIE XYZ color space, we can move to the next step — presenting those colors accurately on our color devices. To present colors accurately, we need an understanding of the unique color characteristics of those devices. Gaining this understanding is normally done by measuring the color output of a device using a measuring instrument like a spectrophotometer or a colorimeter. After the measurements are taken, software saves information in an ICC color profile that represents the color space of that particular device. Once this information is saved, the color management system can translate colors from CIE XYZ to the color device's color space for accurate viewing.

Here's an example of how a color management system (CMS) can translate colors. Suppose you use a color space, defined by a gamma of 2.2, to define the color appearance of an image in a color-managed application such as Photoshop or After Effects. If your monitor has a gamma of 1.8, color values sent to your monitor will be adjusted to display the gamma 2.2 color space used by the image. The CMS will attempt to reproduce color appearance as defined by the color space associated with your image or project, not the color space of the device being used to show you those colors. Using this color conversion framework allows you to open your After Effects project on many different types of computers and monitors and see the same color appearance on all.

Figure 2, below, shows an example of the CIE XYZ color space being used to translate colors from one device color space to another device color space. The translation of colors is a two-step process. Step one converts colors from the device-dependent color space of one device (a digital camera in this example) to CIE XYZ. The camera profile is used to define the RGB colors created by the camera and translate those colors to CIE XYZ. Step two translates colors from CIE XYZ to the color space of the second device (a computer monitor in this example).

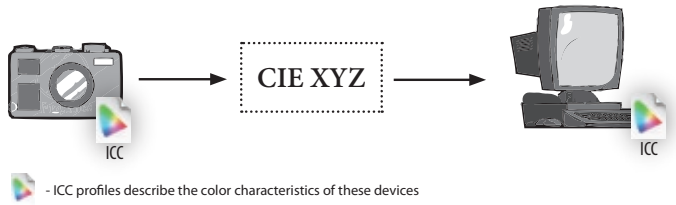

Figure 2 — The CIE XYZ color space provides a device-independent color encoding that allows for the proper translation of device-dependent colors.

This color conversion framework can be used to adjust colors for many different devices in your workflows.

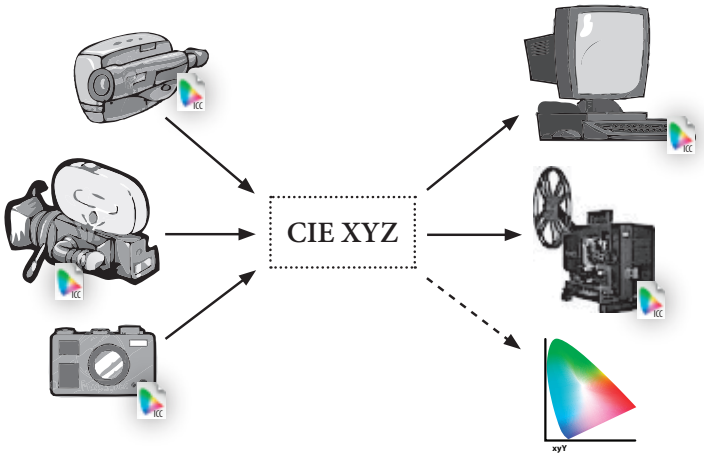

Figure 3 — The CIE XYZ color space provides a device-independent color encoding that allows for the proper translation of device-dependent colors.

In Figure 3, above, colors from different types of cameras are adjusted for presentation using a computer monitor or cinema projection device. Colors can also be converted to other device-independent color spaces, like CIE xyY.

Adobe provides color profiles for commonly used devices in video and digital cinema workflows. (See Appendix B - "Adobe-supplied ICC profiles" for more information.) However, it is highly recommended that you create a custom color profile for your computer monitor. There are several quality software vendors that offer profiling utilities that use a measuring instrument (colorimeter or spectrophotometer) to create custom profiles for your monitor.

Project working space

CIE XYZ is a very powerful color encoding method. Color values using the CIE XYZ color space do not need additional metadata to define color appearance. However, CIE XYZ is not commonly used in video and digital cinema workflows and cannot be used to define data in your After Effects project. Color data in your After Effects project is defined using RGB values. So how does After Effects use color management to support accurate and consistent color? This is where the project's working color space (*working space*) comes in. The project working space in After Effects serves as an RGB color space that is used by After Effects for all compositing operations. The project working space acts as a central reference for color values in your project. By defining a common reference for your color values, After Effects can take advantage of the benefits of color management, converting colors as needed in your workflow to present accurate and consistent color on a wide variety of output devices.

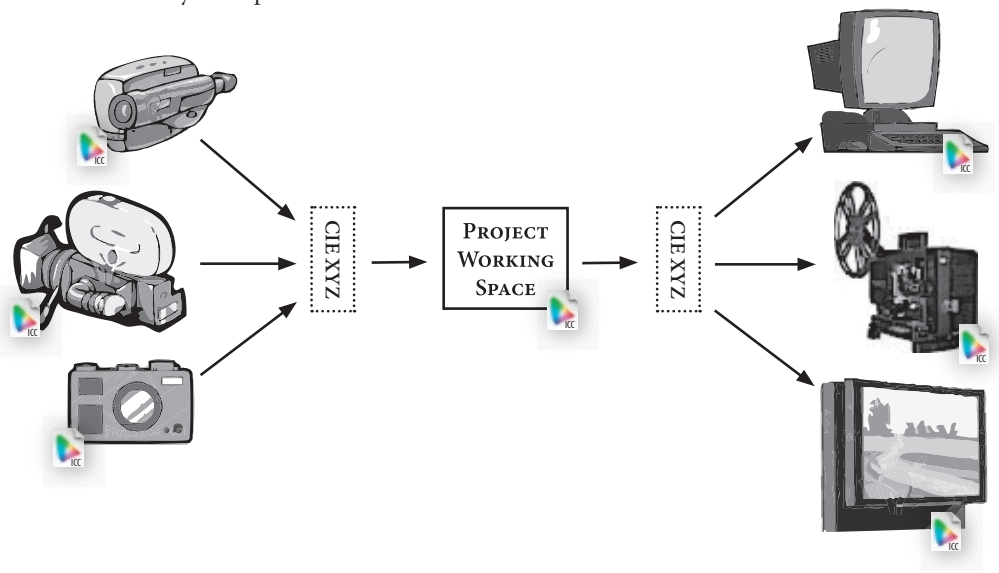

Figure 4 — The After Effects project working space acts as a common color space for the translation of imported and exported colors.

Choosing a project working space

If you are going to use color management in After Effects, you must select an ICC color profile from the Working Space menu in the Project Settings dialog box. This is how color management is activated in After Effects. But which one is the right one for you? This document provides recommended working color space choices in the workflows defined in chapters 2-4. However, here are a few pointers for the selection of a proper working space for your workflow.

Color space size

- ***For 8-bpc and 16-bpc projects*** - Your working space will define the gamut boundaries of your project (that is, limits on how saturated your color can become). You don't want to artificially restrict your color gamut if you intend to output files to a device with relatively large color gamut.
- ***For 32-bpc projects*** - The gamut defined in your project is boundless. You do not have to worry about restricting colors to the boundary of the color space you choose as your project working space.

Neutral-balanced color spaces

Some color spaces define neutral colors as equal amounts of red, green, and blue. Other color spaces—usually those that represent color rendering properties of real-world devices—do not define neutral color as equal amounts of red, green, and blue. Defining neutral colors using equal amounts of red, green, and blue can be handy when color-correcting images. If you know that a particular part of a scene is neutral, you can ensure that those areas contain equal amounts of red, green, and blue. Examples of neutral-balanced profiles are the Adobe-supplied video profiles (HDTV (Rec. 709), SDTV NTSC, SDTV PAL) as well as commonly used profiles like sRGB IEC619-66-2.1, Adobe RGB (1998), and ProPhoto RGB). Examples of profiles that are not neutral-balanced are the Adobe-supplied profiles for digital cinema cameras and projectors, and profiles for negative and print film stocks.

Using the Universal Camera Film Printing Density profile as a project working space

The Universal Camera Film Printing Density color space is a good choice as a project working space when compositing for cinema workflows using Cineon scans from camera film. There are a couple of reasons to choose this profile.

- If you select this profile as your project working space (and do not linearize this working space) and also used this profile to interpret footage, the DPX log values in the Info panel will not change after import. This can be helpful to those that are familiar with 10-bit log values and prefer to control color using these values.
- In some cases, converting colors into the project working space will cause channel cross-talk and produce negative values. This may be true for cases were highly saturated colors in film scans are interpreted using ICC profiles for specific film stocks. Using the Universal Camera Film Printing Density profile to interpret footage and as project working space eliminates this potential problem.

Appendix B: Adobe-supplied ICC Profiles

FILE NAME	DESCRIPTION	DEVICE DETAILS	DEVICE TYPE	SCENE OR PRESENTATION ENVIRONMENT PROFILE*	RGB ENCODING	APPROX. COLOR TEMP.
CAPTURE DEVICES						
VideoHDTV.icc	HDTV (Rec. 709)	High-definition video camera. The specification for the ITU-R Recommendation 709 can be downloaded here: http://www.itu.int/rec/R-REC-BT.709-5-200204-I/en	video camera	scene	full range RGB 0-255	6500
VideoNTSC.icc	SDTV NTSC	NTSC video camera. Uses the same tone response curve as that defined for HDTV (Rec. 709) specified in ITU-R Recommendation 709.	video camera	scene	full range RGB 0-255	6500
VideoPAL.icc	SDTV PAL	PAL video camera. Uses the same tone response curve as that defined for HDTV (Rec. 709) specified in ITU-R Recommendation 709.	video camera	scene	full range RGB 0-255	6500
VideoHDTV16-235.icc	HDTV (Rec. 709) 16-235	The HDTV (Rec. 709) 16-235 color profile will produce maximum black on your monitor for the value 16 and lightest white at the value of 235.	video camera	scene	RGB 16-235	6500
VideoNTSC16-235.icc	SDTV NTSC 16-235	The SDTV NTSC 16-235 color profile will produce maximum black on your monitor for the value 16 and lightest white at the value of 235.	video camera	scene	RGB 16-235	6500
VideoPAL16-235.icc	SDTV PAL 16-235	The SDTV PAL 16-235 color profile will produce maximum black on your monitor for the value 16 and lightest white at the value of 235.	video camera	scene	RGB 16-235	6500
FilmSceneUniversalPD.icc	Universal Camera Film Printing Density	Provides general-purpose unbuild for camera negative film. Defines appearance similar to Kodak Vision2 500T Color Negative Film 5218/7218.	camera negative film	scene	10-bpc DPX printing density	3200
FilmSceneK5205PD.icc	Kodak 5205/7205 Printing Density (by Adobe)	KODAK VISION2 250D Color Negative Film 5205/7205	camera negative film	scene	10-bpc DPX printing density	5500
FilmSceneK5218PD.icc	Kodak 5218/7218 Printing Density (by Adobe)	KODAK VISION2 500T Color Negative Film 5218/7218	camera negative film	scene	10-bpc DPX printing density	3200
FilmSceneK5229PD.icc	Kodak 5229/7229 Printing Density (by Adobe)	KODAK VISION2 Expression 500T Color Negative Film 5229/7229	camera negative film	scene	10-bpc DPX printing density	3200
FilmSceneFE160PD.icc	Fujifilm ETERNA Vivid 160 Printing Density (by Adobe)	FUJICOLOR Negative Film ETERNA Vivid 160	camera negative film	scene	10-bpc DPX printing density	3200
FilmSceneFE250DPD.icc	Fujifilm ETERNA 250D Printing Density (by Adobe)	FUJICOLOR Negative Film ETERNA 250D	camera negative film	scene	10-bpc DPX printing density	5500
FilmSceneFE250PD.icc	Fujifilm ETERNA 250 Printing Density (by Adobe)	FUJICOLOR Negative Film ETERNA 250	camera negative film	scene	10-bpc DPX printing density	3200
FilmSceneFE400PD.icc	Fujifilm ETERNA 400 Printing Density (by Adobe)	FUJICOLOR Negative Film ETERNA 400	camera negative film	scene	10-bpc DPX printing density	3200
FilmSceneFE500PD.icc	Fujifilm ETERNA 500 Printing Density (by Adobe)	FUJICOLOR Negative Film ETERNA 500	camera negative film	scene	10-bpc DPX printing density	3200
FilmSceneFF64DPD.icc	Fujifilm F-64D Print-ing Density (by Adobe)	FUJICOLOR Negative Film F-64D	camera negative film	scene	10-bpc DPX printing density	5500
FilmSceneFF125PD.icc	Fujifilm F-125 Printing Density (by Adobe)	FUJICOLOR Negative Film F-125	camera negative film	scene	10-bpc DPX printing density	3200
FilmSceneFR500DPD.icc	Fujifilm REALA 500D Printing Density (by Adobe)	FUJICOLOR Negative Film REALA 500D	camera negative film	scene	10-bpc DPX printing density	5500

FILE NAME	DESCRIPTION	DEVICE DETAILS	DEVICE TYPE	SCENE OR PRESENTATION ENVIRONMENT PROFILE*	RGB ENCODING	APPROX. COLOR TEMP.
CAPTURE DEVICES						
DCamSceneAD20DLog.icc	ARRIFLEX D-20 Daylight Log (by Adobe)	ARRIFLEX D-20 shot in daylight using logarithmic encoding	digital motion picture camera	scene	10-bpc DPX	5500
DCamSceneAD20TLog.icc	ARRIFLEX D-20 Tungsten Log (by Adobe)	ARRIFLEX D-20 shot under tungsten light using logarithmic encoding	digital motion picture camera	scene	10-bpc DPX	3200
DCamSceneDOriTLin.icc	Dalsa Origin Tungsten Linear (by Adobe)	Dalsa Origin under tungsten light using linear encoding	digital motion picture camera	scene	10- to 16-bpc linear	3200
DCamScenePGenTLog.icc	Panavision Genesis Tungsten Linear (by Adobe)	Panavision Genesis under tungsten light using Panalog encoding	digital motion picture camera	scene	10-bpc Panalog	3200
DCamSceneTVipFSDLog.icc	Viper FilmStream Daylight Log (by Adobe)	Thomson Viper in daylight (no filters) using Filmstream log encoding	digital motion picture camera	scene	10-bpc Filmstream	5500
DCamSceneTVipFSTLog.icc	Viper FilmStream Tungsten Log (by Adobe)	Thomson Viper under tungsten light (no filters) using Filmstream log encoding	digital motion picture camera	scene	10-bpc Filmstream	3200
PROJECTION DEVICES						
FilmTheaterF3510RDIPD.icc	Fujifilm 3510 (RDI) Theater Preview (by Adobe)	Theater preview of Fujicolor Positive Film F-CP-3510. Film-out on ARRI recorder with Carlos aims onto Fujicolor Recording Film ETERNA-RDI, printed on B&H model C, projected using xenon light source. DPX 445, 445,445 is calibrated to specified LAD Status M and LAD Status A.	color print film	presentation environment	10-bpc DPX printing density	5900
FilmTheaterF3513RDIPD.icc	Fujifilm 3513DI (RDI) Theater Preview (by Adobe)	Theater preview of Fujicolor Positive Film F-CP-3513DI. Film-out on ARRI recorder with Carlos aims onto Fujicolor Recording Film ETERNA-RDI, printed on B&H model C, projected using xenon light source. DPX 445, 445,445 is calibrated to specified LAD Status M and LAD Status A.	color print film	presentation environment	10-bpc DPX printing density	5900
FilmTheaterF3521RDIPD.icc	Fujifilm 3521XD (RDI) Theater Preview (by Adobe)	Theater preview of Fujicolor Positive Film 3521XD. Film-out on ARRI recorder with Carlos aims onto Fujicolor Recording Film ETERNA-RDI, printed on B&H model C, projected using xenon light source. DPX 445, 445,445 is calibrated to specified LAD Status M and LAD Status A.	color print film	presentation environment	10-bpc DPX printing density	5900
FilmTheaterK2383PD.icc	Kodak 2383 Theatre Preview 2 (by Adobe)	Theater preview of KODAK VISION Color Print Film 2383. Film-out on ARRI recorder with Carlos aims onto KODAK VISION Color Intermediate Film 5242, printed on B&H model C, projected using xenon light source. DPX 445,445,445 is calibrated to specified LAD Status M and LAD Status A.	color print film	presentation environment	10-bpc DPX printing density	5900
FilmTheaterK2393PD.icc	Kodak 2393 Theatre Preview 2 (by Adobe)	Theater preview of KODAK VISION Color Print Film 2393. Film-out on ARRI recorder with Carlos aims onto KODAK VISION Color Intermediate Film 5242, printed on B&H model C, projected using xenon light source. DPX 445,445,445 is calibrated to specified LAD Status M and LAD Status A.	color print film	presentation environment	10-bpc DPX printing density	5900
FilmTheaterK2395PD.icc	Kodak 2395 Theatre Preview 2 (by Adobe)	Theater preview of KODAK VISION Color Print Film 2395. Film-out on ARRI recorder with Carlos aims onto KODAK VISION Color Intermediate Film 5242, printed on B&H model C, projected using xenon light source. DPX 445,445,445 is calibrated to specified LAD Status M and LAD Status A.	color print film	presentation environment	10-bpc DPX printing density	5900
DCDM_X'Y'Z'.icc	DCDM X'Y'Z' (Gamma 2.6) 5900K (by Adobe)	DCDM X'Y'Z' encoding (gamma 2.6) in accordance with the DCI spec, for data projected with creative neutrals at 5900K. Full white (Lab 100,0,0) is mapped to 52.37 cd/m2.	digital cinema projector	presentation environment	12-bpc gamma 2.6	5900
DCI_P3.icc	DCI P3 RGB (Gamma 2.6) 5900K (by Adobe)	DCI reference projector with P3 RGB primaries and gamma 2.6, for data projected with creative neutrals at 5900K. Full white (Lab 100,0,0) is mapped to 52.37 cd/m2.	digital cinema projector	presentation environment	12-bpc gamma 2.6	5900

FILE NAME	DESCRIPTION	DEVICE DETAILS	DEVICE TYPE	SCENE OR PRESENTATION ENVIRONMENT PROFILE*	RGB ENCODING	APPROX. COLOR TEMP.
DISPLAY DEVICES						
sRGB Color Space Profile.icm	sRGB IEC61966-2.1	Developed by Hewlett Packard and Microsoft, this color space is recommended color space for web graphics. It also uses the same primary colors as those defined for HD video production in ITU Recommendation 709. Decodes standard PC color values and HDTV video signals to viewing room colorimetry. The specification for sRBG IEC61966-2.1 can be found here: http://www.colour.org/tc8-05/Docs/colorspace/61966-2-1.pdf	computer display and TV monitor	presentation environment	full range RGB 0-255	6500
AdobeRGB1998.icc	Adobe RGB (1998)	Color space with a larger gamut than sRGB IEC61966-2.1 but smaller than ProPhoto RGB. Good choice for print publication, as almost all colors available using standard printing conditions can be encoded using this profile. Decodes color values to viewing room colorimetry. The specification for Adobe RGB (1998) can be found here: http://www.adobe.com/digitalimag/adobergb.html	computer display	presentation environment	full range RGB 0-255	6500
AppleRGB.icc	Apple RGB	This profile describes the color characteristics of the legacy Apple Trinitron monitor, commonly used for press workflows before the widespread adoption of color management. Decodes standard Macintosh color values to viewing room colorimetry.	computer display	presentation environment	full range RGB 0-255	5000
ColorMatchRGB.icc	ColorMatch RGB	This profile describes the color characteristics of the Radius Press-view monitor, commonly used for press workflows before the widespread adoption of color management. Decodes ColorMatch color values to viewing room colorimetry.	computer display	presentation environment	full range RGB 0-255	5000
PAL_SECAM.icc	PAL/SECAM	Based on color standards in the European television industry. Decodes PAL video signal to viewing room colorimetry. The specification for PAL/SECAM can be found here: http://www.ebu.ch/CMSimages/en/tec_doc_t3213_tcm6-10508.pdf	TV monitor	presentation environment	full range RGB 0-255	6500
SMPTE-C.icc	SMPTE-C	Based on color standards in the US television industry. Supercedes color definitions in the NTSC 1953 ICC profile. Decodes NTSC video signal to viewing room colorimetry. The specification for SMPTE-C can be found here: http://www.smpte.org/smpte_store/standards/	TV monitor	presentation environment	full range RGB 0-255	6500
CIERGB.icc	CIE RGB	A very large color space defined by the CIE. Should only be used when encoding colors with greater than 8 bits per channel. Not commonly used. Most large-gamut encodings use the ProPhoto RGB ICC profile.	extremely wide gamut output device	presentation environment	full range RGB 0-255	5500
ProPhoto.icm	ProPhoto RGB	Developed by Kodak Corp. Should only be used when encoding colors with greater than 8 bits per channel. Decodes colors to viewing room colorimetry. The specification for ProPhoto RGB can be found here: http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=39747&scopelist=ALL	extremely wide gamut output device	presentation environment	full range RGB 0-255	5000
WideGamutRGB.icc	Wide Gamut RGB	Very large color space using primary colors that extend beyond the range of human visual perception. Should only be used when encoding colors with greater than 8 bits per channel. Not commonly used. Most large-gamut encodings use the ProPhoto RGB ICC profile	extremely wide gamut output device	presentation environment	full range RGB 0-255	5000

* ***The Adobe-supplied ICC profiles can be divided into two general categories:*** *scene (scene-referred) profiles and presentation-environment (output-referred) profiles. Users should consider using these types of profiles in different parts of their workflows. See the section entitled "Scene & presentation environment profiles" in this appendix to better understand the distinction between these two types of profiles.*

About color profiles

Precise, consistent color management requires accurate ICC profiles. For example, without an accurate profile for video footage or motion picture film stocks, an image may appear correct in one application and incorrect in another application, simply due to any difference between the color characteristics of the capture medium and the assumptions made by the application displaying the image. This misleading representation may cause you to make unnecessary, time-wasting, and potentially damaging "corrections" to an already satisfactory image. With an accurate profile, an application importing the image can correct for any device differences and display an image's correct colors.

A color management system uses the following kinds of profiles:

- ***Monitor profiles*** — Describe how the monitor is currently reproducing color. This is the first profile you should create, because it is critical for accurate display of color on your computer monitor. If what you see on your monitor is not representative of the actual colors in your document, you will not be able make critical color decisions when editing your project files.
- ***Input device profiles*** — Describe what colors an input device is capable of capturing. Adobe supplies many input profiles representing the color characteristics of several types of video cameras, as well as profiles for popular camera negative film stocks. Scanner profiles are also examples of input profiles you can use in your workflow.
- ***Output device profiles*** — Describe the color space of output devices like digital cinema projectors and desktop printers. The color management system uses output device profiles to properly map the colors in a project to the colors within the gamut of an output device's color space.
- ***Project working space profiles*** — Define the specific RGB color space used in your project for compositing. By specifying a profile as a project working space, the application provides a definition of actual color appearances in the project.

Scene & presentation environment profiles

Adobe provides a wide range of ICC profiles for motion picture and video workflows. Many of these profiles represent the color and lighting characteristics of scenes when captured using digital or film cameras. Other profiles represent the color and lighting characteristics of images seen when viewed in environments with much more limited dynamic range, like movie theaters or computer monitors. For instance, a typical dynamic range of a scene viewed outside during the day in natural light could be 10,000:1. However, a scene viewed on a television or computer monitor may have a dynamic range of only 100:1. An understanding of the dynamic range a device "sees" or renders is incorporated into the ICC profiles built for those devices. As an example, the video camera profiles provided by Adobe are based on the range of colors and tones available in those scenes when those scenes are captured by the camera. The range of luminance in those scenes is much greater then that rendered by movie projectors or television monitors.

How does this apply to a color-managed workflow in After Effects? Because "scene" profiles contain an understanding of the scene contrast as recorded by the camera, they are best suited to use for composing. This is the case for the HD video workflow, described in Chapter 2, which uses a color depth of 16 bpc. The limited contrast of the "scene" profiles allow for more naturalistic blending and compositing.

In the HD TV and digital cinema workflows, you may have cases where there is a mismatch between the image state (scene/camera vs. presentation/display profile) of the footage that you are importing into your project and your project working space. This may cause unexpected contrast and tone changes to your footage when output. Imported images represented by the presentation profiles (e.g., sRGB IEC 61966-2.1) have already been rendered from the contrast of the original scene captured by the camera. When these images are rendered again during playback on an HD monitor (or theater projection system for the digital cinema workflow), images will appear darker.

New projects created with After Effects CS4 will automatically compensate for differences in the image state of your footage, project working space, and rendered output. This is controlled using the Compensate For Scene-referred Profiles option in the Project Settings dialog box. In most

cases, this option should remain checked to enable correct viewing and rendering of compositions. For more information on this feature, see the white paper discussing this issue on the Adobe web site at www.adobe.com/go/learn_ae_sceneoutputreferredpaper.

The list of Adobe-supplied profiles at the beginning of this appendix provides information defining profiles as either "scene" or "presentation environment" type profiles.

Limited-range video profiles (HDTV (Rec. 709) 16-235, SDTV NTSC 16-235, and SDTV PAL 16-235)

If you have already looked at the profile lists in After Effects CS4, you may have noticed several color profiles with names ending with "16-235". You may be wondering what these profiles define and when they would be used in your workflow.

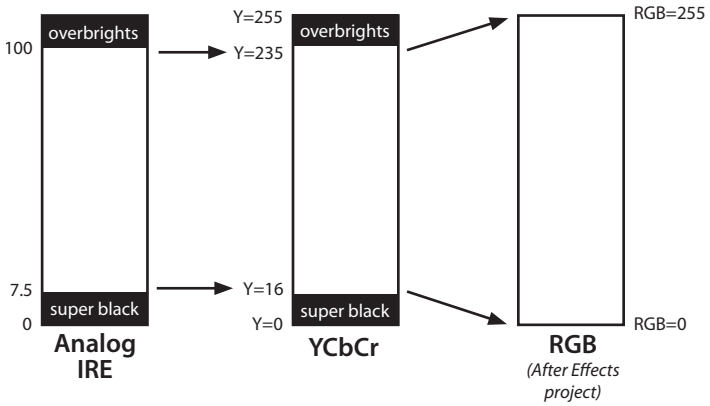

Figure 1 — Luma expansion to full-range RGB

These profiles are built to support video workflows that require the user to define a limited tone range for the RGB values used in the After Effects project. Why would this be necessary? In many cases, recorded analog video limits the range of tone in a captured image to "video safe" levels of luminance (normally IRE values from 7.5 to 100 in the US). However, it may be the case that luminance levels are recorded below 7.5 IRE (super black) or above 100 IRE level (super white or overbright). This presents a problem. When these analog IRE voltage values are translated to the YCbCr color space during the analog to digital conversion, it is normal for the 100 IRE value to translate to 235 Y (the luma part of the YCbCr color space) and the 7.5 IRE value to translate to 16 Y. Since After Effects works with RGB values, there will be an additional translation from YCbCr to RGB before work can be done in After Effects. The translation of colors from YCbCr to RGB is normally done by the codec used for a specific video format. This codec may translate the luma values to limited range RGB (16-235) or the codec may translate luma values to full range RGB (0-255). In some cases, a codec used in the workflow may have controls for how it will interpret luma values. In other cases, this translation is hidden from the user. You may be working with footage from several different formats that treat luma levels in different ways. This could add additional time and cost to your project as you manually tweak each piece of footage to comply with the requirements of your output.

The Adobe-supplied "16-235" profiles address this issue and provide additional flexibility in workflows where control of luma expansion/compression is critical. Here are some workflows where the use of the "16-235" profile may be helpful:

1 Expand luma levels on import:

If your HD (or SD) footage has limited range of 16-235 and you would like to expand values in your footage to the full RGB range of 0-255, choose a full range RGB profile in the Working Space menu in the Project Settings dialog box (probably the HDTV (Rec. 709) profile) and assign the HDTV (Rec. 709) 16-235 profile to your footage in the Interpret Footage dialog box. After Effects will convert colors from the profile you assign in the Interpret Footage dialog box to the project working space profile, mapping 16 to 0 and 235 to 255 when the colors are converted.

Choosing the "16-235" profiles in Interpret Footage dialog box and using a non-"16-235" profile as your working space will achieve the same result as choosing the Expand ITU-R 601 Luma Levels option in the Interpret Footage dialog box in After Effects 7.

Note: *When working in 8-bpc or 16-bpc mode, colors from 0-16 and 235-255 will be clipped.*

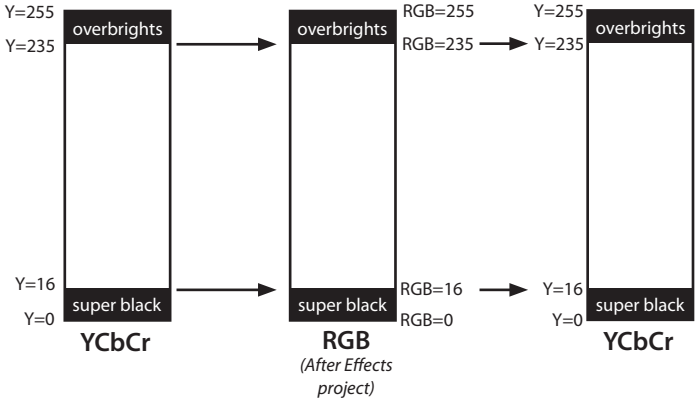

Figure 2 — Maintaining luma levels in the After Effects project

2 Maintain luma levels in project at 16-235:

If you would like to maintain the 16-235 range in your project and view RGB 16 as darkest black and RGB 235 as maximum white on your computer monitor, choose the HDTV (Rec. 709) 16-235 profile in the Working Space menu in the Project Settings dialog

box and assign the HDTV (Rec. 709) 16-235 profile to your footage in the Interpret Footage dialog box. Color values will be preserved because the profile assigned to your footage in the Interpret Footage dialog box is the same as the profile set for the project's working space. However, 16 RGB will be mapped to the darkest black on you monitor and 235 mapped to the lightest white on your monitor, creating the impression of a full-range image on your monitor. Keep in mind that some blending modes and effects expect black to be at a value of 0. Unexpected results may appear when black is not set at 0.

Note: *You can maintain footage values by using the full-range HDTV (Rec. 709) profile for interpreting footage, for the project working space, and for the output profile. However, if your footage is within the limited range of 16-235 and you use the HDTV (Rec. 709) profile as the project working space, then images will appear to have less dynamic range and contrast.*

3 Compress luma levels on output:

Choose one of the "16-235" profiles in the Color Management tab of the Output Module Settings dialog box. These profiles will insure that the luma levels in your rendered file will be within the 16-235 range. If your project working space was full-range (0-255), then color values will be compressed into the limited 16-235 range on output.

If your project working space was one of the "16-235" profiles, there will be no luminance compression on output, but the final output will be within the limited 16-235 range.

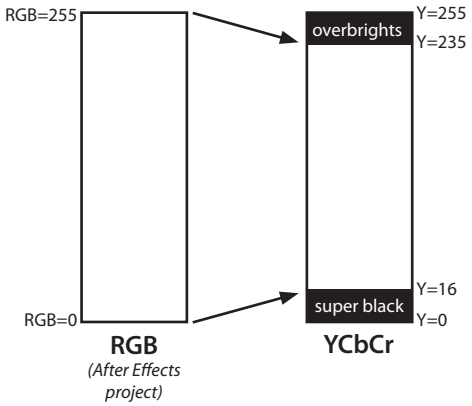

Figure 3 — Luma compression for video output

Appendix C: Glossary

Adobe RGB: An RGB working space that provides a relatively large gamut of colors and is well-suited for documents that will be converted to CMYK.

black: The absence of light. The color that is produced when an object absorbs all light.

calibration: The process of altering a device to bring its behavior into accordance with a known standard. For example, monitors are calibrated to a specific color temperature, gamma, and black and white luminance. Calibration is typically accomplished by measuring the behavior of a device with an instrument, comparing the measured behavior with the standard to which the device is being calibrated, and then adjusting the device so that it complies with that standard.

camera raw: Any of several formats for photographs that capture all of the raw camera sensor data, along with metadata that describes the camera settings.

characterization: A method of describing the unique color characteristics (usually in the form of an ICC profile) of color rendering devices such as monitors, scanners, cameras, and printers.

chroma: Color saturation. Neutral colors have no chroma.

CIE: Commission Internationale de l'Eclairage (International Commission on Illumination). A standards body responsible for setting standards for color and color measurement.

CIELAB (L*a*b*): A device-independent color space based on the CIE XYZ (1931) color model. CIELAB describes colors using a lightness channel (L*) as well as two chroma/hue channels (a* and b*). CIELAB is one of the profile connection spaces used by color management systems.

CIE XYZ: A device-independent color space created by the CIE that describes color using primaries based on human perception. The primaries are based on how our eyes respond to different wavelengths of light.

Cineon: A file format designed to represent scanned images for motion picture workflows. Data in a Cineon file normally represents printing densities.

colorimeter: A device that measures emitted color using three or more elements (usually red, green, and blue filters). A colorimeter is typically used with software to create ICC device profiles for monitors.

color conversion: The process of translating color values from one color space another.

color gamut: The total range of colors produced by a device. A color is said to be "out of gamut" when its position in one device's color space cannot be directly translated into another device's color space. For example, the total range of colors that can be reproduced from a film scan is greater than the amount of color possible on an LCD monitor, so the total gamut for film scan is said to be smaller than the gamut for the LCD monitor.

color management system (CMS): A software framework that processes application requests for color-managed color conversions using ICC profiles and CMMs for translation from one color space to another color space. The CMS also provides lists of profiles and in some cases preference information to application software. ColorSync on Mac OS®, ICM 2.0 on Windows, and Adobe Color Engine are examples of CMSs.

color matching functions: The relative amounts of three additive primaries needed to match each wavelength of light, usually based on the CIE Standard Observer. The human eye, digital cameras, and scanners all have color matching functions.

color model: A system used to numerically describe colors. Some models include red, green, blue (RGB); hue, lightness, saturation (HLS); cyan, magenta, yellow, black (CMYK); lightness, a*, b* (L*a*b*).

color space: A color encoding that defines specific characteristics in a color model so a coordinate defined inside a color space can be defined unambiguously in terms of appearance. For example, the RGB color model contains a number of color spaces, including Apple RGB, Adobe RGB (1998), and sRGB. Though each of these define color by the same three axes (R, G, and B), they differ in gamut as well as other specific characteristics.

color temperature: A measurement of the color of white light, expressed in Kelvin. (The Kelvin scale is a measure of temperature, starting from absolute zero.) The color temperature is the color of light a perfect black-body radiator emits when heated to that temperature. Computer monitors typically have a color temperature of 5000-9300 Kelvins: 5000 Kelvins is a yellowish-white, 9300 Kelvins is a bluer white.

DeltaE: An amount used to specify color difference. DeltaE measures the distance between two colors are apart in the L*a*b* color space.

destination profile: An ICC color profile representing the device or color space to which color values are converted to in order to preserve color appearance.

device-dependent: Describes a color space defined in terms of physical colorants, such as a monitor's RGB or a printing press's CMYK. So called because the actual color produced from a set of device-dependent values depends on the colorants and physical properties of the device.

device-independent: Describes a color model not related to any device, such as one instead based on human visual perception. Device-independent color models contain all colors that may be perceived by a human observer. They are used as the intermediary space known as the profile connection space (PCS) in ICC color conversions, and may also be used to store or transmit color values.

DPX: File format normally representing the density of the three primary color channels in a scan from negative film.

gamma: The slope of a curve defining the relationship between input and output of tone. This term is usually associated with monitors, defining the relationship between input signals from the video card to signals sent to liquid crystal filters in a monitor.

HDTV (Rec. 709): ICC profile based on the capture and transfer characteristics of high-definition video signals. (see Recommendation 709 below).

HDTV (Rec. 709) 16-235: ICC profile based on the capture and transfer characteristics for high-definition video signals using a maximum highlight value of 235 and a minimum shadow value of 16.

Hue: Differentiation of different areas of the visual spectrum. In common use, hue refers to the name of the color, such as red, orange, or green.

ICC: An open industry consortium with 60 members established for the purpose of creating, promoting, and encouraging the standardization and evolution of an open, vendor-neutral, cross-platform color management system architecture. For more information, visit the ICC Web site at www.color.org.

ICC profile: A file describing the color gamut and reproduction characteristics of a device—such as a scanner, monitor, or printer—by mapping color values to a device-independent color space like CIE XYZ or CIELAB.

image state: An attribute of the image encoding indicating the part of the workflow the image refers to. Examples of image state are scene images (scene-referred) and presentation viewing images (output-referred). Scene images are can be understood to have a wider dynamic range and less contrast than presentation viewing images.

luminance: The brightness of a surface, determined by the amount of light it reflects or emits.

neutral: Any color that is perceived to have no hue; such as white, gray, or black.

profile connection space (PCS): A device-independent color space used by a CMM for translating colors from one color space to another. The CMM translates colors from the source color space defined by an ICC profile to the PCS, and then from the PCS to the destination color space using

a second ICC profile. The PCS is used by the CMM; it is not visible to users.

Recommendation 709: ITU-R Recommendation BT. 709, more commonly known by the abbreviations Rec. 709 or BT. 709, standardizes the format of high-definition television. Rec. 709 and sRGB are sometimes used interchangeably. However, Rec. 709 specifies the capture and transfer characteristics of an HD TV signal, and sRGB specifies the characteristics of a reference monitor that can be sued to view that HD TV signal.

rendering intents: The methods, specified by the ICC, used for mapping colors from one color space to another. The four rendering intents are Perceptual, Saturation, Relative Colorimetric, and Absolute Colorimetric.

source profile: An ICC profile describing the color gamut and reproduction characteristics of a device or color space from which images are captured, scanned, or stored, such as a digital camera, scanner, or standard working space. Colors are converted from a source profile to a destination profile.

spectrophotometer: A device that measures a color sample throughout a specified number of wavelengths through the visible color spectrum.

sRGB: A color space using the ITU-R BT. 709-5 primaries, the same as are used in studio monitors and HDTV, and a transfer function (gamma curve) typical of CRTs.

white point: The color quality of white usually expressed using xy chromaticity coordinates.

working space: Default ICC profile used by the application to define appearance of color values. In After Effects, the project working space is the color space used for all compositing functions.

XYZ color model: see CIE XYZ

Appendix D: Additional resources

Below is a brief list of helpful color management-related documents and resources.

After Effects CS4 Help

http://www.adobe.com/go/learn_ae_documentation

Forums

Adobe User to User Forums
http://www.adobe.com/support/forums/
Adobe-hosted forums

Apple's Colorsync mail list
http://lists.apple.com/mailman/listinfo/colorsync-users
Apple-hosted forum for distribution of color management information. Most topics are related to color management in print publishing workflows.

ICC Users mail list
http://www.color.org/icc_users.html
ICC-hosted forum. Concentrates on the proper implementation of the ICC specification.

Websites

International Color Consortium
http://www.color.org/
Web site hosted by the International Color Consortium. This web site contains the latest ICC profile specification as well as technical documents related to the use of color management.

Digital Cinema Initiative
http://www.dcimovies.com/
Information related to open specifications used for digital cinema production and distribution.

Charles Poynton website
http://www.poynton.com/Poynton-color.html
http://www.poynton.com/Poynton-video-eng.html
Charles Poynton is an independent author who has written many influential books related to color and video technology.

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