

## Basics of Chromakey Production and Rules to Shoot By

by David Valentin

Many of us find the term "chromakeying" to be a bit daunting. Even the name is a little on the confusing side, as it sounds like something you pay to have done to a classic '57 Chevy's bumpers. Of course, it becomes at least a little more familiar to us when it's boiled down to its most popular derivative in this neo-digital age: "greenscreening."



I've done a lot of research into this subject since we first decided to do this issue in January, but I'm hard pressed to give a more concise description of the technology than the one that effects filmmaker Zach from Fox's *On the Lot* put it: "greenscreening is just basically telling the camera to replace anything it sees as green with whatever you [the director] want."

So where exactly does the term "chromakeying" come from? "Chroma" is the word used to describe color that a camera can record in technical terms. (As opposed to "Luma", which is the word used to describe the light that a camera can record.) Keying is an old production term that refers to removing an object from a picture using a form of matte. So Chromakeying is simply removing any color that you designate and creating a matte in the shape of the removed color. Over these matted out areas, the keying or editing software you use shows any background you choose.

With that said, for most of our readers, that doesn't make the actual way greenscreening or chromakeying works any less mysterious. It's all well and good to realize that you shoot something or someone in front of a colored background that is different than your subject and you can have almost any editor or keyer delete the background. However, anyone who's dabbled in this strangely occult field has probably discovered that their results often don't hold a candle to the work done by ILM or TroubleMaker Studios.

When you try greenscreening and don't get great results, it can be really tempting to just write it off as something that's not able to be done in a believable way on a low budget. Hollywood has extremely powerful equipment, software, and a lot of money to make its movie magic, so it can be easy to believe that their advantage allows them to do what we cannot. As we were getting prepared for this issue, I looked at the most common hurdles to low budget filmmakers being able to get good quality greenscreen results.

The number one hurdle was simply a lack of readily available information on the art of greenscreening. Up until the past couple of months, the only training on greenscreening that I had been able to locate was some pretty basic work in Total Training's Advanced After Effects series and a few powerful lessons in Andrew Kramer's [Serious Effects & Compositing](#). As such, I decided to find training that most people were unaware of and feature it here, as well as offering training in this magazine. Ironically, as I was in the final stages of preparation for this issue, the first book I've ever seen published on chromakeying was published by Elsevier: [Bluescreen Compositing](#). And, this month, *Creative Cow* and *Post* both published a few articles on the art of Greenscreen shooting. This makes me think that a lot of us realized the need for information in this area at about the same time, which is always a good sign for everyone.

With that said, this article is designed to give you some understanding of how to recognize the limitations low budget filmmakers have in regards to their equipment and how to do your best to overcome them in production. (To help overcome the issues you will face in post, we did a shootout of six different chromakey software packages that're available [which you can read here](#) and we have included two articles from the aforementioned *Bluescreen Compositing* by John Jackman, [one on zMatte](#) and [one on Adobe Ultra CS3](#))

To explain why many of us have had frustrating results when it comes to greenscreening, we must start with the fact that we have been working with sub-optimal source material.

*What do I mean by sub-optimal?* DV, HDV, and even most HD footage is sub-optimal. This is due to how DV, HDV, and HD cameras that are in the affordable range record light (luma) and color (chroma) information. (The only exception to this is the new Red camera, which is only affordable because Jim Jannard, the president of Red, is already the multi-millionaire owner of Oakley Sunglasses and doesn't mind creating a Hollywood-quality digital camera for about 10%-15% of the cost Sony sells there competing cameras for. The \$30,000 startup range is still outside most of our readers pocket books, but it's massive stride in the right direction compared to \$250,000 to \$300,000 competitors.)

Color information takes up a lot of bandwidth but is not as noticeable to the human eye as light data is. As such, when DV camera manufacturers were playing lifeboat with different pieces of information for the recording and compression codecs used in these cameras, they decided to record every pixel of light their cameras sensors picked up, but only one out of four pixels of color data for NTSC DV cameras. This was called "4:1:1" color space, with:

- the "4" denoting that out of every 4 pixels, every pixel's light information would be recorded,
- the first "1" denoting that 1/4 pixels would have color information recorded in the first line,
- the last "1" denoting that 1/4 pixels would have color information recorded in the second line.

From here, it is compressed, but, luckily, each frame is compressed separately.

PAL DV cameras (and now HDV cameras) record with a 4:2:0 color space, which, again, records four out of four light pixels, but records color information on two out of four pixels of the first line, and NO color information on the second line. In order for HDV to fit on a single tape, multiple frames must be grouped together and compressed in clusters of between 7 and 15 frames. (7 for JVC and 15 for Sony.) Obviously, when you mash groups of frames together and then must untangle them before you can even begin to key them, this makes getting good keys harder.

HD extends from HVX200 all the way to compressed Viper footage and has a 4:2:2 color space. Again, four out of four pixels have their light data recorded, while every other pixel has

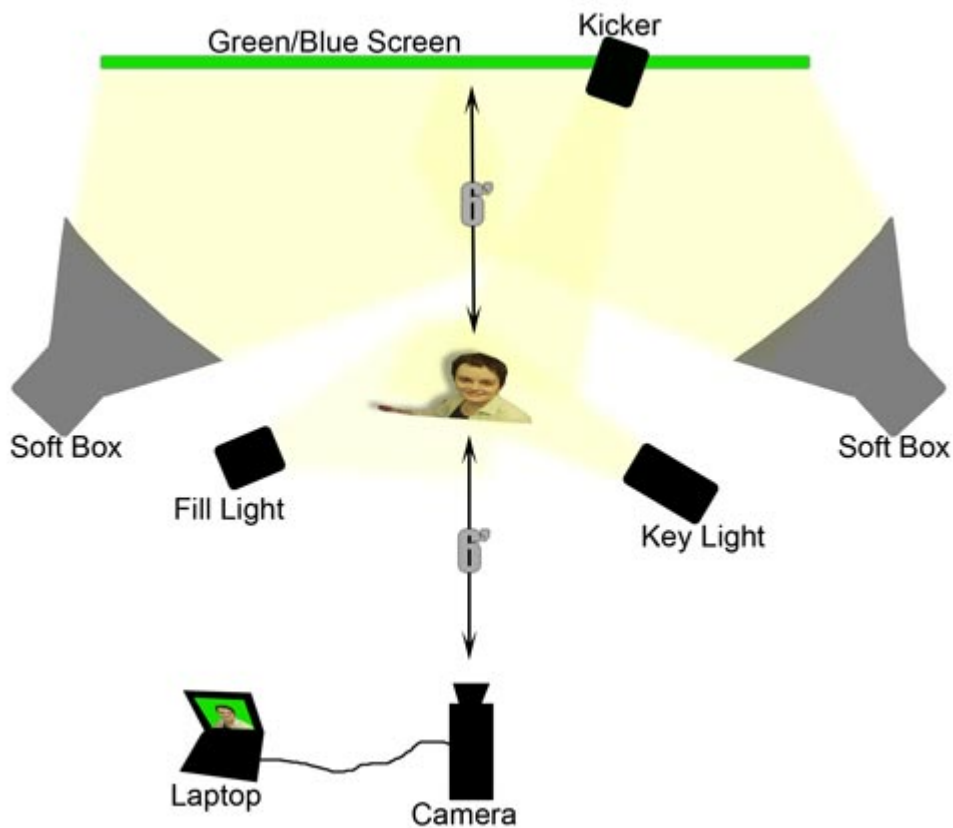
its color data recorded in both the first and second line. Again the footage is compressed before being recorded to the hard drive or tape, but like DV, each frame is compressed individually, which means that there is less damage done by the compression.

So what's the color space in those high-end cameras that Robert Rodriguez used to shoot *Sin City*? Uncompressed 4:4:4. Which means that every pixel is recorded for both light and color and recorded without compression to a RAID array. Obviously, this gives you optimal chroma-key work, as the keying program isn't trying to guess where pixels are due to insufficient color information. (The aforementioned Red camera generates this same color space provided it's uncompressed Redcode RAW stream is recorded.)

For most of us, 4:4:4 is not something we will likely have access to until the Red drops further in price, we sell one of our films for a substantial profit, or we try to hijack the signal from our cameras before its color information gets decimated. (Believe it or not, a company called Real-Stream has a \$2500 adapter which they will install in a DVX100 or HVX200 camera so that you can download uncompressed 4:4:4 data directly from the camera's imagers. Unfortunately, the program that reads this data stream is only available for Macs and, reportedly, extremely unwieldy to use. Hopefully, in the future, they will come with a cross-platform package that has the kinks worked out.)

As such, we need to figure out how to overcome the problems our undersampled cameras have with chroma-keying. In this article, we will discuss how to shoot to have the best possible footage to take into post production, which should give you the best possible keys. If you do both production and post-production well, you will be surprised by how much potential greenscreening can open up to you.

I will use the term "greenscreening" predominantly in these rules, rather than chromakeying. Obviously, you can substitute blue if you choose to shoot with bluescreen. Or, any other color you may choose to shoot with, for that matter.



### Rules to Shoot By

1. **Make sure that your background is opaque and without wrinkles.** While this can be a permanent enclosure in a permanent greenscreen studio, it can also be a temporary setup. We've included an article on making a great greenscreen backdrop that's opaque and wrinkle free for about \$50 in this issue, [which you can read here](#). (Plus, it includes a good paint color choice you can pick up at Lowe's or Home Depot.)
2. **Keep at least 6' between your actor and the greenscreen and 6' between the camera and the actor.** This prevents shadows from hitting the background and lowers the amount of "spill"—reflected green that washes over your actor.
3. **Use soft boxes or some sort of diffuse light to light your greenscreen.** We've used the twin 500W Smith Victor Economy softboxes that make up their [KSB-1000](#) to good result. With a little creativity and some heat-proof diffusion, you can also use three 500W 3200K flood bulbs in three Home Depot clamp scoops (the ones that have porcelain fittings) for about \$40 for all three. (However, you really have to pay attention to rule #4 if you do this.)
4. **Use a light meter to test that you have even lighting across the background and make sure you have no more than a 10% variance in illumination in any part that will be filmed.** While you can use a handheld light meter, my recommendation is that you plug your camera into a laptop that has some sort of lightmeter software in it. Adobe's *OnLocation CS3* (which was Serious Magic's *DVRack 2*) is an excellent example of this. (Also, if you have a software package like Adobe *Ultra CS3*, you can

actually do test keys to see how well you've lit things. Folks who buy the PC version of Adobe's *CS3: Production Premium* will have both of these helpful packages included in the bundle.) *[If you don't have a lightmeter or a laptop with the necessary software, you can make a cheap lightmeter by adjusting the two zebra levels on your camcorder and zooming in on different parts of your screen with the auto-iris turned on. If you adjust the zebra levels close enough to one another, you'll be able to make sure that you're within a 10% illumination variance throughout your screen.]*

5. **Don't overlight your greenscreen.** You want the background to be as close to pure green as possible. If you overlight the background, you will wash out the green color and you will have difficulty keying the background properly. Additionally, there is a greater chance that green light will spill on your subject if the screen is overlit.
6. **Light your main actors dynamically and with separate lighting than your greenscreen.** The lighting is designed to look like the lighting in the background you will be adding in post, and is usually three-point light—which is made of a key light, a fill light, and a kicker. (This is another great thing about having a laptop with you, as you can see the background image as you are setting up the lighting. Plus, even if you don't have Ultra, you can record a few seconds of footage, digitize it real quickly, composite it in your favorite keyer, and make sure your lighting will blend with the background.) The most realistic keys match this perfectly. (Just make sure that you spread your key and fill lights a bit wider than normal to prevent their light getting on the greenscreen, or you could screw up #4, #5, or both.)
7. **Turn off all the lights which are illuminating the greenscreen before white balancing.** This is a very helpful fact that Tom Stern brought up in his MFM article on shooting DVX/HVX greenscreen footage. As this tip applies to all greenscreen shoots, I repeat it here. If you white balance with the greenscreen illuminated, it screws up your white balance and basically causes the green to become washed out. (Which basically leads you back to issue #5) Just don't forget to turn back on the greenscreen lights before you shoot your sequences!
8. **Experiment with the camera until you get the settings that yield the most difference between your actor and the green background.** Each camera is different, but the more true green you can record the background in your camera, the easier it will be. (If you have the DVX100 or HVX200, check out [the aforementioned article by Tom Stern on its presets for greenscreen.](#))
9. **If you have a camera that shoots progressive footage, shoot progressive.** Interlacing makes it harder to get a clean key, and will therefore have to be removed in post, anyway.
10. **If you have a camera that shoots 24 fps, shoot with that.** Cameras that shoot true 24 fps usually have their shutter open 20% longer per frame, which means that more light data is being recorded. As many of the keyers designed for DV/HDV/HD footage combine luma and chroma data, the more data you can record on both levels, the better the key they can produce.
11. **If you can shoot at a higher resolution than what your project demands, do so.** Obviously, the greater the resolution your camera can record, the more data for the keyer to work with afterwards. The huge benefit in shooting at a higher resolution than what you will output at is that you can key at the higher resolution and then shrink the image to fit the output resolution. This will give you much more precision and make minor keying artifacts virtually unnoticeable.
12. **Don't shoot greenscreen with a 35mm adapter.** If you've read any of the articles, critiques, or reviews in this magazine, you're probably aware that we love the film look a 35mm adapter can provide. However, for greenscreen work, you want your subject to have sharp, clean, in-focus edges. Once you've keyed your subject cleanly, then

you can create the look of shallow depth of field in post with out of focus backgrounds and feathered focus edges on your subject.

While these are the main rules to shoot by, I wouldn't be very helpful if I didn't also leave you with some information about what to watch out for with your talent. You can do all these twelve things perfectly, and talent can cause problems if you're not careful.

1. **Don't have your talent show up until you have most of the greenscreen set up.** Unless you have built a greenscreen studio and will be shooting in there, then you should plan on at least two to four hours to set up a greenscreen and light it properly for the first time. You don't want your talent hanging around getting bored, tired, and cranky. (And you don't want them to get hot and sweaty, as we cover in #4.)
2. **Make sure that your talent wears nothing green--or that is largely green derivative.** There are lots of things like teal and aqua that are a perfect blend of blue and green which are bad choices for your talent to wear, but which many people wouldn't realize because they get tunnel vision on avoiding just green.
3. **Make sure you have nothing shiny on your actors or as part of the physical set.** Shiny things reflect green and therefore will become transparent. Matte clothes are best for actors and matte finishes on pieces of furniture you may use. As even glossy wood furniture can reflect green, you can imagine what happens with stainless steel furniture and glass table tops. Same thing goes for props like water bottles, crystal balls, and reading glasses.
4. **Make sure you have fresh make up on your actors at all times.** While makeup is necessary for any film endeavor to get the look you want, it's extremely important for greenscreen as it prevents your actors from becoming shiny and reflecting greenscreen light. With your actor(s) standing in front of one set of lights and right near another bank of lights, you can be sure that the makeup will melt off at a faster rate than in other types of shoots. As such, plan on having the makeup refreshed regularly.

**We at CTV Perth, are here to assist your production and feel free to anytime use our expertise to achieve your best production values.**

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