Exposing the RED: Perfect Exposure, Every Time

A Creative Cow Feature Article

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Article Focus: Director DP, David Battistella, REDtrepreneur, early adopter and obsessed student of the RED camera system takes a closer look at how to hit the sweet spot on the RED sensor. David shows how understanding RED’s inner workings will help you expose your scene just right, every time.

There has been much discussion on how to properly light and expose the RED camera sensor. Any new piece of technology introduces a lot of testing and much discussion about how to get the best image. This article will focus on some of the things you should do and watch out for when you are shooting with the RED camera.

TECHNOLOGY OVERVIEW

The RED camera system uses a proprietary single chip 4K CMOS sensor called the MYSTERIUM. This sensor is the
same size as 35mm film so it allows for use of 35mm lenses (PL, NIKON, CANON or IMS mount systems). It is similar to the sensors that are found in Digital SLR still cameras except that it captures at 24 or 30 frames per second, and when cropped to 2K windowed mode, can capture up to 120 frames per second.

The camera records to either RED DRIVE (320 gig proprietary raid drive) or to Compact Flash card (currently 16 or 8 GB). The RED records 4K raw data to these drives using a wavelet based compression scheme.

The big advantages of shooting RED?

- 35mm depth of field to your image.
- A 4K (4096 pixel wide) image is recorded. (4 times the size of a 2k film scan)
- The image is stored in a RAW format so as extraction algorithms improve, so does your footage.
- Your looks are not “baked in” to the RAW files. They remain separate and may be changed at any point,

**WHAT TO CONSIDER**

RED is not HD. Nor is it film. It might be best described as a SUPER HIGH Definition digital cinema camera. I like to call it a portable 4K telecine machine myself. All the basic principles of photography apply to RED but I wanted to share some of what I have found, along with what others (who have really put the camera through its paces) have discovered in their testing.

One thing is for sure. It seems to be a blend of using what you know, seeing how it responds and coming up with the correct strategies for exposure.

Jack Mosor of PS production services Toronto recently technically supervised the five camera shoot of cinematographer Jon Leonetti’s, latest film, HYBRID, with six RED cameras on location in Saskatchewan, Canada. Jack has done extensive testing and response of the RED sensor under variable, lighting conditions, frame rates, lenses and multi camera shoots. His company embraced the RED, seeing it as a leap forward over HD and a bridge into the future of digital cinema.

The one thing Jack has noticed is the how well the RED emulates the film cameras they have in house. Actually feels it represents two camera’s’

“The RED is a full blown 24P film style camera, but the really nice thing is that it also shoots speed up to 120 FPS. That means on set it can double as your high speed camera and it records faster frame rates at 2K 3K and 4K resolutions. Everything with RED is film centric, so it was easy for us to bridge to digital. We were excited that we could use all of our existing glass with the RED and that the sensor could capture so much detail and latitude over the early HD camera’s.”

Because RED is digital, many of the digital rules apply. There is a hard floor for black and a hard ceiling for white and the sensor records linear data, unlike film, which records logarithmic data. That is why it's important to preserve highlights when shooting RED (if you want to see them) or you will “hard clip.”

(Cow author and film compositor Pete O'Connell gives a great look at the differences between linear and logarithmic exposure in film and video, in an article here in the Cow library. He's speaking in the context of Cineon files, but the information applies to any kind of digital format as well.)

This is where RED differs from film. Film recorders capture data in a logarithmic color space, which creates a softer curve from the deep blacks through the midrange to the brightest highlights. The RED sensor captures linear data so a curve needs to be applied to have it mimic the response of film. How you expose will effect how “filmic” your image looks.

So, there are some differences. What we want to do in this article is help you understand how to get the most out of your RED sensor. We’ll talk about a few shooting situations and help guide you through the reasons you might expose the way you do. I’ve enlisted the help of a few DP’s Dylan Mcleod CSC, Gregor Hagey, Macgregor and RED’s Ted Schilowitz to help navigate this for you.
RED has recently introduced Build 16 of the camera firmware. This is significant because this build makes some firmware improvement to the camera’s imager and also introduced the REDspace color space. Many of the principles discussed in this article apply to Build 15 and Build 16 but some things are improved in BUILD 16.

It is important to note that RED has not changed the rating of the sensor. This remains constant at 320 ASA. It is also important to know that the RED camera’s sensor is also DAYLIGHT balanced at 5000 Kelvin. This is significant because it means that the camera prefers daylight sources, and will yield the sharpest images with daylight balanced sources like LED and daylight balanced fluorescent sources.

This is not to say that you can not shoot with RED in tungsten light, but you should always add some blue to at least one of your light sources to activate the blue channel in the sensor. This will help to reduce the overall noise of the image. For example you might use a quarter blue on the backlight and keep the key at a warmer color temperature.

Generally, I have found that all cameras with CCD chips perform better (slightly sharper images) under daylight lighting conditions. The RED is no exception.

In my own tests I have found that lighting with a mixture gives a nice feel of warmth and sharpness. I consistently rate 3200 Kelvin sources at about 3900 to 4300 Kelvin to warm up the image and reduce the amount of blue channel noise being recorded. This is a strategy I devised to have nice looking QuickTimes that could easily be adjusted or tweaked in a straight to video color correction session in order to maximize the quality out of a straight to video image.

That is only one strategy being adapted, but there are some other tips that you might be interested in. Dylan Mcleod is a CSC DP who put the RED through it’s paces earlier this year while on a documentary that traversed the world and put him in many different shooting situations.

“I have noticed that RED has greater latitude than HD but not quite as much as film. I also find that highlights tend to clip in a more pleasing way with the RED. In HD it can really look bad! Of course film has a unique way of rolling of the shoulder that can’t quite be matched by HD or RED. However with RED it is possible to tweak your RAW images so you can get close by simulating a shoulder roll off with curves in either REDCINE or REDALERT.”

This is indeed one of the great advantages of shooting RED. The metadata is not baked in and you have the opportunity to extract the most out the image at the finishing stage. But it is still very important to preserve the highlights with RED.
Many DPs therefore rate the camera at 400 500 or 640 ASA. This makes for a pleasant QT image, but also helps you to underexpose a bit (to help prevent clipping of the sensor).

RED’s Ted Schilowitz can confirm what DPs are finding, the RED is getting much more data that HD but is still about 2 stops less than film. Ted explains it this way.

“RED has a slightly different exposure index than today’s negatives that is weighted more into the shadows and the mid tones. So where as with today’s negatives, if you poll a bunch of DP’s and they are shooting primarily to go to telecine or some sort of digital output with their film neg, they tend to overexpose a little bit by their nature, their instinct is to have what we call a thick negative. They are going to open their stop a ¼, ½ or full stop OVER.

In the RED world you have to take that logic and sort of SKEW it a bit because it is a digital sensor. With every digital sensor the danger is that you blow out the highlights quicker than you do with film. If you learn to expose the camera properly it means exposing for what we call the sweet spot for the image. So you are exposing for your mid range and you are protecting your highlights.”

Gregor Hagey owns RED number 98 and has been shooting features and several tests on it for almost a year. The short film he DP’d -- “feel my pain”-- was one of the first in Canada to be printed to film.

“With Red and its’ RAW image format the DSLR still photographer’s approach is best. The most effective way to get the best picture when shooting a RAW image is to expose to the right. This means no matter what your final image will look like expose the shot so it’s as close as comfortable to the right edge of the histogram. This gives the most detail and texture and least amount of noise to the picture no matter how dark the final image is.

As you can see most of the brightness values are in the top 2 stops, so the more information you can capture there will give you the most detail and least amount of noise in your picture.”

That means the best way to get the most useful pixels out of the RED sensor is to not let those pixel blow out to white, unless that is the look you are looking for. Traditionally in film you could “blow out the highlights” and recover them later. When you do this in a digital sensor you never get it back, those pixels are forever white. Ted confirms this.

“When you blow out the pixels on a digital sensor, you can’t get the image back, it’s just white and it is going to be white.”

Don’t freak out to much about over exposure. There is a lot of latitude in a RED image and there is plenty of room for recovery. You don’t really have to panic too much about blowing out pixels. This one of Dylan’s Mcleod’s experiences after his complete set of filters went missing.

“There were some situations where I would normally control the windows of an interior by putting a grad over them. Without my filters I had no choice but to let them blow – like right off the map – probably six or seven stops over. Only the best film stock would allow recovery of that kind of overexposure.

In hindsight, they look totally fine and natural blown out like that. I have learned not to be such a control freak over highlights.”
ONBOARD TOOLS

Dylan Mcleod used a combination of the RED’s onboard tools and in front of the lens filtration to control the hot spots that he go faced with in some tough situations.

“I found MacGregor’s idea that the camera should be rated at 500 ISO when you are worried about highlights and 100 ISO when you are worried about noisy blacks to be excellent advice.

“At the beginning of the shoot I was really careful about clipped highlights, but after viewing footage in REDCINE and playing with the ISO after the fact to see how much information could actually be pulled back from those highlights, I became less worried.

I generally would watch the stoplights and when all three channels were just clipping, I knew I would be okay.”

But there were some instances when Dylan had the time to really take control of the image too. During a RED seminar I was giving a DP asked me about using his set of chocolate filters with the RED. My response was that if you were looking for the color cast of that filter, it would be useful and it would definitely affect the way the camera is seeing color information. Perhaps a more useful approach would be the amount of ND that the filter is giving you. Even with the amount you can manipulate the image in post, it never hurts to have the favorite old tools at the ready.

“Aside from camera controls I also make extensive use of various types of graduated filters. From straight ND’s to “ovals,” I really like to stack them up to keep the image nicely controlled.”

The RED offers many digital tools to help you nail exposure. There are several assists build into the camera to help you along with your light meter. I still use an old dial-up light meter and it is a great tool, but I like to combine it with some of the tools built into the RED.

The image histogram is a great tool for anyone who is really comfortable with DSLR imaging, to help you understand where your exposure is. You generally want a nice wide histogram when you are exposing because this gives you the most amount of room to maneuver in post.

RGB Histogram at bottom, center. Click image for larger.
Starving the sensor will result in having to push the image a fair bit and, unless that is the specific look you are going for, maybe not the optimum way to expose a digital sensor.

I use the histogram in conjunction with the RED stop lights, an RGB representation of which color channels are clipping. The highlight focus assist is also a great tool, because it gives you a monochrome image which is a really nice way to see the latitude of the scene.

Highlight Focus. Click image for larger.

Ted likes to use the SPOT meter along with the histogram. RED’s spot meter is always rated at 320 ASA (the sensor’s rating) and it gives a reading from one to 100 IRE anywhere in the frame. This is a nice way to check for the amount of latitude you are getting in the image.

Spot meter. Note IRE at bottom of frame. Click image for larger.
Dylan likes to use false color. When activated, this mode looks like you are looking through the eyes of The Predator from the Predator movie. It’s a zone color system superimposed over the image. If you are in the pink, you are overexposing the sensor.

"Now I find I approach things as I would with Build 15, but if I need to “open up” a bit for shadow detail I have a really easy way of quickly checking (via RAW VIEW and false color) how far I can go before the highlights are “really” gone.

“Make sure you understand what each of the various monitoring tools are showing you and you are well on your way to supreme exposure control.”

AESTHETICS

But what about image aesthetics? This is a very important point. We all have used various terms to describe motion picture images, perhaps the favorite being “filmic.” For ages we hated or loved the “video look”, but where does RED fit
in? It’s a digital sensor, which technically makes it “video”, but with the compression schemes and good lighting techniques the RED images can be very filmic.

I have noticed that the RED rolls of the highlights more the way a film stock does. In REDSpace, the dark to shadow or highlight detail is more like film in how it blows out. The sensor itself captures linear data but it might be the wavelet compression that helps “draw” an image that feels right.

People have made the RED look like a tack sharp regular old video camera as well, so what is the trick to getting that “film look” with RED? Gregor Hagey:

“I don’t know if there is a particular aesthetic to Red. It looks most like 35mm film, but not identical. It’s a digital format that has a very organic look to it.”

Dylan Mcleod agrees that RED is its own thing:

“RED has its own unique look. Unlike film, it is grainless. And unlike HD, the ability to finely control depth of field really makes RED stand out. I love the high resolution images and regardless of the end format I will always want to shoot at the highest resolution available.”

But Ted gives some practical tips to get a more film looking image.

“Don’t be so worried about getting stuff in eighties and nineties (IRE) for the subject matter, get your flesh tones and your faces in the 40’s and 50’s, get you shadows in the 20’s and 30’s and get your highlights in the 70’s and eighties if you want them to be nice highlights. Use the tool as a creative tool. Know the where the range and know where the limitations are of the system and then use it to your best benefit.”

Perhaps the most important thing to do with the RED when you first get your hands on it is TEST. I can say that I did not take the RED out on any shoots without going over it with a fine-toothed comb. The menus are deep and the combination of settings and the language can be mesmerizing. RED has made a tool that is very customizable with access to ALL LEVELS of menu. There is no “safe mode” so how things are configured is very important. This is what makes testing so important. While it can be configured to be “run and gun,” the RED is a sophisticated tool, with many film-style dialogs. If you are not a DP who is used to this, it can be daunting.

Gregor Hagey does have some great advice for DPs test things out.

“Testing is extremely important. RED is only a year old. There is still much to discover about the format. The camera is also evolving every month with new firmware updates. The Red camera from October 2007 is not the same Red as today.”

One thing is for sure. The RED is not vaporware. It’s a professional filmmaking tool. For you video guys out there, embrace it. For you film guys, treat it like a new 320 ASA film stock. The RED marks a true beginning to the affordable digital cinema camera and I think anyone from Indies to seasoned filmmakers can find that exciting!