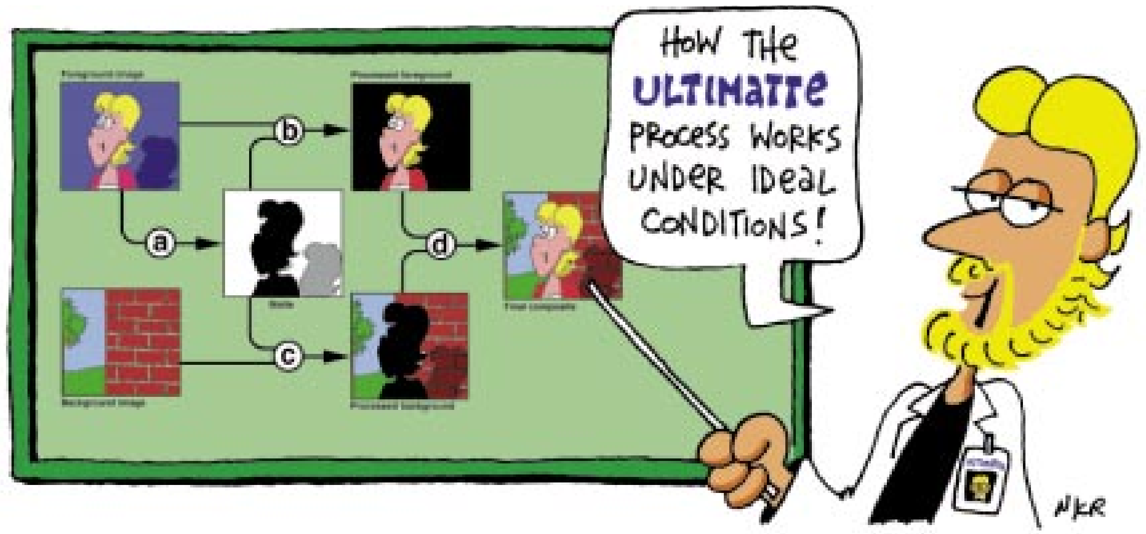
ULTIMATTE®
O V E R V I E W

Ultimatte Corporation

Contents

Chapter 1

CREATING THE COMPOSITE



In this chapter, we will cover the steps that the ULTIMATTE® system goes through to create a composite. Most of the process is automated; when there are no problems with the backing, lighting, or wardrobe colors, little or no operator input is needed.

The reason for covering the details of how this process works is so that when a problem does arise, the operator can quickly recognize the cause and how to correct it. Different problems requiring different solutions can have similar symptoms on-screen; understanding how the system views the images will speed finding the correct solution.

Chapters Two and Three will discuss problems that can arise, and the ULTIMATTE functions that can reduce or eliminate them.

In this chapter we examine a problem-free composite, with the foreground subject in front of a good-quality,

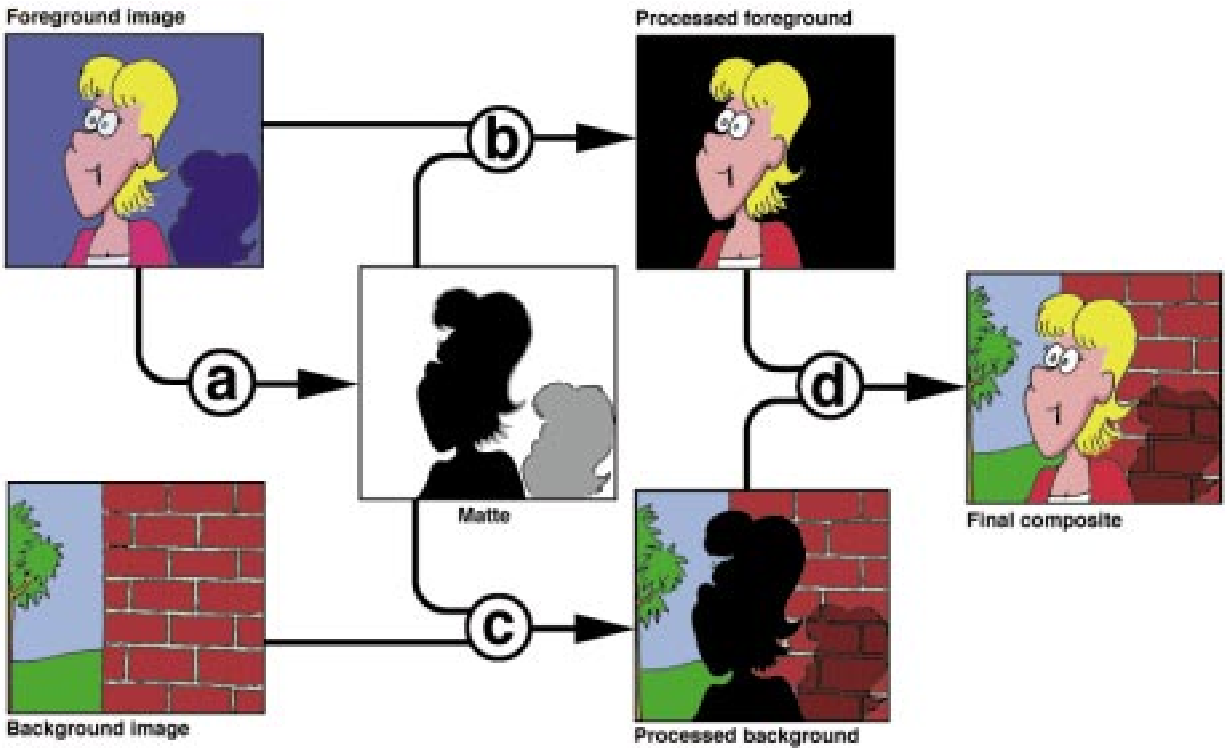


Figure 1-1. The steps in creating the composite: a. generating the matte, b. processing the foreground, c. processing the background with the matte, d. adding the processed foreground to the processed background for final composite.

evenly lighted blue backing. Of course, the ULTIMATTE system works with other backing colors (see sidebar, page 4); the principles discussed here are the same.

Figure 1-1 shows the steps the foreground and background images go through to be composited. Depending on the ULTIMATTE system used, these foreground and background images could be live video, digital motion picture footage or still photographs, but the steps used to process and composite them are the same.

We will examine each one of these steps in detail.

A. Generating the Matte

The foreground image — a subject against a blue backing — enters this step. The image that leaves — the matte — is a black silhouette of the subject against white, with transparent areas (such as shadows and soft edges) seen as grays (Fig. 1-2). The matte is used both to remove the blue backing from the foreground image before compositing and to control where the background image appears in the final composite.

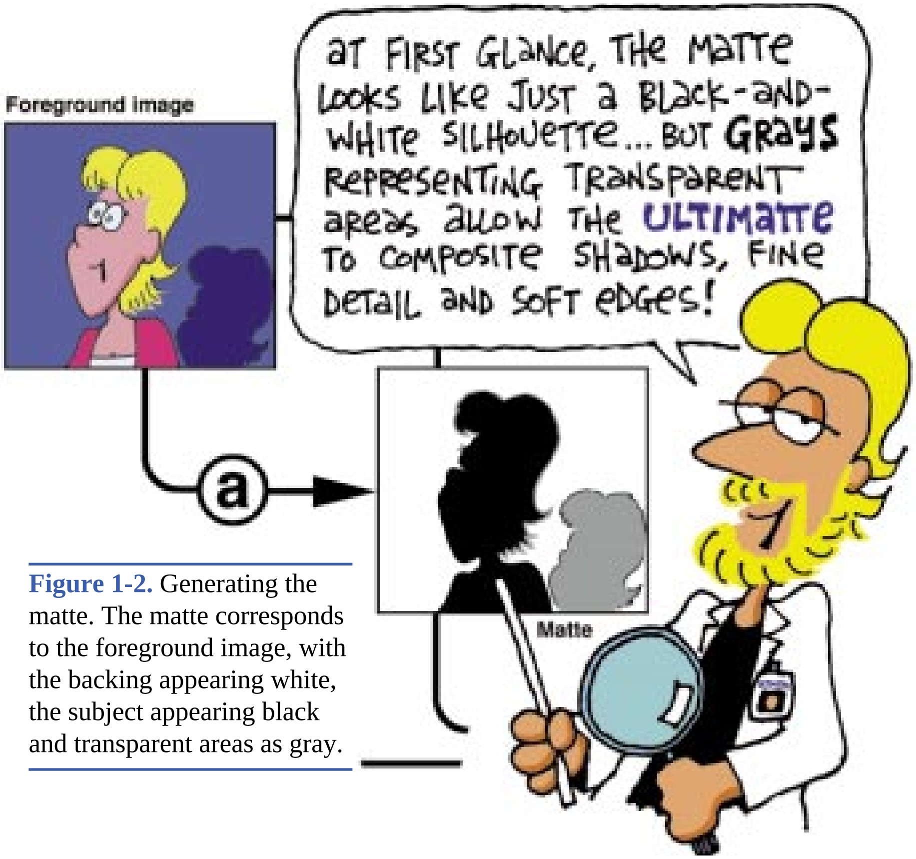


Figure 1-2. Generating the matte. The matte corresponds to the foreground image, with the backing appearing white, the subject appearing black and transparent areas as gray.

Each point, or pixel, of the matte corresponds to a pixel of the foreground image. Where the blue backing appears in the foreground is where we want the matte to turn on the background in the final composite, so we refer to the corresponding pixels of the matte, seen as white, as fully on. Where solid objects appear in the

Why is my matte image inverted?

Some systems using an ULTIMATTE software plug-in will display the matte image as a white silhouette against black — the inverse of what is shown in this manual. The internal logic is exactly the same; those systems simply require the matte to be displayed differently.

Why does my bluescreen shot use a green screen?

While these composite shots are usually referred to as "bluescreen shots," they frequently use a green backing. Why? Where once it was easier to obtain a good blue backing than green (hence the preponderance of blue stages), the quality of paints has increased to where now blue and green are equally good for compositing. The decision of which to use is primarily based on what colors need to be used in the foreground: for Superman in royal-blue tights, a green backing is called for, while the Jolly Green Giant should be shot against blue. Red can also be used, but since skin tones are reddish, they are harder to reproduce against a red backing than against blue or green; red is usually reserved for miniatures or product shots where both pure blues and greens need to be reproduced in the foreground.

Some ULTIMATTE systems can also work with black or white backings; these are used primarily for titles and animation.

With so many color options, why do people still use the term "bluescreen shot"? We agree that it's confusing. May we humbly suggest that if you're **using** ULTIMATTE, the term "ULTIMATTE shot" might be more appropriate?

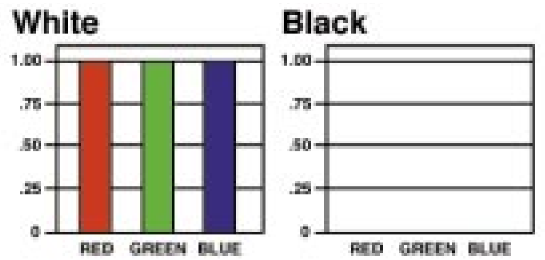


Fig. 1-3. The red, green and blue components of a white pixel (left) and a black pixel (right)

foreground, we want the matte to turn off the background; these pixels, seen as black, are fully off.

To understand how the matte is generated, keep in mind that the color and brightness of any pixel of the foreground image can be represented by percentages of red, green and blue. A white pixel is 100% red, 100% green and 100% blue, a black one is 0% of each. Every hue and shade between white and black can be represented in this way (Fig. 1-3). We'll use decimal values for percentages, so that each of the three color components can range from 0 to 1.00 (100%).

While we give the numbers for these values in our examples, it is more important to look at the bar graphs to really understand the relationships between the color components. The functions of the ULTIMATTE system are derived from these relationships; from knowing which colors have a good separation between the components and which don't. Learning to recognize how these components make up a color — for example, spotting that a particular shade of blue has a high green content or that a certain red has some blue contamination — will become essential in solving problems that can hurt the realism of a composite.

The ULTIMATTE system was designed with the recognition that pure colors in nature are almost non-existent: every naturally occurring color contains some amount of red, green and blue. For many colors, those amounts are not extremely different. Most blues, for example, contain quite a bit of green and red.

By creating a backing in which the component colors have been purposely mixed to have extreme differences, it becomes possible to automatically distinguish between a subject in front of the backing and the backing itself. Making that distinction is the starting point for creating an ULTIMATTE composite.

ULTIMATTE logic starts by looking at the differences between the color components at each pixel in the foreground image. Specifically, it determines which value is greater, red or green, then subtracts that value from blue.

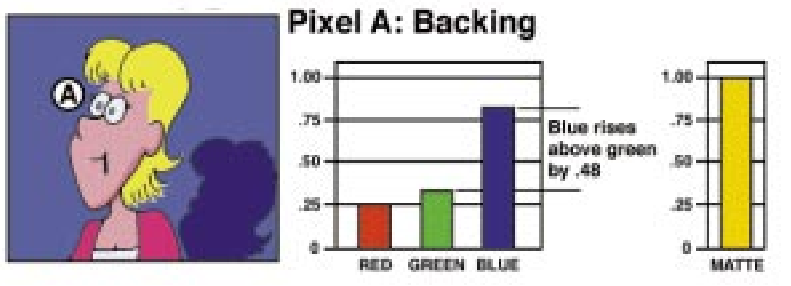


Fig. 1-4. A pixel in the unobstructed blue backing will have a pronounced difference between blue and the higher of red or green, in this case .48. Where this difference is greatest is the **peak point**, and defines where the matte will be fully on (value of 1.00).

This difference, how far blue rises above green or red, will be greatest in the unobstructed blue backing. Looking at such a point in our example (Pixel A) yields the following values: .25 red, .34 green and .82 blue. Since green is higher than red, its value is subtracted from blue's to give .48, a typical difference for a good backing (Fig. 1-4). Again, more important than the numbers is looking at the chart and understanding the proportions of the

Other Color Backings in Generating the Matte

Our discussion of how the color components are used to generate the matte with a blue backing applies also to green and red backings, except that with a green backing we are comparing the green component to the higher of red or blue, and with a red backing we are comparing the red component with the higher of green or blue.

Black and white backings use a slightly different logic. With black, the matte is an inverse function of the **highest** of the red, green or blue component at any given pixel (where the foreground is black, the matte is fully on; as the color components rise, matte values decrease). With white, it is a direct function of the **lowest** of red, green or blue (where the foreground is white, the matte is fully on; as the color components drop, the matte values also decrease).

The settings with black and white backings depend on the effect desired and almost always require manual adjustment.

color components in the blue backing. Note how high blue rises above red and green; you will always want a pronounced difference like this in the backing. This difference defines the level of the matte at this point and, correspondingly, of the background image at this point in the final composite.

Where this difference is greatest in the image is the matte's **peak point**. This defines where we want the matte to be fully on, or white. (Some ULTIMATTE systems identify the peak point automatically; others require the user to select the point to use—see Chapter Three.)

Since the matte is black-and-white, a single value from 0 to 1.00 can represent the black to white range for any pixel. Therefore, we want the pixels that match the peak point (a .48 difference in our example) to set the corresponding pixels on the matte to fully on, that is, to a value of 1.00.

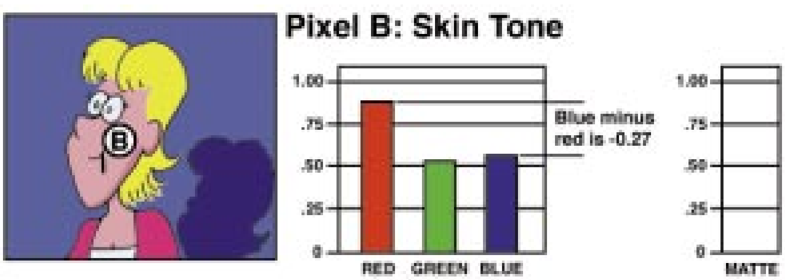


Fig. 1-5. A pixel in the solid foreground subject yields 0 or a negative number when the higher of red of green is subtracted from blue (in this case, -0.27). Where this difference hits 0 or below defines where the matte will be fully off (value of 0).

By default, the ULTIMATTE system defines pure white in the foreground image, red = green = blue = 1.00 for a difference of 0, as the minimum point. At pixels with a difference of 0 or below, the corresponding pixels of the matte will be set to fully off, or 0 (black).

For example at Pixel B, a point on the foreground subject, red is greater than green, so its value, .85, is subtracted from blue's, .58, to give -.27 (Fig. 1-5). Our minimum point is 0, so at this pixel the matte is 0: fully off.

Reproducing blues

Having the minimum point defined by white, where blue is equal to red and green, means that any shade of blue in the foreground image will be treated as part of the backing. In many cases, some shades of blue will appear on the foreground subject which we will want to reproduce. These shades of blue can be distinguished from the backing by slightly altering the formula we use to determine the separation between color components at any pixel. Where before we simply subtracted the higher of red or green from blue, now we will multiply the higher of red or green by a numeric value before subtracting. This value is set by the **Matte Density** control. Effectively, this will allow any pixel to have its blue component exceed both its red and green components by a small amount and still be considered an opaque part of the foreground subject (that is, have a matte value of 0).

For example, at Pixel C, on the iris of one of the subject's blue eyes, green is greater than red, so its value, .75, is subtracted from blue's, .81, to get .06. (Looking at the graph, Fig. 1-6, note how green is in relation to blue;

this is typical.) With the minimum point set where the difference is 0, Pixel C would be treated as a dark part of the backing; in the final composite, the blue of the iris would be replaced with the corresponding area of the background image. Using **Matte Density**, a value is set that when multiplied by the higher of red or green, will result in 0 when subtracted from blue. For Pixel C, the value is 1.08 (1.08 times .75 equals .81).

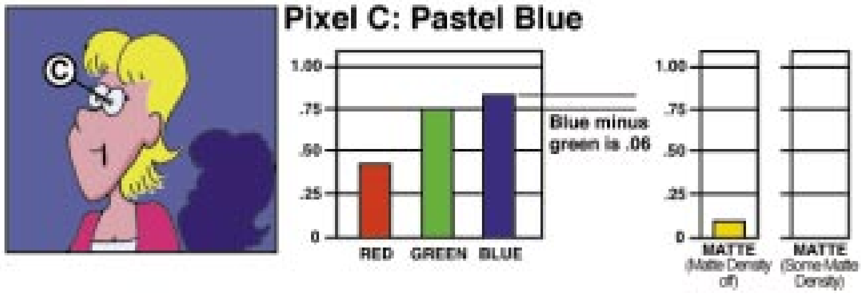


Fig. 1-6. In a pastel blue pixel, the blue component rises above red and green, which would normally cause it to be treated as part of the blue backing, generating a small matte value. By adjusting the **Matte Density**, blue can be allowed to rise above red and green to a certain point before being considered part of the blue backing, meaning that some shades of blue can be used and reproduced in the foreground subject (matte value of 0). Use of **Matte Density** is covered more fully in Chapter Three.

Assuming that Pixel C is the bluest area of the foreground that we want to keep from compositing, 1.08 becomes our **matte density value** for this image.

While we are looking at charts and numbers to show how this process works, setting Matte Density is usually done quite simply by observing the matte as the control is adjusted: gray areas on the matte will darken and go black. In our example of Pixel C, the irises of the subject's eyes would appear gray initially on the matte; the user would adjust MATTE DENSITY until the irises were black. The minimum point, where the matte equals zero, would thus be properly set. (Matte Density and other controls are discussed in more detail in Chapter Three.)

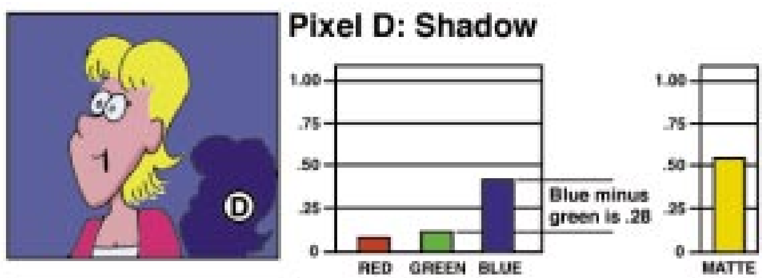


Fig. 1-8. A pixel in a shadow or transparent area of the foreground image will yield a difference between 0 and the peak point difference when the higher of red or green is subtracted from blue. For Pixel D, in a shadow, .13 green is subtracted from .41 blue for a difference of .28. Differences in this range generate proportional values for the matte between 0 and 1.00, where the matte is partially on (gray). In this case, the generated value is .56.

Linearity: key to reproducing shadows and soft edges

The ULTIMATTE logic now has a **peak point** where the matte will equal 1.00 and a **matte density value** to adjust the blue-minus-the-higher-of-red-or-green difference. Each pixel of the foreground image can now be mapped onto the matte image. This mapping is done linearly, that is, a foreground pixel with a difference which is 75% of the peak point will generate a value of .75 for the corresponding pixel of the matte, a foreground pixel with a difference 23% of the peak point will generate a value of .23 and so on. This can be seen by graphing the values as in Fig. 1-7: the linearity is represented on the graph by a straight line between zero and the peak point difference (.48).

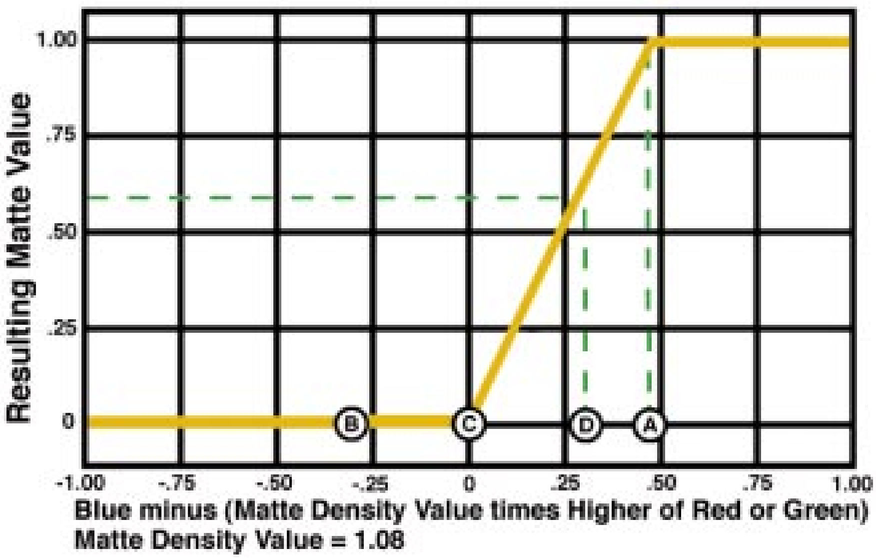


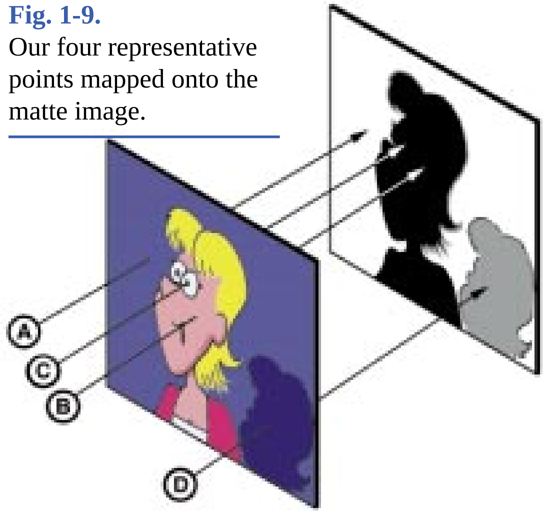
Fig. 1-7. The graph shows generated values for pixels in the matte as a function of blue minus the matte density value (1.08) times the higher of red or green in the foreground image. The greatest difference, .48 at Pixel A (unobstructed blue backing), defines the matte value of 1.00 (white). Differences of 0 and below (in solid foreground objects such as at Pixel B and pastel blues such as at Pixel C), yield a matte value of 0 (black). Differences between 0 and .48, transparent areas of the foreground image (shadows, soft edges), result in proportional values between 0 and 1.00 (grays): the difference at Pixel D, .28, yields a matte value of .58. Using the formula represented by this graph, the ULTIMATTE system maps the values generated by all of the pixels in the foreground image to create the matte image.

This linearity is key to creating believable composites. Areas of the foreground image where the blue backing is at a lower intensity generate lower intensity areas of the matte, which translate to matching areas of lower intensity in the background of the final composite. The most obvious advantage to this is the ability to reproduce shadows and transparent objects, since they partially obscure the backing, lowering its intensity.

For example, Pixel D is in the shadow area of the backing. Here, green is higher than red, so its value .13, is subtracted from blue's, .41, for a difference of .28 (Fig. 1-8). (Note, looking at the chart, that the red, green and blue components, while down in intensity, are at approximately the same proportions as they were for Pixel A in the unobstructed backing.) Checking this difference of .28 on the graph in Fig. 1-7 yields a value of .58, showing as gray in the matte. The matte will turn the background image on at this pixel only 58%, as if that point in the background was in the original shadow.

Less obvious but frequently more important to the overall realism of the matte is that the edges of most objects against the blue backing will appear slightly blurred, or soft, when examined closely, due to the properties of the lens, the depth of field and the shutter speed. This softness is effectively also a transparent area, and the ULTIMATTE system's ability to reproduce it means that edges around composited subjects will have a natural look.

Fig. 1-9.
Our four representative points mapped onto the matte image.



Using the formula represented by the graph in Figure 1-7, the ULTIMATTE system maps the values generated by all of the pixels in the foreground image to create the matte image. Figure 1-9 shows this mapping for our four representative points.

Having seen how the matte is generated, let's move on to processing the foreground image.

B. Processing the Foreground

The foreground image — a subject against the backing — enters this step. The most obvious effect of this step is that the image that leaves is of the subject against black (Fig 1-10). More subtle is that any blue tint the subject may have picked up from spill (blue light reflecting from the stage) or flare (blue light refracting within the camera lens) is removed. We will examine these — suppressing the backing and removing the unwanted tinting—separately.

1. Suppressing the Blue Backing

In the previous section, we identified the **peak point**: the best blue of the backing. We also generated the **matte image**: a map showing where the backing is unobstructed (fully on), where it is in shadow or obscured by a soft-focus object (partially on), and where it is completely hidden by the foreground subject (fully off).

To suppress the backing, we subtract this best blue of the peak point from every pixel of the foreground image, to the degree the matte is on at each pixel. Where the matte is fully on (backing is unobstructed), the blue will

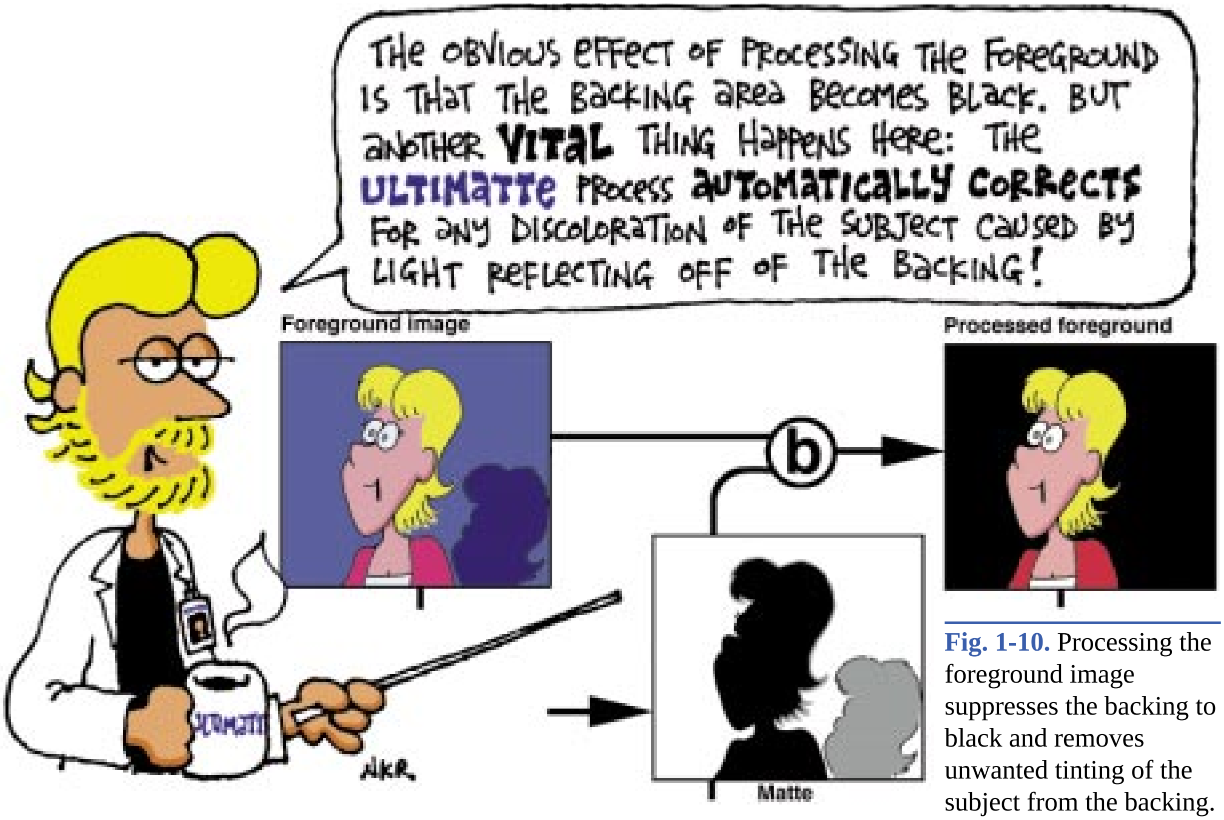


Fig. 1-10. Processing the foreground image suppresses the backing to black and removes unwanted tinting of the subject from the backing.

be fully subtracted; here, the foreground will be dropped to black. Where the matte is fully off (backing is completely hidden), **no** blue will be subtracted; here, the foreground will be unaffected.

Where the backing is partially obscured by a semi-transparent object (smoke, motion blur, soft-focus edge), the pixels are blue, but tinted by the color of the obscuring object. Here, subtracting the peak point by the amount the matte is on will remove just the blue contributed by the backing. This leaves the tint from the object, which will properly be composited into the final image; the semi-transparent object will realistically appear to obscure the background image. (For a shadow, where there is no tint from an obscuring object, the result of subtracting the peak point blue will be to drop the foreground in the shadow area to black.)

Let's take a look at the four reference points we used earlier: Pixel A in the backing, Pixel B in the subject, Pixel C in a pastel blue in the foreground subject, and Pixel D in the shadow.

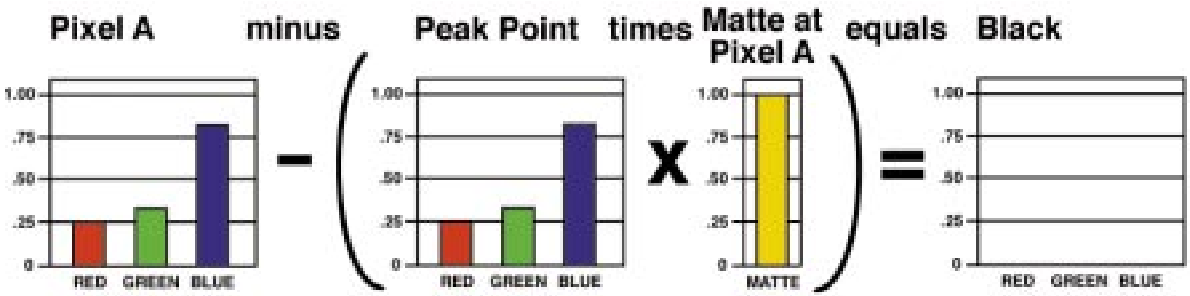


Fig. 1-11. Unobstructed blue backing at Pixel A is suppressed to black in the processed foreground image.

A pixel in the backing

Pixel A, in the unobstructed backing, has the same component values of the peak point: .25 red, .34 green and .82 blue. As we saw earlier, the matte is fully on at this point with a value of 1.00. Each component of the peak point multiplied by 1 yields the same .25 red, .34 green and .82 blue which, subtracted from each component of Pixel A, results in 0 red, 0 green and 0 blue: black (Fig. 1-11). The blue backing at this pixel is suppressed to black, as we want.

Pixels in the subject

Pixel B, in the foreground subject, has component values of .85 red, .53 green and .58 blue. (Note: blue does not exceed green in skin tones except where there is excessive blue spill light reflecting from the backing. This

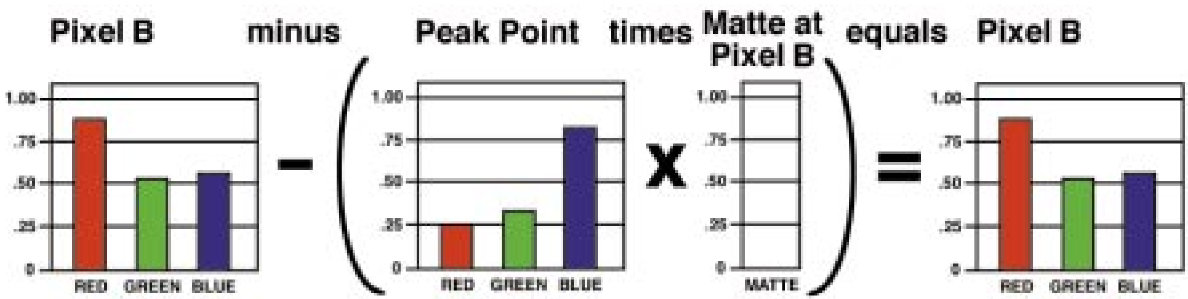


Fig. 1-12. Pixel B, in the foreground subject, is unaffected in the processed foreground image.

blue spill will be dealt with in part 2, below.) As seen earlier, the matte is fully off at this point with a value of 0. This value multiplied by the peak point yields 0 red, 0 green and 0 blue. Subtracting these from Pixel B leaves the original values: .85 red, .53 green and .58 blue (Fig. 1-12). The foreground subject at this pixel is unaffected, again, as we want. Similarly, the matte is fully off at Pixel C; that pixel will also be unaffected.

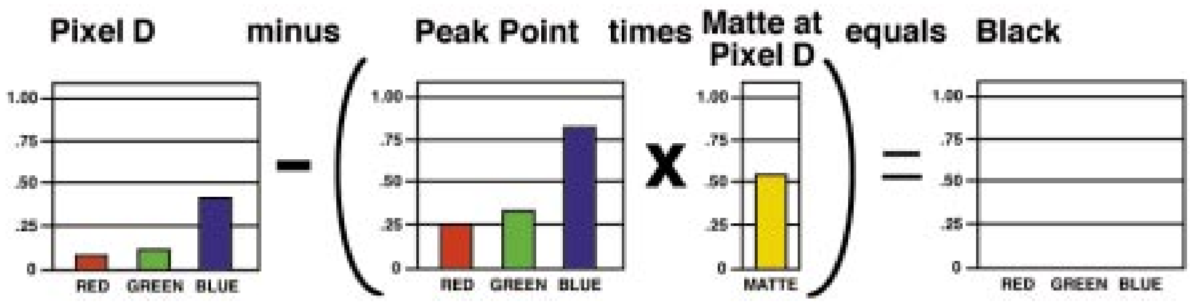


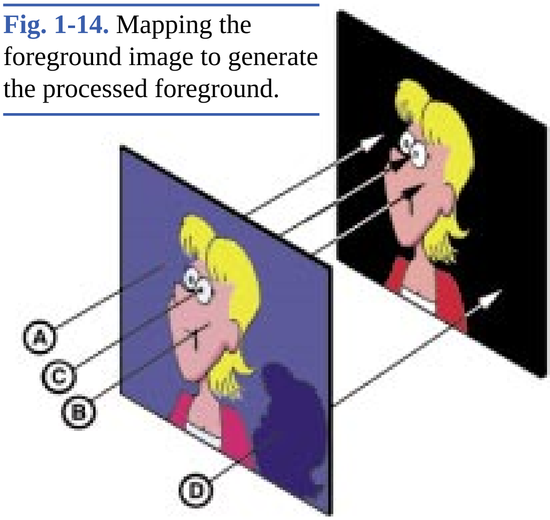
Fig. 1-13. Pixel D, in a transparent area (in this case, a shadow), is suppressed to black in processed foreground image.

A pixel in the shadows

Pixel D, in the shadows, has component values of .10 red, .13 green and .41 blue. The matte is about half-on at this point with a value of .56. Multiplying this by the reference pixel yields .14 red, .19 green and .46 blue. Subtracting this result from Pixel D yields -.04 red, -.06 green and -.05 blue. We clip at 0, resulting in red = green = blue = 0 = black (Fig. 1-13). Again the blue background, even when reduced in intensity due to a shadow or soft edge, is suppressed to black.

In this way, every pixel of the foreground is either suppressed to black or left unaffected. Figure 1-14 shows our four representative points mapping from the foreground image to the processed foreground.

Fig. 1-14. Mapping the foreground image to generate the processed foreground.



2. Blue Spill and Lens Flare Suppression

The foreground subject can take on a blue tint due to light reflecting off of the blue stage (spill) or from surface reflections within the camera lens (flare). The ULTIMATTE process removes this contamination automatically by using the following observation:

For most colors in nature, if the blue component exceeds green, it does so by less than green exceeds red. This is true even for many natural pastel shades of blue, which the ULTIMATTE process can reproduce. The exceptions are deep blues, which have already been suppressed as part of the backing, and magentas.

Fig. 1-15. Although the backing has been suppressed, blue light reflecting from it is causing a purplish tint on the skin tone at Pixel B. ULTIMATTE spill-suppression logic removes the tint by holding the blue component to the level of green.

We will assume, then, since deep blues have already been suppressed, that any time the blue component in a color exceeds green by **more** than green exceeds red, it's because of reflected blue light contaminating the color. So by allowing the value of blue at any pixel in the image to exceed green only by the amount green exceeds red (or, if green is equal to or less than red, holding blue to the level of green), any unnatural bluish tints will be removed while **natural** blues will be unaffected.

For example, Pixel B, on the subject's skin tone, has component values of .85 red, .53 green and .58 blue. Blue spill from the backing is giving the subject's skin tone a purplish cast. The suppression logic sees that red exceeds green, so it drops the value of blue to the value of green, from .58 to .53. Pixel B's component values are now .85 red, .53 green and .53 blue, eliminating the blue tint (Fig. 1-15).

Going on to Pixel C, the pastel blue of the eye, red is .41, green is .75 and blue is .81. Here, green exceeds red by .34, so blue would be allowed to exceed green by .34, up to 1.09 (actually, it would clip at 1.00). Since blue is already less than that level, its value remains unchanged (Fig. 1-16).

Other Color Backings in Processing the Foreground

Spill/flare suppression works similarly with green and red backings as they do for blue. The logic is slightly different, but the effect is the same: to remove contamination of foreground colors caused by the backing. The differences become relevant when manual control is necessary to reproduce certain colors in the foreground; this is covered in detail in Chapter Three, ULTIMATTE CONTROLS**: Gate 1/3** and **Gate 2**.

With a white backing, the logic for suppressing the backing is essentially as described for blue. There is no need for spill/flare suppression, however, so that logic is bypassed.

With a black backing, the foreground processing is bypassed completely since the backing does not need to be suppressed and there are no spill or flare problems.

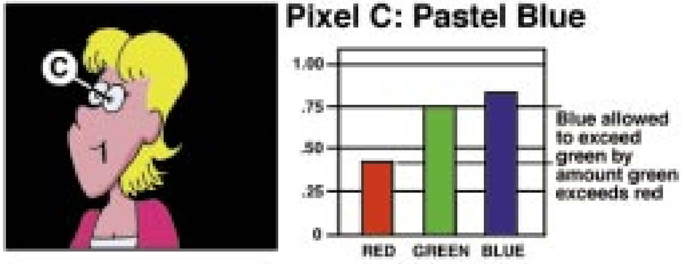


Fig. 1-16. A natural pastel shade of blue is left unaffected by the suppression logic since its blue component rises above green by less than green rises above red.

ULTIMATTE logic, therefore, corrects the colors of the foreground subject, when needed, to what they would have been if the subject had been photographed on a black, instead of blue, stage.

The color that fools this logic is magenta, mentioned before as an exception to the "blue exceeds green by less than green exceeds red" rule. This can be seen by simply considering Pixel B again: the purplish tint of the skin tone is eliminated by holding the level of blue to the level of green. But what if the subject were wearing purplish clothing that had color components identical to Pixel B? The logic would still hold the level of blue to green, incorrectly changing the color. Essentially, by holding down the level of blue, the logic changes shades of magentas to shades of red. If magenta needs to be reproduced on a blue stage, the spill-suppression logic must be adjusted manually (see Chapter Three, ULTIMATTE CONTROLS: **Gate 1/3** and **Gate 2**).

Don't try to correct for blue spill using colored light!

A common mistake is to try removing the apparent discoloration on foreground subjects by hitting the subject with a complementary color. For example, trying to compensate for light reflecting from a blue backing by putting amber gels over side lights. This simply adds an undesired amber tint to the subject and causes hard edges in the final composite. Unless a specific lighting effect is being attempted (such as using a strong orange backlight to match a dramatic sunset in the background image), all the lights on the stage should match in color temperature. Trust the ULTIMATTE logic to correct for discoloration.

A problem can also arise with some shades of yellow and brown. Here, the blue component should be **less** than green but, if contaminated by blue spill, the suppression logic will allow blue to **equal** green. The result is for these colors to be slightly desaturated. This can also be corrected manually (see Chapter Three, ULTIMATTE CONTROLS: **Black Balance** and **Gray Balance**).

Another important consideration about spill/flare suppression: light reflecting from the backing cannot be used for back or sidelighting the foreground subject; it will be suppressed along with other spill. Lighting of the subject must be done as if the backing were non-reflective black; back and sidelighting must be provided directly, at a color temperature matching that of the other set lights (see sidebar).

C. Processing the Background

The background image enters this step. The image that leaves appears to be the background with a black "hole" in the shape of the foreground subject (Fig. 1-17). This is accomplished by multiplying each pixel of the background image by the corresponding pixel of the matte.

The result is the background image being fully on in areas that correspond to the unobstructed blue backing of the foreground image, being partially on (darker) in areas that correspond to shadows and transparent areas of the foreground image, and being fully off (black) in areas that correspond to the foreground subject.

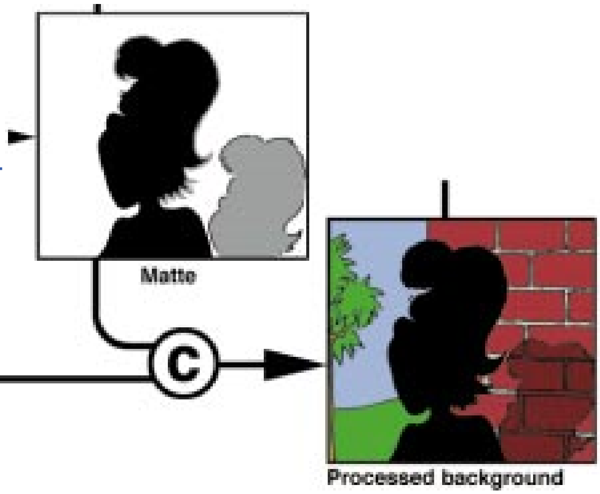


Fig. 1-17. Each point in the background image is multiplied by the corresponding point in the matte to create the processed background.

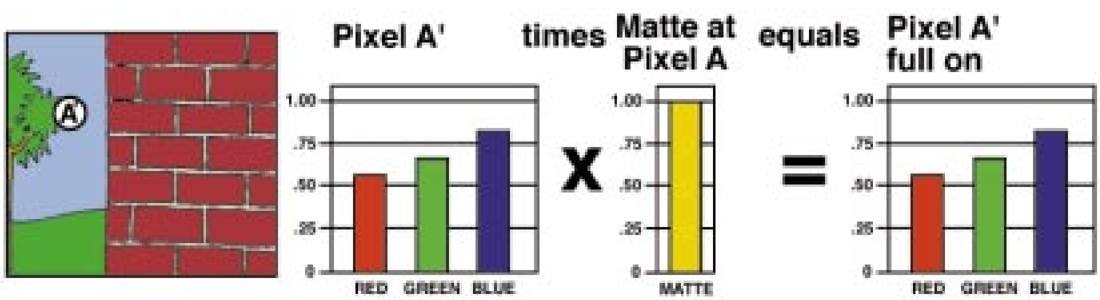


Fig. 1-18. Pixel A′ corresponds to the backing area of the foreground, so is turned fully on in the processed background image.

Consider pixels at points in the background that correspond to the pixels we have been examining in the foreground:

Pixel A′ corresponds to Pixel A, the point in the foreground backing. The component values of

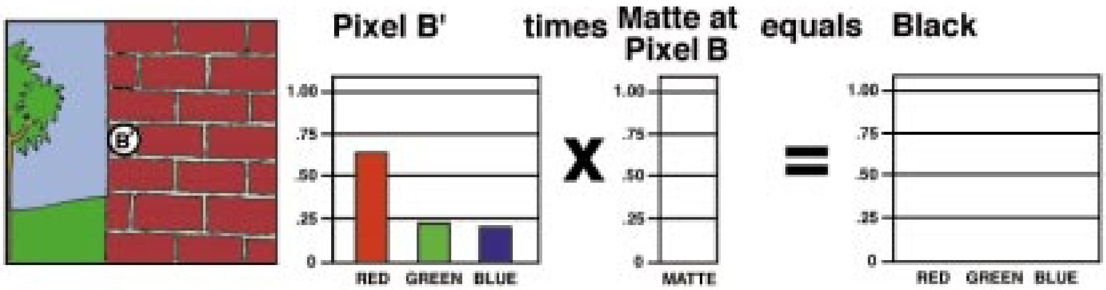


Fig. 1-19. Pixel B' corresponds to the subject area of the foreground, so is turned off in the processed background image.

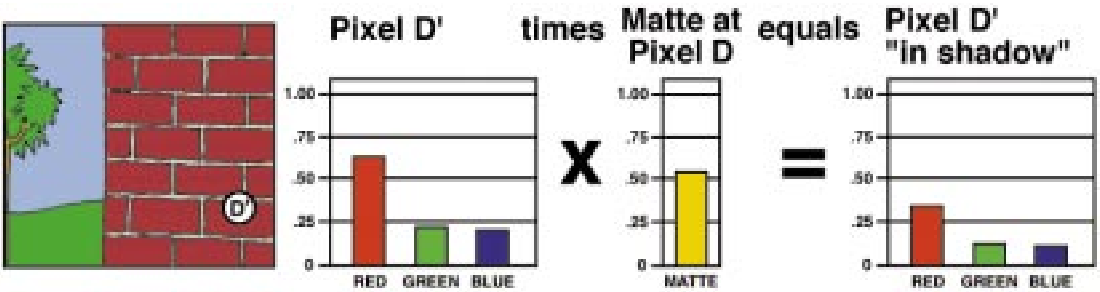


Fig. 1-20. Pixel D′ corresponds to a shadow area of the foreground, so is reduced in intensity to match the shadow.

Pixel A′ — .55 red, .67 green and .82 blue — are multiplied by the value of the corresponding point of the matte. Since Pixel A was in the foreground backing, the matte at this point is 1.00: the value of Pixel A′ will be unchanged. This point of the background will be fully on (Fig. 1-18).

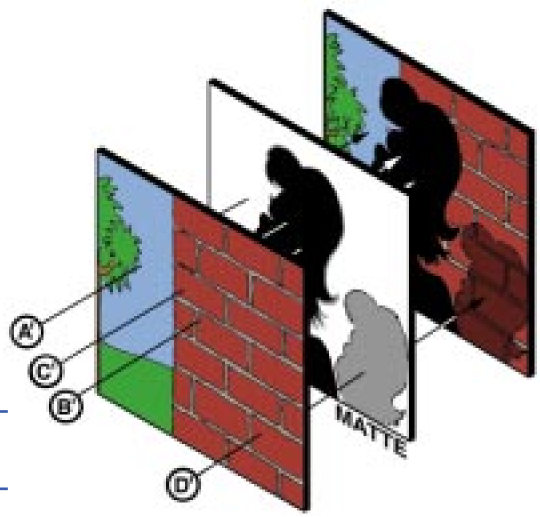


Fig. 1-21. Mapping the background to the processed background image.

As we've seen, the pixels in the subject, Pixels B and C, both generated a matte value of 0. This value multiplied by the corresponding pixels in the background, Pixels B′ and C′, also yields 0: black. These points of the background are fully turned off (Fig. 1-19).

Pixel D′ corresponds to Pixel D, the point in the shadow on the backing. For Pixel D, the matte value was found to be .58. This, multiplied by the component values of Pixel D′ — .63 red, .23 green and .21 blue — yields .35 red, .13 green and .12 blue: this new point is the same color as Pixel D′, but darker, as if it is in shadow — the desired effect (Fig. 1-20).

In this way, each pixel of the background image is mapped, multiplied by the corresponding pixel of the matte, to the processed background image (Fig. 1-21). We now have the processed foreground and the processed background and are ready to generate the final composite.

D. The Final Composite

The processed foreground image and the controlled background image enter this step. What leaves is the final composite image (Fig. 1-22).

This is accomplished simply by adding each point in the processed foreground image to the corresponding point in the processed background image to create the new, composite, image (Fig. 1-23).

We've seen how the ULTIMATTE logic works at each step of the compositing process. In the next chapter we will examine the ULTIMATTE controls and how they affect the composite to correct problems or to create special effects.

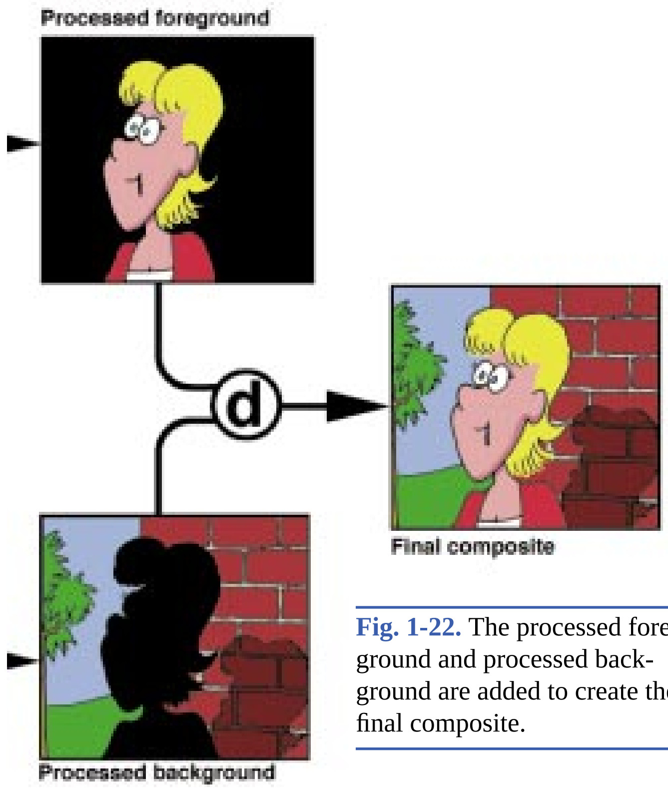


Fig. 1-22. The processed foreground and processed background are added to create the final composite.

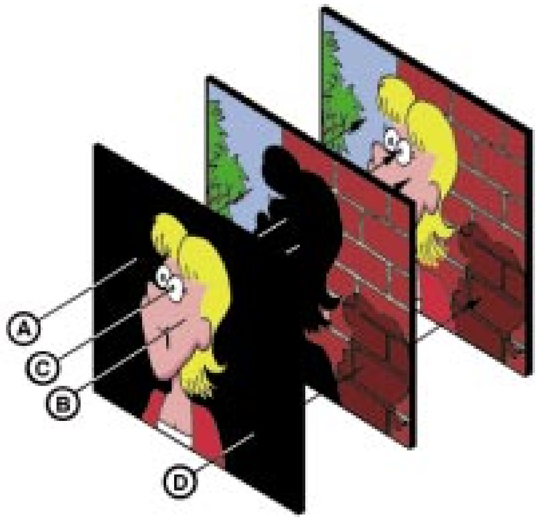


Fig. 1-23. Each point in the processed foreground is added to the corresponding point of the processed background to generate the final composite.

Other Color Backings in Processing the Background and in the Final Composite

At this point in the process, the matte has been generated and the backing, along with foreground contamination from it, suppressed. The color of the backing is no longer a consideration; these steps are the same no matter which color backing is used.

Chapter 2

PRE-PROCESSING: Screen Correction & Grain Killer

The vast majority of problems that occur when using the ULTIMATTE system are a result of the backing being flawed or uneven. Once upon a time, when the ULTIMATTE system was exclusively for live video shoots, the best solution was to re-paint or re-light the stage.

Today, however, the images to be composited may come from movie film, videotape, or scanned photographs. With compositing taking place days or weeks after the image has been shot, re-painting or re-lighting is no longer an option.

While the ULTIMATTE offers a range of controls to compensate for problems with the backing (covered in Chapter Three), these frequently lower the quality and believability of the composite.

The best solution today is to use the ULTIMATTE SCREEN CORRECTION function. SCREEN CORRECTION comes close to letting you re-paint and re-light the backing long after it's been shot: it is a pre-processing step that evens out the backing in the foreground image before the image enters the ULTIMATTE process (described in Chapter One).

Fig. 2-1. The foreground image at left has an uneven backing: the upper corners are dark due to lens vignetting and a poorly painted patch appears behind the model. Using this image as input to the ULTIMATTE process will result in a less-than-perfect composite. The SCREEN CORRECTION function can compensate for the flaws, producing an image with an even backing (center). If the image is noisy due to film grain or camera noise, the GRAIN KILLER function can filter the noise from the backing without affecting the foreground subject. After applying SCREEN CORRECTION and GRAIN KILLER, the image approaches the ideal conditions needed to achieve a perfect matte from the ULTIMATTE process as described in Chapter One.

Another pre-processing function that is available is ULTIMATTE GRAIN KILLER. Originally designed to filter film grain from the backing areas of the foreground image, GRAIN KILLER is also effective at reducing visual noise introduced by video cameras and photo scanners.

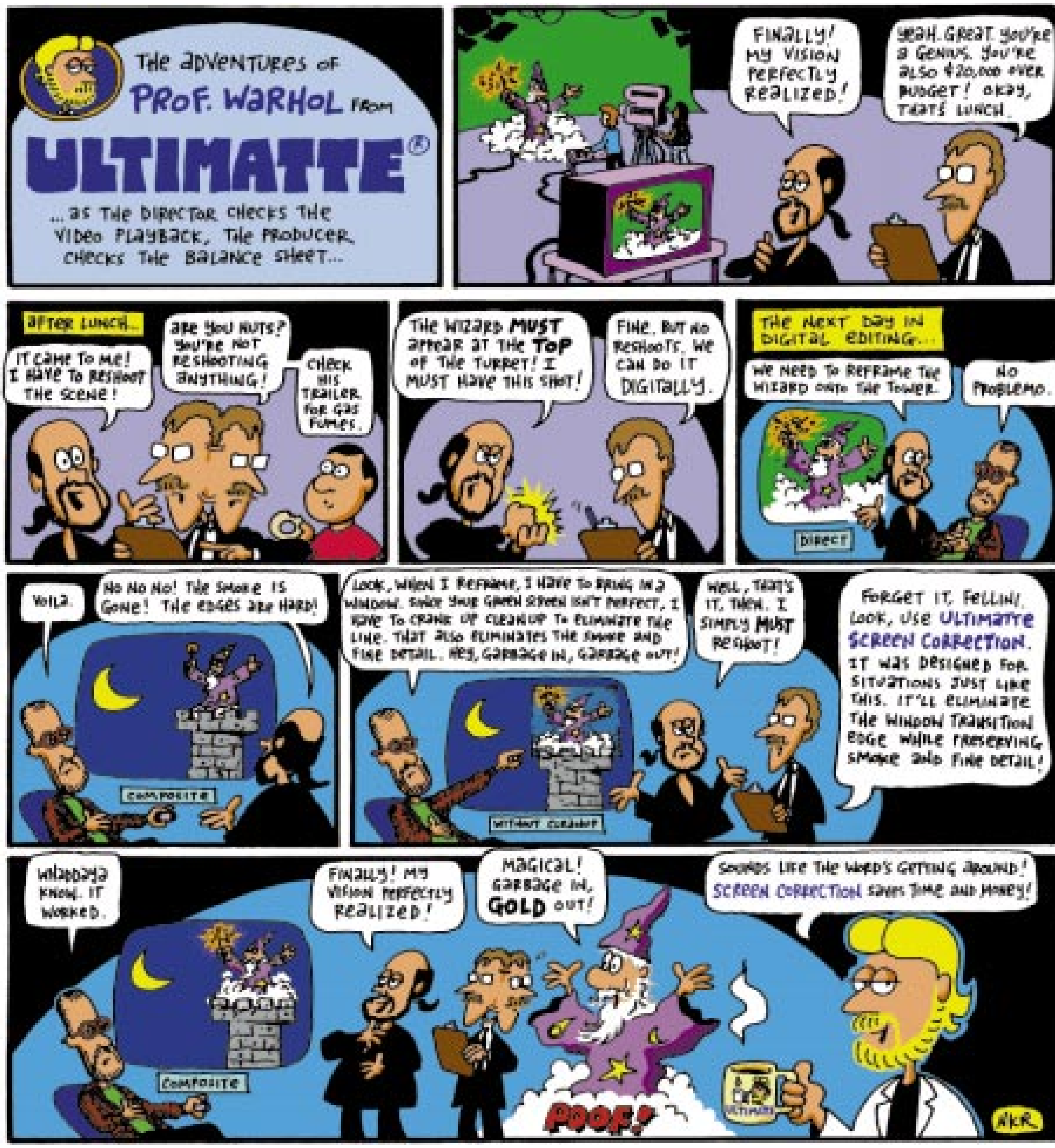
Both of these functions are applied to the foreground image before it enters the ULTIMATTE process (Fig. 2-1). (Note that GRAIN KILLER loops back; it is usually applied several times to achieve the desired effect.) Applied properly, these functions clean up the backing area without affecting the foreground subjects. The controls for these functions have no effect on the compositing process itself; their only goal is to make the foreground image approach the “ideal conditions” described in Chapter One so that the ULTIMATTE process can work most effectively.

In this chapter, we examine SCREEN CORRECTION and GRAIN KILLER in detail.

SCREEN CORRECTION

SCREEN CORRECTION is used to remove problems with the backing: hot spots from uneven lighting, dark corners due to lens vignetting, floor glare, and imperfections (such as seams, patches, textures, or repainted areas) in the backing material. Problems also arise with the use of set pieces (pieces painted the same color as the backing and aligned to match elements of the background image — such as a wall or stairs); seams, shadows and glare from these pieces are common and difficult (or impossible) to eliminate only through lighting. Not dealt with, these problems will be visible in the final composite.

After applying SCREEN CORRECTION, however, the foreground image will become the foreground subject against a backing of uniform brightness and color, with the subject itself unaffected. This pre-processed


THE ADVENTURES OF PROF. WARHOL FROM ULTIMATTE®
...AS THE DIRECTOR CHECKS THE VIDEO PLAYBACK, THE PRODUCER CHECKS THE BALANCE SHEET...
FINALLY! MY VISION PERFECTLY REALIZED!
YEAH. GREAT. YOU'RE A GENIUS. YOU'RE ALSO $20,000 OVER BUDGET! OKAY, THAT'S LUNCH.
AFTER LUNCH...
IT CAME TO ME! I HAVE TO RESHOOT THE SCENE!
ARE YOU NUTS? YOU'RE NOT RESHOOTING ANYTHING!
CHECK HIS TRAILER FOR GAS FUMES.
THE WIZARD MUST APPEAR AT THE TOP OF THE TURRET! I MUST HAVE THIS SHOT!
FINE. BUT NO RESHOOTS. WE CAN DO IT DIGITALLY.
THE NEXT DAY IN DIGITAL EDITING...
WE NEED TO REFRAME THE WIZARD ONTO THE TOWER.
NO PROBLEMO.
DIRECT
VOILA.
NO NO NO! THE SMOKE IS GONE! THE EDGES ARE HARD!
COMPOSITE
LOOK, WHEN I REFRAME, I HAVE TO BRING IN A WINDOW. SINCE YOUR GREEN SCREEN ISN'T PERFECT, I HAVE TO CRANK UP CLEANUP TO ELIMINATE THE LINE. THAT ALSO ELIMINATES THE SMOKE AND FINE DETAIL. HEY, GARBAGE IN, GARBAGE OUT!
WELL, THAT'S IT, THEN. I SIMPLY MUST RESHOOT!
FORGET IT, FELLINI. LOOK, USE ULTIMATTE SCREEN CORRECTION. IT WAS DESIGNED FOR SITUATIONS JUST LIKE THIS. IT'LL ELIMINATE THE WINDOW TRANSITION EDGE WHILE PRESERVING SMOKE AND FINE DETAIL!
WITHOUT CLEANUP
WHADDAYA KNOW. IT WORKED.
FINALLY! MY VISION PERFECTLY REALIZED!
MAGICAL! GARBAGE IN, GOLD OUT!
SOUNDS LIKE THE WORD'S GETTING AROUND! SCREEN CORRECTION SAVES TIME AND MONEY!
COMPOSITE
POOF!
NKR

foreground now becomes the foreground image for the normal ULTIMATTE process.

Use of SCREEN CORRECTION eliminates the old solution for dealing with these problems: the increase of the **Clean Up** control. While **Clean Up** (described in Chapter Three) can reduce the effects of an uneven backing, it frequently does so at the cost of losing fine edge detail and shadows. SCREEN CORRECTION compensates for the uneven backing with **no** loss of fine detail, soft edges, or shadows. **Users who learned on older ULTIMATTE systems should get in the habit of going to SCREEN CORRECTION instead of Clean Up.**

How it works

First, an image of the bare stage is stored: the **reference frame**.

Next, a **peak poin**t is selected and a **matte** is generated from the reference frame: the **reference matte** (Fig. 2-2). This process is exactly as described in Chapter One, Section A — "Generating the Matte." The matte will be white (fully on) in areas that match the peak point; unevenness in the backing will show up as gray areas.

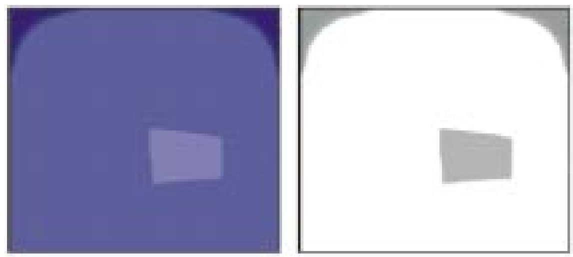


Fig. 2-2. An image of the bare backing (left) is used to generate the **reference matte** (right).

Using the same peak point, a matte is generated from the foreground image: the **foreground matte**. (The mattes generated at this time are **only** used for the SCREEN CORRECTION step; a new matte used for compositing will be generated once the corrected foreground image enters the ULTIMATTE process.) Here, the matte will be white (fully on) in areas that match the peak point and black (fully off) in areas of the foreground subject. Grays can result from either transparent areas or unevenness of the backing (Fig. 2-3).

Using the peak point and the reference frame, a **correction frame** is generated. Each pixel of this frame has the Red, Green and Blue values of the peak point minus the values of the corresponding pixel of the reference frame. In other words, if each pixel of the reference frame were added to the corresponding pixel of the correction frame, the result would be an image where every frame would be equal to the peak point: a perfect backing.

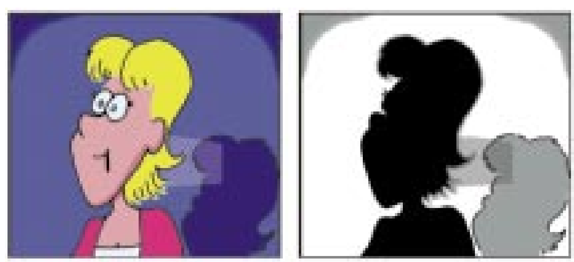


Fig. 2-3. The foreground image (left) is used to generate the **foreground matte** (right).

For example, consider Point X, a pixel in the "good" area of the unobstructed backing (Fig. 2-4). Here, the color values equal the peak point (.25 red, .34 green, .82 blue) so the difference is zero. The values at the point corresponding to Pixel X in the correction frame will be Red = 0, Green = 0 and Blue = 0.

Pixel Y, in the darkened upper left corner of the backing, has values of .16 red, .13 green and .38 blue (Fig. 2-5). Subtracting this from the peak point values of .25 red, .34 green and .82 blue yields the correction values at

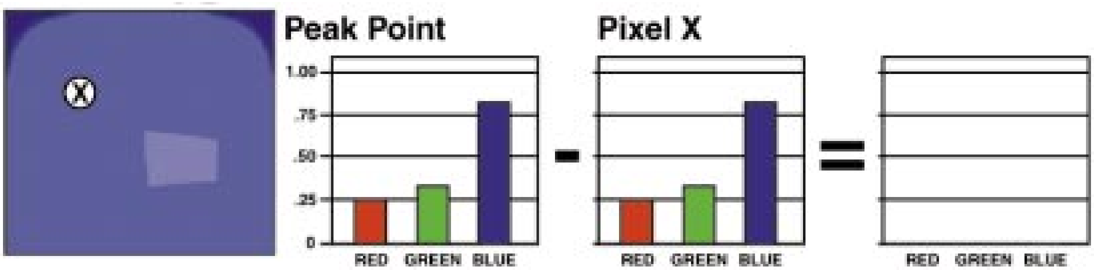


Fig. 2-4. Pixel X has values matching the peak point, yielding correction values of zero.

this point of .09 red, .21 green and .44 blue.

Pixel Z, in the painted patch, has values of .42 red, .45 green and .84 blue (Fig. 2-6). Subtracting this from the peak point values yields the correction values at this point of -.17 red, -.11 green and -.02 blue.

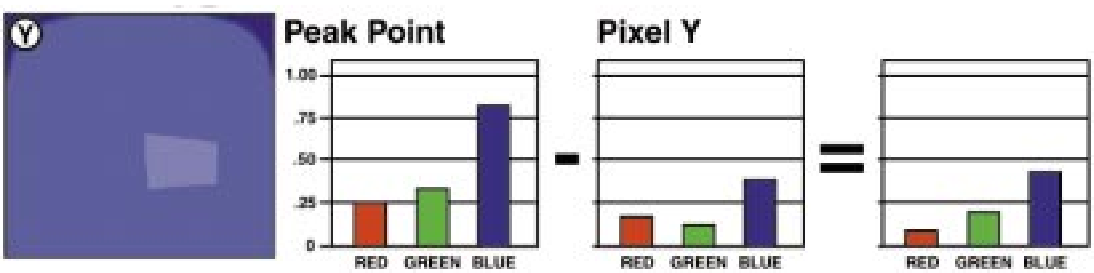


Fig. 2-5. Pixel Y has values darker than the peak point, yielding positive correction values.

Now, the value of each pixel in the foreground matte is divided by the value of the corresponding pixel in the reference matte and the result is mapped to the corresponding pixel of a new **correction matte** (Fig. 2-7). Anywhere the two values match must be a pixel in the unobstructed backing and the resulting value is 1.00 (fully on). Anywhere the foreground matte value is zero must be a pixel in the foreground subject and the resulting value is 0 (fully off). Anywhere the two values are unequal but the foreground value is not zero must be a pixel in a transparent area, such as a shadow, and the resulting value will be between 0 and 1.00 representing how much the backing is **obstructed**, independent of the **unevenness** of the backing.

Notice that the correction matte is nearly identical to the matte generated by the ULTIMATTE process under

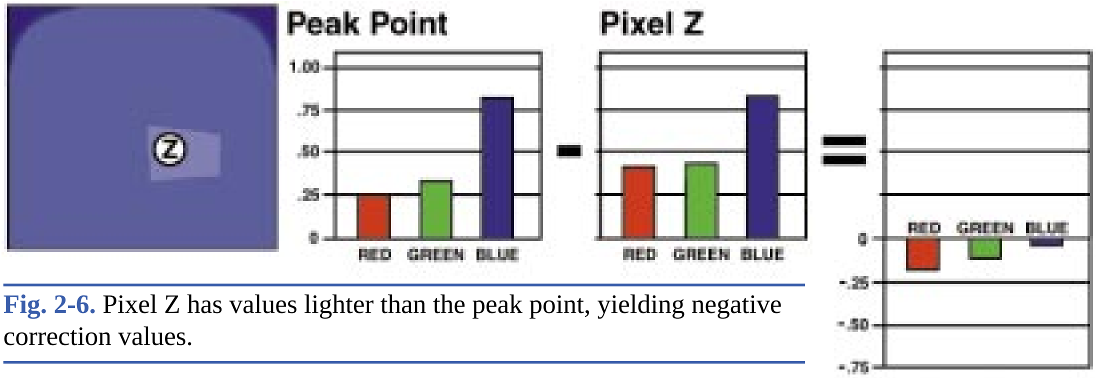


Fig. 2-6. Pixel Z has values lighter than the peak point, yielding negative correction values.

ideal conditions: all areas of the unobstructed backing are at 1.00. The unevenness of the backing has been eliminated from this matte in both the unobstructed and transparent areas.

Finally, each pixel of the correction frame is multiplied by the corresponding pixel of the correction matte and the result is added to the corresponding pixel of the foreground image, creating a new, corrected foreground image (Fig. 2-8). Anywhere the matte is fully on, the full value of the corresponding pixel in the correction matte will be added to the value of the pixel in the foreground matte: the result will be equal to the peak point, giving a perfect backing in the unobstructed areas. In the transparent areas, the correction matte pixels will be multiplied by a value between 0 and 1.00, dropping their values so that when added to the foreground image pixels, the result is an even but darkened area of the backing. In the subject areas, the correction matte is at 0 so nothing is added to the foreground image; the subject areas are unaffected.

Fig. 2-7. Dividing the foreground matte (center) by the reference matte (left) yields the **correction matte** (right). Flaws in the backing do not appear in the correction matte, as if the matte were generated with an even backing (compare with Fig. 1-2).

Note in our example that the patched area of the backing appears partly unobstructed, partly in shadow in the foreground image. In the unobstructed area (Fig. 2-8, Pixel 1), the correction matte is fully on, so the full correction values for this area (-.17 red, -.11 green and -.02 blue, found at Pixel Z above) are added to the pixels here to make them match the “good” areas of the backing (those that match the peak point).

In the shadow area of the patch (Fig. 2-8, Pixel 2), the value of the correction matte is .56 (see Pixel D in Chapter One). Multiplying this by the correction values for the patched area yields -.10 red, -.06 green and -.01 blue, which when added to the values at these pixels in the foreground image results in .14 red, .19 green and .46 blue, which matches the shadow against the "good" areas of the backing (.56 times the peak point values).

The corrected foreground image is now ready to go into the ULTIMATTE process or, if necessary, into the ULTIMATTE GRAIN KILLER function.

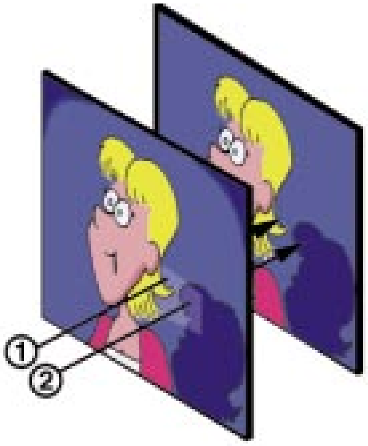


Fig. 2-8. Mapping the foreground image with flawed backing to the new corrected foreground image. Note that the logic corrects an unobstructed flawed point (1) to match the ideal unobstructed backing, while a similar flawed point in shadow (2) is corrected to match the ideal backing in shadow.

Using Screen Correction for a Locked-Off Shot

For a locked-off shot (a scene in which the camera doesn't move or zoom), only a single reference frame needs to be stored. Each foreground image (that is, each frame of the scene) will use the same reference frame for comparison.

The easiest way to create the reference frame is at the time of shooting the foreground image: light the scene as it will be shot, then remove the actors and any props that are to be composited. Film or record several frames of the bare backing. Then, with the camera locked down, bring the actors and props back in and shoot the scene.

At the time of compositing, average the frames of the bare backing to create the reference frame (a single frame can be used, but it is better to average together several — eight to ten is recommended — to eliminate any deviations that may be introduced by film grain, camera noise, or other variables). Once the reference frame is complete, SCREEN CORRECTION is essentially an automated process; the controls associated with it are simply fine tuning adjustments to prevent any level of "correction" in the foreground subject areas that are supposed to be opaque.

Using Screen Correction with Motion Control

If SCREEN CORRECTION is needed in a scene requiring the camera to move, a series of reference frames needs to be recorded. This is accomplished by using a motion control system, such as the ULTIMATTE MEMORY HEAD. The scene is shot with the film or video camera mounted on the MEMORY HEAD, which records all of the camera's moves and zooms to a computer disk. The actors and props are then removed from the stage and the camera is returned to its initial position. Using the information from the computer disk, the camera then duplicates all of its motions from the scene, recording the bare backing.

At the time of compositing, the sequence of images recorded of the bare backing becomes the reference frames: one for each corresponding image of the actual scene.

Using Screen Correction if no Reference Frame was Recorded

If SCREEN CORRECTION is needed for a scene in which the bare backing was not recorded, it is necessary to build a reference frame. This is accomplished by using a paint program such as Photoshop to piece together a frame made up from parts of the foreground images where the backing is unobstructed, sampling and filling the background color as needed.

GRAIN KILLER

GRAIN KILLER was created to remove film grain, a problem which arises when the foreground and background images have originated on motion picture film, but it can also remove visual noise introduced by a video camera or scanner. The problem is that the ULTIMATTE system is so good at compositing fine detail that it will actually composite the film grain or noise from the backing area onto the background, where it adds to the noise already there. The result is a composite where the background areas are noisier than the foreground. Since this noise randomly changes from frame to frame, it cannot be removed with SCREEN CORRECTION.

Trying to remove this noise by simply filtering the foreground image would soften the foreground subject and eliminate fine detail. Instead, GRAIN KILLER uses similar logic from the standard ULTIMATTE process to recognize what areas of the foreground image are backing material, so that just those areas can be filtered. The image that leaves the GRAIN KILLER function is the unaffected foreground subject against noise free backing, ready to enter the normal ULTIMATTE process as the foreground image.

GRAIN KILLER automatically identifies three areas of the foreground image: backing areas (both unobstructed and in shadow), transition areas (caused by blurred and soft edges, and fine detail) and solid subject areas. It then filters the backing areas to smooth out noise caused by film grain, or introduced by a video camera or scanner.

On some systems, the option is available to also apply GRAIN KILLER to the transition areas. This is optional since the filtering will cause these areas to look softer — less sharp — in the final image. If the transition areas are caused by blurred images, this softening will probably be acceptable, but if they are caused by areas of fine detail, such as strands of hair, the softening would be objectionable.

Using Grain Killer

GRAIN KILLER requires some user interaction to achieve its maximum effect, which must be determined subjectively.

First, **Grain Killer** generates a matte and a processed foreground from the foreground image, as described in Chapter One. (This matte and processed foreground are separate from the ones that will be used to make the composite; these are used only for the **Grain Killer** function.) Then the matte and processed foreground are compared and the results are mapped to a new image which we will call the **filter map** (Fig. 2-9): foreground subjects are solid black except for the transition edges, which are colorized for easy identification. The backing area, both unobstructed and shadow area, which would appear as solid white if the backing were pure, will appear speckled with gray, or even be mostly gray. This is where the backing is contaminated by the film grain, causing individual pixels to vary slightly in color from the color of the peak point (our reference point where the backing is brightest and purest; see Chapter One, Section A). (If the colors appear inverted from the description here, see the sidebar on page 3.)

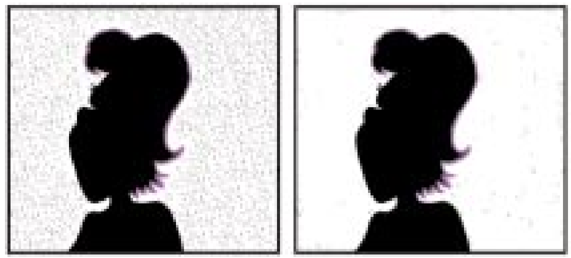


Fig. 2-9. The filter map before adjustment (left) and after (right). The map tells the Grain Killer logic where to filter the foreground image: areas that are white, corresponding to the unobstructed and shadowed backing, are filtered. Optionally in some systems, the transition areas (represented by a color) can also be filtered. Speckling of the image at left is caused by contamination of the backing due to film grain or camera noise. The user enters values which determine the limit between noise and fine foreground detail. At right, compromise values have been entered which eliminate most of the noise contamination while keeping the fine transition detail (color edge).

The user must enter values for red, green and blue (or a single overall value applied to all three equally), which tells the system how much each pixel's component color will be allowed to vary from the peak point's component colors and still be considered part of the backing. These numbers must be high enough to include the variations due to grain, yet not so high that noticeable amounts of the transition areas will also be included, which will cause softening of fine edge detail.

This can be viewed on the filter map: when the numbers are high enough, the speckling mostly or entirely disappears from the backing area. Too high, and parts of the transition areas are lost. A compromise setting will probably be necessary, leaving some contamination in the backing, and losing a bit of the transition edge. If a compromise can't be found, the original image may simply be too grainy for **Grain Killer** to be useful, and a high-quality composite may not be possible.

Once an acceptable setting has been found, the **Grain Killer** filter algorithm is applied to the foreground image, only in areas that correspond to clear backing areas of the map. The filter averages pixels that are next to each other to smooth out the variations in their color components. 25 pixels are averaged at a time (in 5 by 5 squares) as long as they are all in the clear backing area defined by the matte. For pixels too close to a transition edge for an unobstructed 5 by 5 square to be defined, 9 pixels (a 3 by 3 square) are averaged.

As noted before, some systems allow the choice of extending the filtering to include the transition areas. This should only be done if those areas are all the result of soft, blurred or out-of-focus edges. If those areas include fine detail which must remain sharp, GRAIN KILLER should not be applied to the transition areas of the image.

The resulting foreground image will show a smoothing out of the noise in the backing area and, optionally, the transition areas, with the grain in the subject unaffected. But while the backing has been smoothed, it may appear mottled. This is because some pixels may have had greater variations from the peak point than their neighbors; averaging these points will smooth the variations but not eliminate them. However, these areas can be smoothed out further by simply applying GRAIN KILLER again to the resulting image.

GRAIN KILLER can, and in most cases should, be applied to the image more than once, usually three to six times, following the same process as above. The function is set up to allow multiple passes: the resulting image from one pass simply becomes the input image of the next.

The user must judge when a repeated use of GRAIN KILLER no longer has an appreciable effect. The finished pre-processed foreground image is then ready for input to the standard ULTIMATTE process.

Chapter 3

ULTIMATTE CONTROLS

Based on over 20 years of experience, ULTIMATTE systems today automatically analyze the foreground and background images and set over a dozen adjustments. In most cases, this results in an excellent final composite with little or no user adjustment. Where problems do arise, it is most often due to an uneven or poorly lighted backing; SCREEN CORRECTION, described in Chapter Two, can automatically compensate for these flaws.

At times, though, it is necessary to override these automatic systems, whether to compensate for lighting problems, to allow certain colors to be used in wardrobe or simply to make an aesthetic choice.

This chapter explains, in general, the controls for ULTIMATTE software systems. **Not all controls described here are found on every ULTIMATTE product.** This is an overview; exact use of some controls varies from product to product. Refer to the instruction manual for a specific product for information on what controls are available and how to set them.

Trade-offs of using the controls are also listed. These are problems that can be introduced by overuse of a particular control. In most cases, a compromise setting can be found that reduces the original problem without creating a significant new one.

WHAT IS ULTIMATTE INTELLIGENCE?

Some ULTIMATTE systems offer ULTIMATTE INTELLIGENCE: software that performs the functions of an experienced operator. The user follows prompts for clicking the cursor on various parts of the foreground, background, and matte images to gather measurements. Based on this information, ULTIMATTE INTELLIGENCE automatically adjusts numerous controls, choosing “probable best” settings based on the experience of ULTIMATTE engineers.

ULTIMATTE INTELLIGENCE is a valuable addition to computer-based ULTIMATTE systems where it can take considerable time to see the result of a manual control adjustment. And, frequently, the final results will be better.

Of course, ULTIMATTE INTELLIGENCE can be overridden at any point to set the controls manually.

Alternatives are included for many of the controls. These include other controls that might also correct the problem, possibly with less negative effects, and corrections that can be made on-stage, such as wardrobe and lighting changes. While it is frequently impractical to reshoot the images being composited, these alternatives are included so that problems created on-stage can be recognized and avoided in the future.

The controls in this chapter are ones that directly affect the steps of the ULTIMATTE process. Some systems also feature the functions SCREEN CORRECTION and GRAIN KILLER. These functions actually work on the foreground image before it enters the ULTIMATTE process to improve the apparent quality of the backing. These functions are described in **Chapter Two: Pre-Processing.**

A. Overview of the Controls

This section outlines the ULTIMATTE controls, grouped by the four steps—Generating the Matte, Processing the Foreground, Controlling the Background, and the Final Composite—described in Chapter One. The following sections will describe each control in greater detail.

Generating the Matte

These controls are most closely related to generating the matte, the process described in Section A of Chapter One. For the most part, these controls help prevent the background from printing through the foreground subject, or to help correct problems caused by the backing being uneven or dirty.

- **Peak Detection:** Sets the reference backing color values (the peak point) which set corresponding matte values to 1.00 (fully on).Trade-off: With an uneven backing, choosing too bright a peak point will cause darker areas of the backing to reproduce as shadows in the final composite; choosing too dark a peak point will cause foreground subjects to acquire glowing edges against the brighter areas of the backing.

• **Matte Density:** Keeps the background image from printing through foreground subjects that are shades of the backing color. Trade-off: Can cause dark edges around foreground subject.

• **Black Gloss:** Keeps the background from printing through areas where the backing is reflecting off of dark surfaces. Trade-off: Can cause dark edges around foreground subject; shadows will darken and become opaque.

• **Black Matte:** An ULTIMATTE INTELLIGENCE control that automatically sets Matte Density and Black Gloss once an area of print-through is selected. Trade-off: Can cause dark edges around foreground subject.

• **Black Gloss 2:** Keeps the background from printing through areas where the backing is reflecting off of dark surfaces. Trade-off: Can cause dark areas of the foreground subject to become darker.

• **Clean Up** (and related controls **Clean Up Threshold** and **Clean Up Balance**): Keeps fine imperfections on the backing (dirt, footprints, etc.) from showing up in the final composite. Also useful for removing support wires. Trade-off: Can cause hard edges around foreground subjects; fine edge detail, smoke and shadows will lighten and disappear.

• **White Matte:** An ULTIMATTE INTELLIGENCE control that automatically sets Clean Up once an area of backing imperfection is selected. Trade-off: Can cause hard edges around foreground subjects: fine edge detail, smoke and shadows will lighten and disappear.

• **Red, Green and Blue Density:** Helps reduce dark edges from around foreground subjects (introduced by the use of Matte Density and/or Black Gloss).

Processing the Foreground

These controls are most closely related to processing the foreground, described in Section B of Chapter One. Processing the foreground has two functions: **suppressing the backing**, and **suppressing backing spill and lens flare** that are discoloring the foreground subject. These controls affect colors in the final composite.

Suppressing the Backing

• **Red, Green, Blue** and **Master Veil Levels:** Eliminates tinting of the background caused by variations in the purity of the backing. Trade-off: Can cause dark edges around foreground subjects.

Suppressing Backing Spill and Lens Flare

• **White Balance:** Makes light foreground colors warmer or cooler with minimal effect on darker colors.

• **Black Balance:** Makes dark foreground colors warmer or cooler with minimal effect on lighter colors.

• **Gray Balance:** Makes mid-range colors warmer or cooler with minimal effect on lighter and darker colors.

• **Gate 1/3** and **Gate 2 (Spill/Flare Suppression Controls)**: Reduces the suppression of spill/flare to allow certain colors to be reproduced in the foreground subject. Trade-off: reducing suppression of spill/flare can cause objectionable discoloration of foreground subjects.

Processing the Background

These controls are most closely related to processing the background, described in Section C of Chapter One. These controls affect the background image level and noise in the final composite.

• **Background Level Balance:** Adjusts the overall level of the background; increasing can eliminate noise in the background caused by a textured backing. Trade-off: increasing the background level can cause glowing edges around foreground subjects.

• **Shadow Noise:** Overrides the automatic shadow-noise suppression logic, allowing lighter, noisier shadows or, in some cases, darker, quieter shadows.

• **External Matte**: Allows an external image to force on areas of the background image independent of the backing (garbage matte) or to force areas of the foreground image that match the backing not to composite (hold-out matte).

The Final Composite

These controls are most closely related to the final composite, described in Section D of Chapter One. These controls are used to ensure that the foreground and background images aesthetically match in the final composite.

• **Foreground Adjustments** (a set of controls): Allows a full range of adjustments to the foreground image's color, contrast, saturation and level. Adjustments are made to the processed foreground; these controls do not affect the matte or spill/flare suppression.

• **Background Adjustments** (a set of controls): Allows a full range of adjustments to the background image's color, contrast, saturation and level.

• **Color Conformance** (a set of controls): A subset of ULTIMATTE INTELLIGENCE that automatically sets the **Foreground** and **Background Adjustments** above based on key points in the final composite — blacks, whites, skin tones—that the operator wants to have match in the foreground and background areas.

B. Controls in Detail: Generating the Matte

Peak Detection

What it's for

The ULTIMATTE logic needs to identify the "best" area of the backing to use as a reference point for generating the matte. Knowing how to select the reference point comes from understanding what the "best" area of the backing means. In most cases, as is described in Chapter One, Section A, the best area will be an area of the backing unobstructed by the foreground subject or shadows. Here, the amount that the backing-color component exceeds the higher of the other two color components (e.g. that blue exceeds the higher of red or green) is at its peak.

If the backing is not even, due to lighting or painting, the peak area should be selected close to important foreground information, such as near a person's face.

Some systems allow several spots to be sampled and averaged to generate the peak reference point. These points should be selected from the same area simply to average out noise in the image, rather than from different areas of the image.

The Trade-Off

With an uneven backing, the user must choose from bright or dark areas of the backing. Selecting the brightest spot as reference point will allow a greater range of shadows and transparencies to be reproduced with less visual noise, but darker areas of the backing will cause the level of the background image in the final composite to be dropped accordingly. For the final composite to look correct, the **Background Level Balance** control would need to be increased, which can introduce noise into the picture and cause foreground-subject edges to glow if pushed too far.

On the other hand, selecting a darker part of the backing will eliminate darkening of the background image and the need to adjust the **Background Level Balance** control, as any point of equal or higher value will cause corresponding matte values of 1.00. However in this case, if the foreground subject appears against the brighter areas of the backing, it can take on glowing edges. Light shadows and thin transparencies in this area will be lost.

Alternatives

If problems are being caused by the backing being uneven, use SCREEN CORRECTION, if available (see Chapter Two). Otherwise, it may be necessary to reshoot with the backing re-lighted or re-painted.

How it Works

Selecting the peak point is covered in Chapter One, Section A.

Matte Density

What it's for

The **Matte Density** control is used to eliminate **print-through**. Print-through occurs when colors in the foreground subject are interpreted by the ULTIMATTE logic as part of the backing. These colors (for example, blue jeans against a blue backing) wind up appearing slightly transparent, allowing the background to be seen faintly through them. As **Matte Density** is increased, these transparent areas become solid.

These colors may also be a result of flare or spill, as discussed in Chapter One, Section B. A white shirt near the blue screen may take on a bluish cast. While the flare/spill suppression logic is designed to remove such discoloration, it occurs after the matte logic; the bluish tint will cause print-through before it can be removed. Increasing **Matte Density** will eliminate the print-through so that flare/spill suppression can eliminate the discoloration.

The trade-off

Areas that should be transparent will also start to become solid. While some of this effect—for example, darkening of shadows—may be acceptable, it can have disastrous results on the realism of the composite. As explained in Chapter One, edges around foreground objects are slightly "soft," having a transition area from the backing to the subject. These soft edges are also transparencies that will be darkened and solidified by the control. Increasing **Matte Density** too far will cause hard, dark edges around the foreground subject.

Setting the control

The effect of **Matte Density** can be easily seen by observing the matte while adjusting the control (Fig. 3-1).

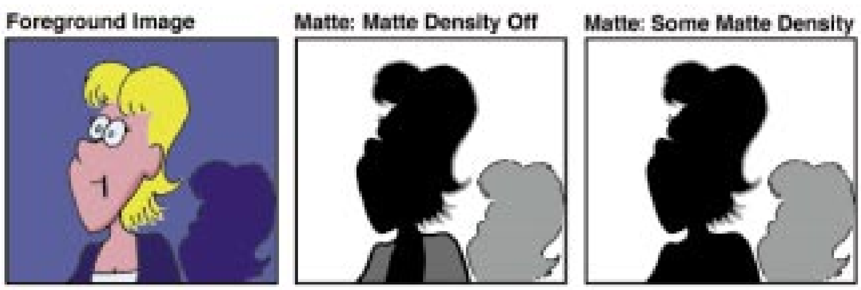


Fig. 3-1. Let's say our model is wearing a Navy blue jacket against a blue backing (left frame). In the matte, the Navy areas are seen as dark gray (middle frame)—these will print through in the final composite. In the right frame, the **Matte Density** control has been advanced just enough to darken the jacket areas to black, without affecting the shadow area.

Areas of print-through will be seen as shades of gray in areas that should be black, that is, in areas that correspond to the foreground subject. Increasing the control will darken these grays to black (opaque). However, to avoid the negative effects of the control, the final composite must also be examined. If dark edges become noticeable, the control should be decreased. Frequently, a compromise setting is found. Depending on what is in the background and whether it is a static shot or a moving image, a slight amount of print-through may not be noticeable in the final composite, or may be far less noticeable (and objectionable) than dark edges.

Red, **Green** and/or **Blue Density** controls (described later in the chapter) may minimize edge problems caused by **Matte Density**.

Alternatives

Since the cause of print-through is the colors in the foreground being mistaken for part of the backing, the surest way to eliminate it is to avoid those colors. If a blue shirt is printing through, switch to a different shirt. If the wardrobe cannot be changed, switch from a blue backing to green.

If the problem is being caused by spill or flare discoloring the foreground subject to an excessive degree, lighting changes on the set may be called for. (Remember: the spill/flare suppression controls have no effect on print-through.)

Also check the effects of the **Black Gloss** and **Black Gloss 2** controls, when available. In many cases, they can help eliminate print-through or lessen the negative effects of using **Matte Density**.

How it Works

Matte Density determines how much higher the backing-color component of each pixel can be above the two non-backing-color components and still have the pixel considered an opaque part of the foreground subject. (With **Matte Density** off, the backing-color component can’t be **any** higher.) This is described in greater detail in **Chapter One,** CREATING THE COMPOSITE**: Section A, Generating the Matte** under **Reproducing blues**.

Black Gloss

What it's for

If there is a black glossy object in the foreground which is reflecting color from the backing, it will be interpreted as a dark area of the backing and the background will print-through. By turning up the **Black Gloss** control, such an object can be made opaque.

The Trade-Off

Dark areas of the backing will become darker. Shadows will become darker and may become black. Edges of foreground subjects will begin to darken.

Setting the control

The effect of **Black Gloss** can be seen by observing the Matte while adjusting the control (Fig. 3-2). Print-through will show up as a dark gray patch in a black area. Increasing the control will turn this area black (opaque). The negative effects of the control can also be observed: grays where shadows and soft edges exist will darken or go black. The final composite must be examined to see if these effects are noticeable and objectionable. As with **Matte Density**, a compromise setting is frequently found.

Fig. 3-2. Let's say our model is wearing a shiny black vinyl jacket which reflects some of the blue backing (left frame). The reflections show up as dark gray areas in the matte (middle frame) which will print through in the final composite. Advancing the Black Gloss control darkens these areas to black (right frame), eliminating print-through.

If available, the **Red**, **Green** and **Blue Density** controls may minimize edge problems caused by **Black Gloss**.

Note: Black Gloss and **Matte Density** are interactive; using **Black Gloss** may allow **Matte Density** to be set lower. Re-adjust **Matte Density** when setting **Black Gloss** so that both are set as low as possible with no print-through.

Alternatives

If the amount of **Black Gloss** needed produces objectionable results that cannot be minimized with **Matte Density Balance**, it may be necessary to reposition or dull the object that is causing the reflection.

Another solution is to alter the background image so that part of it is inverted and compressed vertically and positioned so that this altered portion will be what prints through the glossy object. Now the object will appear to be reflecting the composited background. Done properly, this trick not only solves the problem, it can actually make the finished composite look more realistic.

How it Works

In Chapter One we described the linearity of the ULTIMATTE process: a foreground pixel with a blue-minus-the-higher-of-green-or-red difference 10% between the minimum and peak points generates a matte value of .10, which will turn the background image on 10% at this point in the final composite. This linearity is shown graphed in Figure 1-7. **Black Gloss** throws off this linearity, effectively increasing the slope of the graph (Fig. 3-3), keeping the top point (1.00) constant. Now a 10% difference in the foreground pixel may result in a matte of only .05. The goal is to turn the background off fully (matte of 0) when the color difference of a foreground pixel is close to, but still exceeds, 0. The result will be the background image fully turned off in areas where there is actually some dark backing area. It is up to the operator to decide if these areas should be composited or not. Note also looking at the graph that transparent areas are darkened: Pixel D on the graph (in a shadow area) yields a lower matte value than before, meaning the background image will be decreased at this point, darkening the shadow.

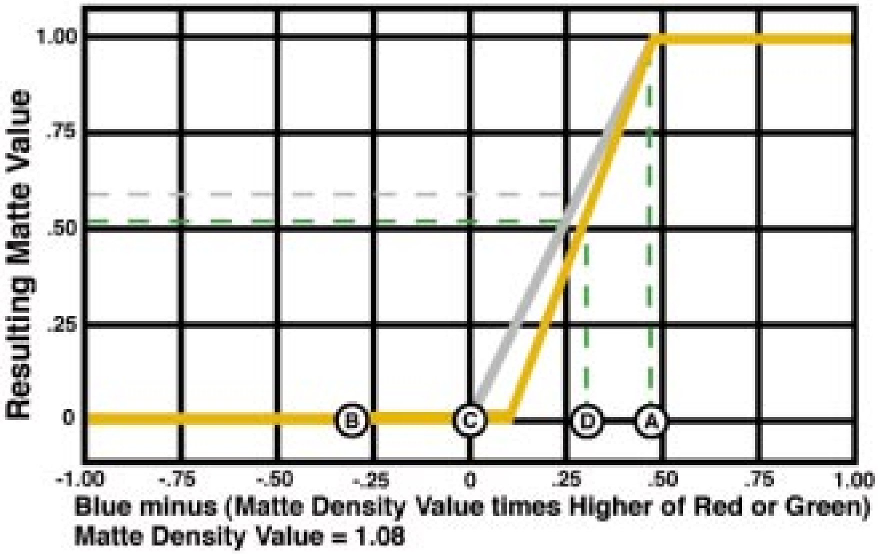


Fig. 3-3. Increasing **Black Gloss** increases the slope of the line graphed in Fig. 1-7 (seen here in gray). The effect is that pixels lighter than, but close to, 0 (points just to the right of Pixel C on the graph) will have matte values of 0, turning the background image fully off in the final composite. Note the effect on Pixel D, in the shadow. Its matte value has dropped noticeably, which will cause the shadow to darken in the final composite.

Black Matte

What it's for

Automatically adjusts **Matte Density** and/or **Black Gloss** based on a sample of an area of the matte that is printing through. Uses ULTIMATTE INTELLIGENCE to come up with a setting to eliminate the print-through.

The Trade-Off

Same trade-off as with **Matte Density** and **Black Gloss**.

Setting the Control

Sample the area of the matte which should be opaque. For example, in Figure 3-2, this would be the gray patches in the jacket area. Selecting the **Black Matte** control will automatically make the adjustments to the **Matte Density** and/or **Black Gloss** controls. The results will be seen on the matte. Light values of the matte will remain relatively unchanged, dark values will become darker.

Alternatives

Same as for **Matte Density** and **Black Gloss**.

Black Gloss 2

What it's for

If the foreground subject has an excessive amount of spill from the backing color, especially in the darker parts of the subject, adjusting **Matte Density** and **Black Gloss** will almost always create dark edges and noisy mattes. Unlike these controls, which adjust the matte, the **Black Gloss 2** control adjusts the foreground image, darkening the darker areas so that less **Matte Density** and/or **Black Gloss** will be needed.

The Trade-Off

Increasing **Black Gloss 2** too far will alter the color of the foreground image to an objectionable degree.

Setting the Control

Adjust the control while viewing the matte so that gray print-through areas become opaque. **Matte Density**, **Black Gloss** and **Black Gloss 2** are all interactive; when one is changed, readjust the others. They should all be set as low as possible with no print-through.

Alternatives

Same as for **Matte Density** and **Black Gloss**.

How it works

The control adjusts the gamma of the **backing-color component** of the foreground image to offset the black end of the curve below zero while keeping the white end constant. The goal is to lower the dark reflections of the backing to zero so that when the matte is generated from this adjusted image, these areas will be seen as opaque (matte value of zero). Since only one of the color components is adjusted, a slight color shift in darker areas of the foreground subject may be noticeable.

Clean Up (plus Clean Up Threshold and Clean Up Balance)

What it's for

The ULTIMATTE logic is designed to reproduce all the fine and subtle details it sees against the backing. And if the backing contains imperfections such as seams, patches or floor dirt, the logic reproduces them, too, compositing them into the final image. By turning up the **Clean Up** control, fine imperfections can be eliminated.

Clean Up can be used to eliminate support wires visible in the foreground image from the final composite. It can also reduce noise in the background area of the final composite.

The Trade-Off

The control cannot distinguish between unwanted backing imperfections and fine foreground detail; using **Clean Up** will wipe out subtle details around the edges of the foreground subject (such as loose strands of hair) and lighten or eliminate shadows, giving the image a cut-and-paste look. **Clean Up** should be used sparingly.

Fig. 3-4. Matte at left shows some darkening of the background in the upper corners due to uneven lighting or lens vignetting. This darkening will transfer to the final composite. At right, **Clean Up** has been advanced just enough to remove the darkening.

Setting the control

The effect of **Clean Up** can be seen by observing the matte while adjusting the control (Fig. 3-4). Backing imperfections will show up as gray spots in the white areas. Increasing the control will turn these spots white (background fully on). The negative effects of the control can also be observed: grays where shadows and soft edges exist will lighten and disappear. The final composite must be examined to see if these effects are noticeable and objectionable. As with **Matte Density**, a compromise setting is frequently found. For example, a flaw in the backing, such as floor scuffs, may be acceptable when composited into the background; the floor in the background image would simply looked scuffed.

On some systems, **Clean Up Threshold** is available to set how much of the image can be affected by **Clean Up**. In certain cases it can eliminate small screen imperfections without affecting the density of most shadows, and can minimize the effect of **Clean Up** on foreground subject edges. **Clean Up Threshold** should be adjusted when viewing the final composite to determine its setting.

The **Clean Up Balance** control (when available) may restore some of the softness or fine details to edges lost by using **Clean Up**. **Clean Up Balanc**e should be adjusted when viewing the final composite to determine its setting. It is rare that this control will have a positive effect; in most cases, the default setting is the best.

Alternatives

Increasing the **BG Level Balance** control can also remove backing imperfections, but it can cause edges to lighten and glow. In some cases, this produces a more acceptable look than the darkened edges that can result from using **Clean Up**.

If neither control produces acceptable results, use SCREEN CORRECTION, if available (see Chapter Two). Otherwise, it may be necessary to clean, repair, or re-paint the backing.

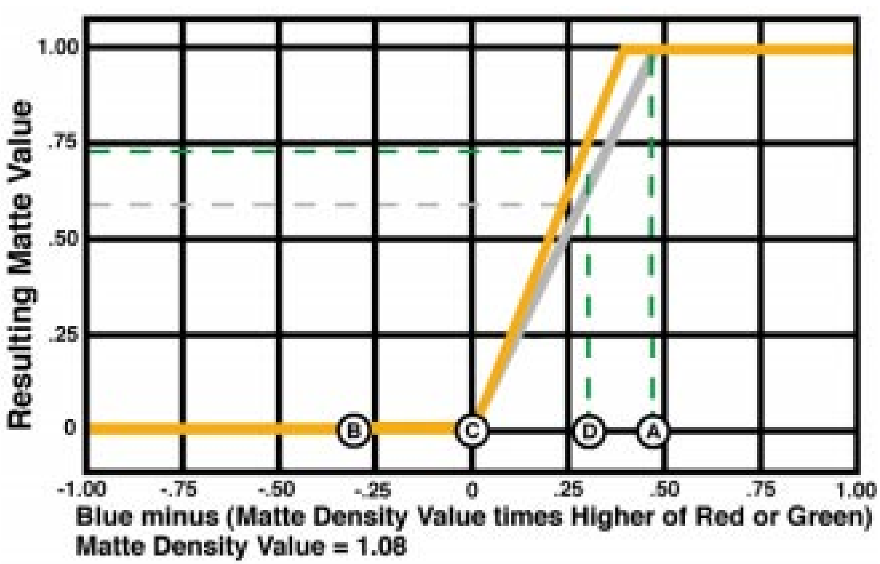


Fig. 3-5. Increasing **Clean Up** increases the slope of the line graphed in Fig. 1-7 (seen here in gray). The effect is that pixels darker than, but close to, the peak point pixel (points just to the left of Pixel A on the graph) will have matte values of 1.00, turning the background image fully on in the final composite. Note the effect on Pixel D, in the shadow. Its matte value has risen noticeably, which will cause the shadow to lighten in the final composite.

How it Works

Where **Black Gloss** introduced non-linearity primarily to the bottom of the matte graph, **Clean Up** introduces it primarily to the top. As **Clean Up** is increased, it increases the slope of the graph (Fig. 3-5) holding the bottom point (0) constant. Now a 75% difference in the foreground pixel may result in a matte of .80. The goal is to turn the background on fully (matte of 1.00) when the color difference of a foreground pixel is close to, but still falls below, that of the peak point. The result will be the background image fully turned on in areas where there is actually some foreground detail or transparency, keeping that detail or transparency from being composited. It is up to the operator to decide if the eliminated detail is unwanted or not. Note also looking at the graph that transparent areas are lightened: Pixel D on the graph (in a shadow area) yields a higher matte value than before, meaning the background image will be increased at this point, lightening the shadow.

Clean Up Threshold, available on some systems, determines where on the graph the effects of **Clean Up** will begin. This keeps transparent areas below the point set by the control from lightening (Fig. 3-6).

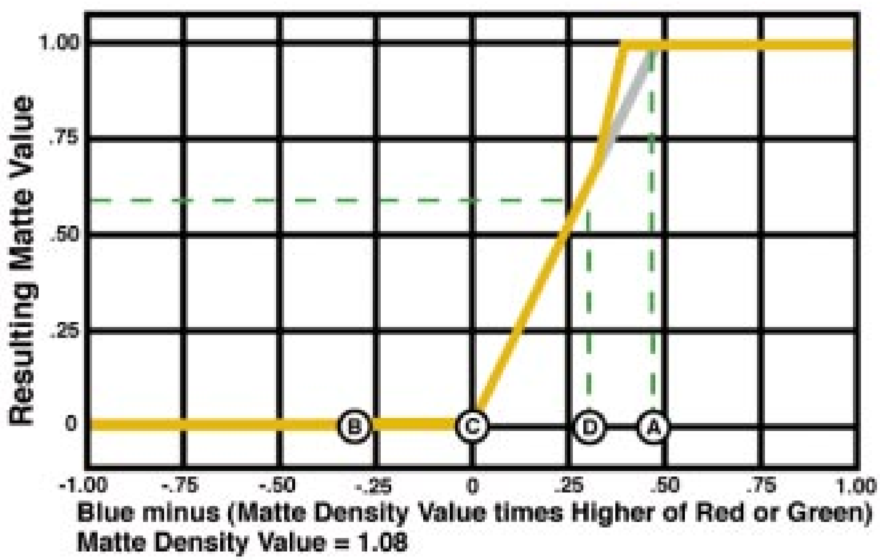


Fig. 3-6. Using the **Clean Up Threshold** control, the effects of **Clean Up** can be limited. Here, the control has been set so only about the top fourth of the graph is affected. Pixels close to the peak point still yield matte values of 1.00 as in Fig. 2-3, but now Pixel D is unaffected.

Previously, we've seen that the matte is used to both control where the backing is suppressed in the foreground and how much to turn on the background image; the same value—the value of the matte at any point—is used in both functions. **Clean Up Balance** causes different values to be used--slightly higher for one function, slightly lower for the other, depending on the direction turned. Turning the control too far results either in dark edges (more backing suppressed than background turned on) or glowing edges (less backing suppressed than background turned on).

White Matte

What it's for

Automatically adjusts **Clean Up** based on a sample of an area of imperfection in the backing. Uses ULTIMATTE INTELLIGENCE to come up with a setting to eliminate the imperfections.

The Trade-Off

Can cause loss of fine edge detail, smoke and shadows (same trade-off as with **Clean Up**).

Setting the Control

Sample the area of the matte which should be fully on (white). For example, in Figure 3-4, this would be the gray patches in the upper corners of the screen. Selecting the **White Matte** control will automatically make the adjustments to the **Clean Up** control. The results will be seen on the matte. Dark values of the matte will remain relatively unchanged, light gray values will lighten or become white.

Alternatives

Same as for **Clean Up**.

Red Density, Green Density and Blue Density

What it's for

Dark edges around certain colors of foreground objects may be lessened with the **Density** controls. This is particularly helpful when using **Matte Density** and **Black Gloss**, which accentuate such edges. When available, there are usually two **Density** controls. The colors they affect are determined by the backing color:

Blue Backing

Red Density: Helps eliminate dark edges from reddish objects (including skin tones)
Green Density: Helps eliminate dark edges from green objects
Blue Density: No effect

Green Backing

Blue Density: Helps eliminate dark edges from blue objects
Red Density: Helps eliminate dark edges from reddish objects (including skin tones)
Green Density: No effect

Red Backing

Green Density: Helps eliminate dark edges from green objects

Blue Density: Helps eliminate dark edges from blue objects
Red Density: No effect

Setting the controls

The **Density** controls are adjusted while viewing the final composite; find the setting where dark edges are minimized.

Depending on the colors in the foreground subject, adjusting the **Density** controls may allow some print-through. In this case, the **Matte Density** control will need to be readjusted.

How it works

When looking at the difference in the color components at each pixel in the foreground image, we compare the component corresponding to the backing color to the higher of the other two components (for example, with a blue backing, we compare blue to the higher of red or green). Adjusting one of the **Density** controls will lower the value of one of these components before the two are compared to see which is higher. With a lower component being chosen, the matte will be higher and the background will be turned on more.

For example, due to **Matte Density** being turned up, we are getting dark edges around green objects against a blue backing. This transparent area has a higher green component than red, so we turn down **Green Density**. When comparing red and green to subtract from blue, the system now chooses red, even though it was originally lower. This yields a greater difference on our graph (Fig. 1-7) for a higher matte. The background image is turned on higher in the transparent area, reducing the dark edge caused by **Matte Density**.

C. Controls in Detail: Processing the Foreground

Red, Green, Blue and Master Veil Levels

What it's for

When processing the foreground, the ULTIMATTE system automatically suppresses the color in the backing area to black. If the backing varies slightly in color in different areas, a residue of the backing color may be left in areas where it is not totally suppressed to black. This residue is added to and discolors the background image in the final composite. The **Veil Level** controls, allow this residue to be suppressed.

The Trade-Off

Can cause dark edges around the foreground subject.

Setting the Controls

The controls can be adjusted while viewing the final composite to remove any discoloring. They can also be adjusted while viewing the matte, where the residue will show up as gray contamination in the backing areas.

Alternatives

Backing variations can be solved by using SCREEN CORRECTION, when available.

Note that horizontal backing areas — the stage floor or tops of set pieces — scatter white light toward the camera. This low-angle glare results in a faint gray veiling on these areas. In most cases, this is acceptable, since the corresponding areas in the background could be logically expected to have the same glare. It can be reduced with the **Master Veil Level** control, at the risk of pushing the backing suppression too far in the vertical backing areas, causing dark edges around the foreground subjects. This floor glare can also be reduced by using a polarizing filter over the camera lens.

How it Works

Chapter One described how the component levels of the peak point in the backing, multiplied by the matte, are subtracted from the other pixels of the foreground image to suppress the backing color. This assumes that the relative levels of the red, green and blue components stay consistent over the backing. Where one or more is higher, not enough of the components will be subtracted to bring them all to zero: a color tint will appear that will be added into the final composite.

The **Veil Level** controls allow for more or less of each color to be subtracted. While turning the controls up will ensure that the backing area of the processed foreground will drop to zero, it can also cause transparent areas to fall to zero.

White Balance

What it's for

The **White Balance** control makes light foreground colors warmer or cooler with minimal effect on darker colors. For example, when using a blue backing, the flare suppression logic can cause blond hair to look white around the edges. Adjusting the **White Balance** control can restore a warmer, more natural color to the hair without significantly affecting other colors.

Can make foreground whites match the cool/warm tint of background whites (hence the name of the control).

Using the control

Adjust **White Balance** while viewing the final composite until desired effect is achieved.

How it works

Overrides the portion of the spill/flare suppression logic that ensures whites in the foreground have equal amounts of red, green and blue.

Black Balance

What it's for

The **Black Balance** control makes dark foreground colors warmer or cooler with minimal effect on lighter colors. For example, adjusting the **Black Balance** control can eliminate flare from most hair colors (blacks, browns, some blondes) with minimal effect on light colors. This can compensate for the slight desaturation of colors that occurs when the spill suppression logic allows the backing-color component of a color to be higher than it should (see Chapter One: CREATING THE COMPOSITE**: Blue Spill and Lens Flare Suppression**).

Can make foreground blacks match the cool/warm tint of background blacks (hence the name of the control).

Using the control

Adjust **Black Balance** while viewing the final composite until desired effect is achieved. Also check the effect of the **Gray Balance** control.

How it works

Overrides the portion of the spill/flare suppression logic that ensures blacks in the foreground have equal amounts of red, green and blue.

Gray Balance

What it's for

The **Gray Balance** control makes mid-range foreground colors warmer or cooler with minimal effect on lighter and darker colors. Can help compensate for the desaturation of some colors described under the **Black Balance** control.

Can make foreground grays match the cool/warm tint of background grays (hence the name).

Using the control

Adjust **Gray Balance** while viewing the final composite until desired effect is achieved.

How it works

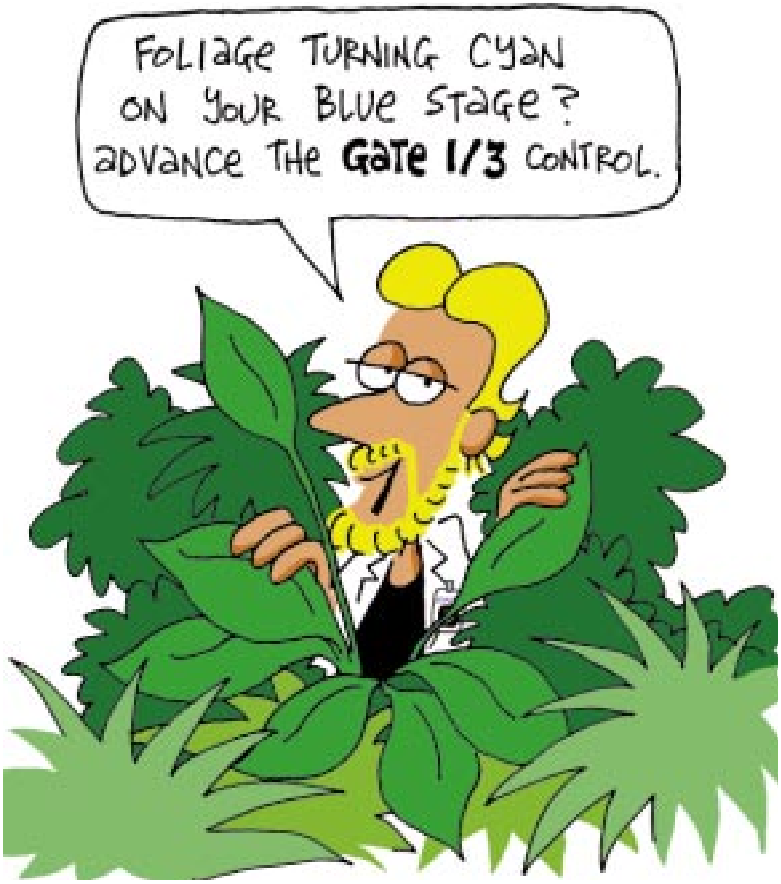
Overrides the portion of the spill/flare suppression logic that ensures grays in the foreground have equal amounts of red, green and blue.

Gate 1/3 and Gate 2 (Spill/Flare Suppression)

As described in Chapter One, Section B, the ULTIMATTE logic removes the effects of spill and flare in which the backing discolors the foreground subject. The trade-off is that certain colors in the foreground cannot be accurately reproduced—the logic assumes they are actually different colors that are being tinted by the backing and "corrects" them.

Gate 1/3 and **Gate 2** allow you to override the suppression logic so that those colors can be used in the foreground.

The effects of the controls varies depending on the backing color, so we will examine how the controls function with blue, green and red backings (spill/flare suppression is bypassed when using a white or black backing).



Blue Backing

GATE 1/3

What it's for

Removes blue spill from foreground green objects. Blue spill causes green objects to develop blue edges, or to turn cyan. For example, by increasing the **Gate 1/3** control, plants which have taken on a cyan tone from blue spill can be brought back to green.

Trade-off

As **Gate 1/3** is increased, foreground colors which are supposed to be cyan will also start turning green.

Setting the control

View the final composite while adjusting the control to achieve the desired effect.

Alternatives

Remove the cyan objects from the foreground so effect of using **Gate 1/3** is minimized, or remove green objects so its use isn't needed. If that isn't possible, adjust lighting to reduce blue spill on the green objects.

Gate 1/3? One third of what?

No, it's not **Gate One-Third**, it's **Gate 1 or Gate 3**. We admit this and **Gate 2** aren't as descriptive of what these controls do as, say, **Clean Up** or **Background Level Balance** are. The names are left over from the earliest ULTIMATTE hardware prototypes, where electronic gates, numbered 1, 2 and 3, controlled which colors could be reproduced. Since **Gate 3** had no effect unless **Gate 1** was closed, those two were eventually combined under one control.

The logic remains the same and the names have stuck. Just picture them as gates in a fence, allowing some colors to pass through, and stopping others.

How it works

Normally, blue is allowed to exceed green by the amount green exceeds red. Increasing **Gate 1/3** brings blue down to the lower of red or green.

GATE 2

What it's for

The spill/flare suppression logic assumes magentas and some pinks are reds that are being discolored by the blue backing; it reduces the blue component, "correcting" them to red. Increasing the **Gate 2** control puts back the blue component, allowing magentas to be reproduced.

Trade-off

As **Gate 2** is increased, blue spill is allowed to discolor reddish objects; this is most objectionable in skin tones.

Setting the control

View the final composite while adjusting the control to achieve the desired effect.

Alternatives

Remove reddish objects from the foreground so effect of using **Gate 2** is minimized, or remove magenta objects so its use isn't needed. If that isn't possible, adjust lighting to reduce blue spill on the reddish objects.

How it works

Normally, blue is allowed to exceed green only when green exceeds red. Increasing **Gate 2** allows blue to exceed green when green is less than red, up to the amount red exceeds green.

Green Backing

GATE 1/3

What it's for

Removes green spill from foreground blue objects.

Trade-off

As **Gate 1/3** is increased, foreground colors which are supposed to be cyan will also start turning blue.

Setting the control

View the final composite while adjusting the control to achieve the desired effect.

Alternatives

Remove the cyan objects from the foreground so effect of using **Gate 1/3** is minimized, or remove blue objects so its use isn't needed. If that isn't possible, adjust lighting to reduce green spill on the blue objects.

How it works

Normally, green is allowed to exceed blue by the amount blue exceeds red. Increasing **Gate 1/3** brings green down to the lower of red or blue.

GATE 2

What it's for

The spill/flare suppression logic strikes a compromise between recognizing yellow as yellow and assuming that all yellows are reds that have been discolored by the green backing; it reduces the green component somewhat in yellows, "correcting" them toward red.

Decreasing the **Gate 2** control removes more green spill from red objects, turning them more from yellow back toward red. Increasing the **Gate 2** control puts back the green component, allowing true yellows to be reproduced.

Trade-off

As **Gate 2** is decreased, objects that are yellow are also turned red. As **Gate 2** is increased, green spill is allowed to discolor reddish objects more; this is most objectionable in skin tones.

Setting the control

View the final composite while adjusting the control to achieve the desired effect.

Alternatives

Remove the reddish objects from the foreground so effect of using **Gate 2** is minimized, or remove yellow objects so its use isn't needed. If that isn't possible, adjust lighting to reduce green spill on the reddish objects.

How it works

Gate 2 determines how high green is allowed to exceed blue at any given foreground pixel where red is higher than blue. The normal setting for **Gate 2** with a green backing is 50%: green can exceed blue by half the amount red exceeds blue. **Gate 2** can be decreased down to 0% (green cannot exceed blue) or up to 100% (green can exceed blue by the full amount red exceeds blue).

Red Backing

Gate 1/3

What it's for

Removes red spill from foreground green objects. For example, plants which have taken on a yellow tone from red spill can be brought back to green.

Trade-off

As **Gate 1/3** is increased, foreground colors which are supposed to be yellow will also start turning green.

Setting the control

View the final composite while adjusting the control to achieve the desired effect.

Alternatives

Remove the yellow objects from the foreground so effect of using **Gate 1/3** is minimized, or remove green objects so its use isn't needed. If that isn't possible, adjust lighting to reduce red spill on the green objects.

Gate 2

What it's for

The spill/flare suppression logic assumes magenta is blue that is being discolored by the red backing; it reduces the red component in magenta, "correcting" it to blue. Increasing **Gate 2** will put back the red component, allowing the magenta to be reproduced.

Trade-off

As **Gate 2** is increased, red spill is allowed to discolor blue objects.

Setting the control

View the final composite while adjusting the control to achieve the desired effect.

Alternatives

Remove the magenta objects from the foreground so effect of using **Gate 2** is minimized, or remove blue objects so its use isn't needed. If that isn't possible, adjust lighting to reduce red spill on the blue objects.

D. Controls in Detail: Processing the Background

Background (BG) Level Balance

What it's for

Overrides the automatic setting of the background level as turned on by the matte, which is based on the selection of the peak point. Decreasing the **BG Level Balance** will darken the background; in some instances, slightly dropping the background level will enhance reproduction of extremely fine edge detail in the foreground subject.

Increasing the **BG Level Balance** will not brighten the background since it clips at 100%, but it will increase the background level in shadow and transparent areas of the composite. This can serve to even out imperfections or textures in the backing that are causing noticeable patterns in the composited background.

The Trade-Off

Decreasing the **BG Level Balance** causes the background image to darken; increasing it can cause edges around the foreground subject to lighten and glow.

Alternatives

Increasing the **Clean Up** control can also remove backing imperfections, but it can cause hard edges due to loss of fine edge detail. In some cases, this produces a more acceptable look than the glowing edges that can result from using **BG Level Balance**.

Better than either of these options is to use **Screen Correction**, if available. Otherwise, it may be necessary to clean, repair, or re-paint the backing.

Setting the control

The **BG Level Balance** control is adjusted while viewing the final composite until the desired effect is achieved.

How it works

BG Level Balance causes each pixel of the matte to be multiplied by a constant. If this constant is less than 1 (control is decreased), the value of each pixel will drop and, when the matte is multiplied by the background, the overall level of the background will drop. This causes shadows and soft transparent, edges to darken in the final composite since the level of background being added to these areas is less than the level of backing that was subtracted.

If the constant is greater than 1 (control is increased), the value of each pixel is increased, up to the clip value of 1.00. When multiplied by the background, the level of the background in shadow areas will be increased; in areas of very light shadows, the background will be fully turned on. Transparent edges will begin to glow in the final composite since the level of background being added to these edges is more than the level of backing that was subtracted.

Shadow Noise

What it's for

In most situations, **Shadow Noise** is left at its default setting; it's the override for an automatic function that reduces noise in shadows and minimizes glare from the backing. For very noisy situations, it may be necessary to increase the control beyond the automatic setting.

The Trade-Off

None.

Setting the control

If necessary, adjust while viewing the final composite until the desired effect is achieved.

Fig. 3-7. A small backing or close-by equipment can limit how wide a shot can be done unless an external matte is used.

How it works

Going back to Chapter One, Section A to look at our graph on how the matte is generated (Fig. 1-7), we can see that a small difference between color components in the foreground can result in a large difference in the matte. Noise present in shadow areas of the backing could be doubled in the matte — or worse if the backing isn't as good as the one in our example. When this matte is used to control the background, the noise is transferred to the background image. A tolerable noise level in the foreground image could become objectionable in the final composite.

To reduce this noise, an automatic function substitutes the quieter blue (or green or red, depending on the backing) foreground signal for the matte signal, whenever the blue is lower than the matte signal.

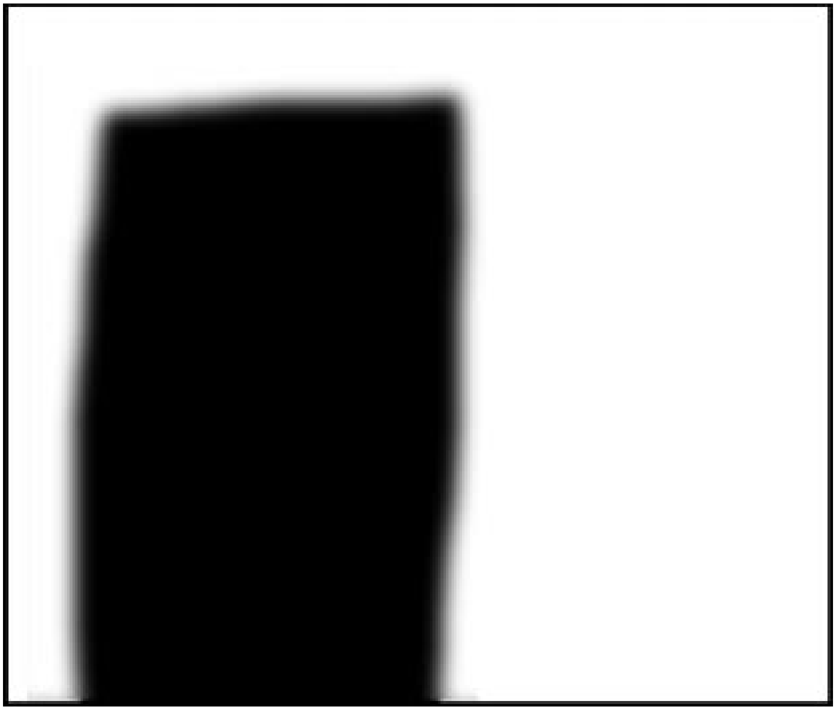


Fig. 3-8. The **external matte** forces the background on in the white areas to extend the backing. Soft edges help blend the background area turned on by the external matte with the background area turned on by the matte generated from the actual backing to create a seamless composite (**Fig. 3-9, next page**).

External Matte

What it's for

An **External Matte** is a grayscale image used to turn the background image on in a particular area of the final composite. It is primarily used in cases where the backing is not large enough to fill the entire camera frame (Fig. 3-7). Created in an external paint program such as Photoshop, the **External Matte** (Fig. 3-8) is sized to frame the backing, overlapping it slightly. The white area outside this frame forces the background image fully on, allowing it to extend beyond where it is turned on by the backing (Fig. 3-9).

In addition to extending the backing, the **External Matte** can be used to hide equipment and crew members that need to be close to the foreground subject and fall within the camera frame.

In some systems, the matte can be **inverted** so that the area inside the frame is where the background will be turned on.

As an alternative to creating the **External Matte** in a paint program, it can be derived from the associated fourth channel of the foreground image. A common reason to use the fourth channel is to create a **Hold-Out Matte**. With a **Hold-Out Matte**, an area is defined where the background is not to be turned on. For example, if an actor is wearing a blue tie that matches the blue backing, the **Hold-Out Matte** would correspond to the outline of the tie and keep it from turning on the background image.

As with the matte generated by the backing (see Chapter One, Section A), the **External Matte** is fully l inear: gray areas will turn the background partially on. This allows for soft edges on the **External Matte**, which can help blend the background area turned on by the External Matte with that turned on by the matte generated by the backing.

Setting the controls

Select **Invert** to turn on the background within the window instead of outside it. Select **Hold-Out** to have the foreground image within the window kept fully on, even if it contains colors that match the backing.

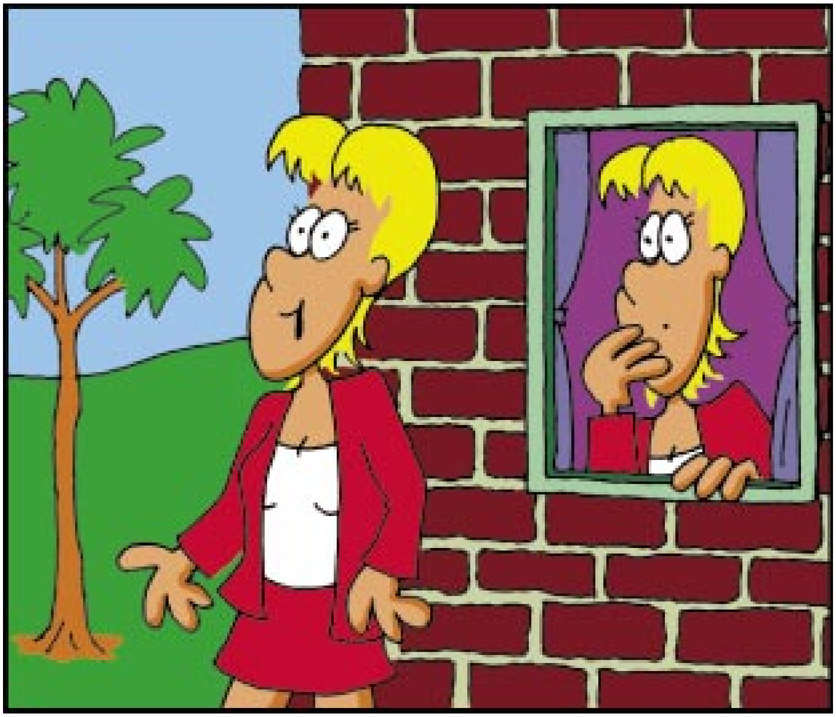


Fig. 3-9. The final composite using the external matte.

E. Controls in Detail: The Final Composite

Foreground Adjustments

FG Level (and FG Red, Green and Blue Levels)

What it's for

Raising or lowering the overall level of the processed foreground to better match the processed background image, or for special effects, such as simulating a night scene. In addition to the overall level, some systems also allow the individual **Red**, **Green** and **Blue** levels of the image to be adjusted.

The default of 100% corresponds to a straight pass through of the processed foreground image. Adjusting the **FG Level** control can drop the foreground level to 0 or raise it to 125%.

The **FG Level** control affects only the processed foreground; it has no effect on suppressing the backing or backing spill/flare, or on the processed background image.

Setting the controls

Adjust the controls while viewing the final composite to achieve the desired effect.

Alternative

Use **Color Conformance** to automatically set these controls.

FG Black (and FG Red, Green and Blue Black)

What it's for

Lightening or darkening the dark areas of the processed foreground to better match the processed background image. In addition to the overall control, some systems also allow the individual **Red**, **Green** and **Blue** levels of the dark areas to be adjusted.

The default of 0% corresponds to a straight pass through of the processed foreground image. Adjusting the **FG Black** control will lower or raise the black level.

The control affects dark areas only; an automatic level control maintains the peak-white level at 100%, or at the setting of the **FG Level control**.

Setting the controls

Adjust the controls while viewing the final composite to achieve the desired effect.

Alternative

Use **Color Conformance** to automatically set these controls.

FG Gamma (and FG Red, Green and Blue Gamma)

What it's for

Lightening or darkening the midrange areas of the processed foreground to better match the processed background image. In addition to the overall control, some systems also allow the individual **Red**, **Green** and **Blue** gammas of the midrange areas to be adjusted, which can be critical to matching colors, especially skin tones.

The default of 0% corresponds to a straight pass through of the processed foreground image. Adjusting the **FG Gamma** control will lower or raise the gamma.

The control affects midrange areas only; an automatic level control maintains the peak-white level at 100%, or at the setting of the **FG Level Control**.

Setting the controls

Adjust the controls while viewing the final composite to achieve the desired effect.

Alternative

Use **Color Conformance** to automatically set these controls.

Background Adjustments

BG Level (and BG Red, Green and Blue Level)

What it's for

Raising or lowering the overall level of the processed background to better match the processed foreground image, or for special effects, such as simulating a night scene. In addition to the overall level, some systems also allow the individual **Red**, **Green** and **Blue** levels of the image to be adjusted.

The default of 100% corresponds to a straight pass through of the processed background image. Adjusting the **BG Level** control can drop the background level to 0 or raise it to 125%.

Setting the controls

Adjust the controls while viewing the final composite to achieve the desired effect.

Alternative

Use **Color Conformance** to automatically set these controls.

BG Black (and BG Red, Green and Blue Blacks)

What it's for

Lightening or darkening the dark areas of the processed background to better match the processed foreground image. In addition to the overall level, some systems also allow the individual **Red**, **Green** and **Blue** of the dark areas to be adjusted.

The default of 0% corresponds to a straight pass through of the processed background image. Adjusting the **BG Black** control will lower or raise the black level.

Control affects dark areas only; an automatic level control maintains the peak-white level at 100%, or the setting of the **BG Level** control.

Setting the controls

Adjust the controls while viewing the final composite to achieve the desired effect.

Alternative

Use **Color Conformance** to automatically set these controls.

BG Gamma (and BG Red, Green and Blue Gamma)

What it's for

Lightening or darkening the midrange areas of the processed background to better match the processed foreground image. In addition to the overall control, some systems also allow the individual **Red**, **Green** and **Blue** gammas of the midrange areas to be adjusted, which can be critical to matching colors, especially skin tones.

The default of 0% corresponds to a straight pass through of the processed background image. Adjusting the **BG Gamma** control will lower or raise the gamma.

The control affects midrange areas only; an automatic level control maintains the peak-white level at 100%, or at the setting of the **BG Level Control**.

Setting the controls

Adjust the controls while viewing the final composite to achieve the desired effect.

Alternative

Use **Color Conformance** to automatically set these controls.

Color Conformance

What it's for

Color Conformance automates the setting of the **Level**, **Black** and **Gamma** controls for either foreground or background (see above), matching hues of blacks, whites and skin tones of subjects in the foreground image and hues of similar subjects in the background image. The user can decide whether to match the foreground hues to the background values or vice versa. The advantage to using **Color Conformance** is avoiding the time waiting for the screen to redraw after any change to the **Foreground** or **Background Adjustments**.

Note that **hues** are matched as opposed to exact **colors**. What this means is that the **proportions** of the red, green and blue components are matched between foreground and background subjects as opposed to the

levels. For example, say that a person is being composited into a background scene that already contains a person. In the background scene, the person stands near a window. The person being composited will be **away** from the window. While we want the **hues** of their skin tones to match, the skin tone of the person near the window should be brighter.

It is usually better to match hues than the exact red, green and blue levels. If the brightness levels do need to be adjusted, the **Foreground** and **Background Adjustments** described previously can be manually set.

Setting the controls

To match whites in the foreground with whites in the background, select **Level**. Instead of manually adjusting the **FG** or **BG** controls as above, click on a point (or a series of points) in a white area of the foreground and a point (or series of points) in a comparable white area of the background. (For a series of points, an average is automatically made; the logic also recognizes, based on the matte, which sample is part of the foreground and which is background.) Select **FG to BG** to make the foreground hues conform to the background hues to make the whites match. Select **BG to FG** to make the background conform to the foreground.

Select **Black** and follow the same procedure to match blacks. Select **Gamma** and follow the same procedure to match a mid-range hue, usually a skin tone.

Alternative

The **Foreground** and **Background Adjustments** can all be adjusted manually, even after **Color Conformance** has been applied.

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