1. REDCODE vs 35mm Film

I'm sure everyone has had this argument with someone they know or work with. I've had this discussion/argument with a cinematographer who has both shot on film and on RED and still prefers 35mm over RED despite the long waiting period and higher costs of production. Maybe it’s an age/generation difference. Here are some facts that I have read regarding RED footage and 35mm film and how each is handled. I highly recommend checking out Paul Wheeler’s High Definition Cinematography Book, it’s a great read!
“A counterargument goes that 35mm film must be sharper because the image has a resolution which is referred to as a 4K resolution, meaning 4000 horizontal pixels or samples. However, after the 4K film negative is finished, it has to be photographically copied several times before being projected onto the cinema screen. At every stage, the quality of the film always suffers. It can be said / shown that the image we view on the cinema screen is unlikely to be better than 1.2K.

Let’s look at a 35mm film’s route from camera to cinema screen. In order to duplicate the original negative many, many times so that it may be shown simultaneously in many cinemas, the picture will have to be copied, photographically, several times.”

A. The original camera master is copied to;
B. An inter-positive print film which is then copied to;
C. An inter-negative film which is then printed to;
D. The release print which is then shown through;
E. The projector lens on to;
F. The cinema screen.

This lengthy process is necessary because film is mechanically vulnerable and should only go through the printing machine a limited number of times. This printing and re-printing process is done in order to get over 3,000 copies of a 35mm film into your local theater. By the time that a 35mm master negative image reaches your cinema screen, most experts agree that the image on the screen is no better than 1.2K to 1.4K, and that’s being generous.

Compare this with true 4K REDCode digital image that has stayed completely digital without any kind of quality loss and you will come to realize that the only degradation your REDCode 4K film will have suffered will have come from the digital projector lens. Hence if the production has stayed within the REDCode 4K domain, the resolution that can be projected on-screen can still be between 2K and 4K (depending on how you finished your production). If you are wondering why I mentioned finishing in 2K, please read the next section.

2. Shoot 4K and finish in 2k?

Although working with the RED camera can be great, please be aware of something that’s very important. At the time of this article, NLEs like Final Cut Pro and Adobe Premiere Pro have released plug-ins that allow you to natively edit REDCODE files. However, this does not mean that they can export back to full 4K R3D files.

When picking a resolution to shoot with, you should keep in mind that although the RED Camera can shoot media at 4K, 3K, and 2K resolutions, there are positives and negatives to each resolution if you’re planning on doing your post-production using Final Cut Studio:
Digital Formats

• 4K media will always be resized to 2K quality during the Log and Transfer process in Final Cut Pro 6.
• 3K media is not supported by Final Cut Pro’s real time effects architecture at this time.
• 2K media is imported as is, with no resizing and is supported by Final Cut Pro’s real time effects architecture. It is the maximum resolution that can be output by Apple COLOR as well.

Remember, RED media is read-only; you cannot export media using the REDCODE Codec. Instead, you will have to finish using either Apple ProRes 422 (HQ) or Uncompressed 10-bit 4:2:2. So while your project was shot with REDCode 4K resolution, you will ultimately be finishing with a 2K quality picture.

This isn’t a bad thing though. As I mentioned, only 2K digital copies can be exported from all existing NLEs. This may change in the future but it will be a couple of years before we can truly edit native 4K images and export at 4K. Even at 2K, your project will still look amazing if not better than 35mm film. If you don’t believe me, try playing a 2K version of your film in an actual theater and you will see what I mean.

3. Some Assembly Required

Whether you bought your own RED Camera or will be renting one, you will be doing something major assembly before starting a RED Production. Before starting the American Salesman shoot, Andy Bragdon brought in his brand new RED Camera. He had ordered the Base Production Pack with his RED Camera.
Assembling the RED

Iskra & I making adjustments

Mounting the RED-RAM

Iskra Valtcheva and I began to put the RED Configuration together when we realized that we were missing another set of rails. The Base Production Pack came with only 1 pair of rails and did not come with any extras. The basic configuration can be a bit difficult to work with since the Hard Drive would block the RED Camera controls. We went ahead and rented some spare rails from Michael Morlan here in Austin to finish the configuration we wanted. Always be sure to check if you have all the parts for the RED Configuration you want to use!
4. Check, Check, & Double Check the Back Focus!

If you have worked with film cameras or 35mm adapters before, then this will just be a refresher. For those of you coming into RED with no background on this, back focus refers to the “focal flange length”. This is the distance between the rear lens element and the CMOS Sensor for the RED. If you find that your focus is sharp when you are zoomed in but soft when zoomed out, your back focus needs adjusting.

Nikon SLR Zoom Lens

Adjusting the Lens

Check & Double Check!

This happened to us when we were testing out the Nikon Primes we would be using for the American Salesman shoot. The 35mm Manual SLR Nikon Lens would be soft while the 135mm Nikon Lens would be just right. Its usually better to measure the back focus if you
have a Manuel SLR Zoom Lens to make sure all of your focal points are in tact. Be sure to consult a RED DP when checking the back focus on the Camera. The last thing you want is for your image to go soft at 4K resolution.

5. Use a GOOD Tripod

RED with O'Conner Tripod

Make no mistake about it. The RED Camera with Hard Drive and Lens will easily weigh in at about 30lbs. You need a DAMN GOOD Tripod to hold this kind of weight, especially for tilts and pans. May I recommend an O’Connor Tripod? Any Tripod that can hold a 35mm Film Camera will do. Don’t even try to use anything less than this or you’ll run into a lot of problems. Be ready to spend some money here.

6. Use Ice Packs with your noisy RED Camera.

If you have never worked with the RED Camera before, then you are in for a rude surprise. THIS CAMERA GETS REALLY HOT! We did some outdoor shots on the latest production of American Salesman and the camera began to overheat on us. Did I mention it was only 8:30am and we had just started 30min prior? In order to prevent a shutdown, we filled a small plastic zip lock back with ice cubes and laid it on top of the RED Camera. If you are shooting a project outside in the summer heat, be ready to bring plenty of ice packs. If not, you will have to shut the camera down mid production in order for it to cool off.
Not only does this camera get HOT very fast, but the cooling fan inside the camera is noisy as hell. Make sure that your sound guy is ready for this since the RED Camera has a loud fan running a majority of the time while in use.

**7. Shoot Sync Sound**

Unlike many other digital cameras that indie filmmakers are used to, the RED Camera does not come with an on-board microphone or a mic attachment. The inputs on the RED Camera are mini-XLR. Controlling the actual audio levels is completely different than using HD cameras such as the HPX170 or JVC GY-HM700 where you can adjust your audio via the knob controls.
I recommend hiring a professional like my buddy Sean McCormick to do sound on a RED Production. If you hire the proper sound professional, make sure you shoot sync sound into your RED Camera, as it will make the entire editing process a lot easier for you.

8. REDCODE 28 vs. REDCODE 36

What makes the these codecs different from any other codecs on the market is that these two codecs from RED deal with actual MegaBytes per second and not Megabits. Don’t be confused with what other companies like Panasonic, Sony, or JVC offer. Panasonic uses DVCProHD and AVC-Intra at 100 Megabits a second. REDCODE uses over 25 MegaBytes.
Remember, there is a huge difference between MegaBits and MegaBytes because 1 MB = 8 Mbits.

- REDCODE 28 runs at over 200 Mbits per second in 2K, 3K, & 4K.
- Panasonic’s DVCPROHD codec runs at 100 Mbits per second in 1080P Mode.
- Sony’s and JVC’s XDCAM EX runs at only 35 Mbits per second in 1080P mode.

REDCODE 28 allows you to use undercranking and overcranking with the RED Camera. You can overcrank to 120 Frames per Second or undercrank to 1 frame a second. The higher your overcrank speed however, the lower resolution you have to use. At the moment, the RED Camera can only overcrank to 120 FPS at 2K quality. It cannot do 3K and 4K at those speeds. Check out the video below of some skateboarders shot at 120FPS at 2K. It is amazing what you can get at this speed!

![Skateboarders shot at 120FPS at 2K](https://vimeo.com/1347)

**skate - shot on red #1347 - 120 fps from Opus Magnum Production on Vimeo.**

REDCODE 28 is also the suggested codec you should use with the RED Camera if you are shooting to Compact Flash cards. With a 16GB Compact Flash Card, you can shoot the following:

- 1min of REDCODE 28 @ 2K = 1.1GB
- 1min of REDCODE 28 @ 3K = 2.5GB
- 1min of REDCODE 28 @ 4K = 4.4GB

Compared to HDV, DVCProHD, and AVC-Intra, REDCODE28 give you full 4:4:4 Intraframe detail but comes at a very high price of storage when shooting at 4K. If you have done the math already, you’ve come to realized that at 4K quality, REDCODE 28 will only give you...
roughly less than 4min on a 16GB Compact Flash card, where as at 2K quality, it can give you much more. If you are going to be shooting your RED project using CF Cards, be ready to have at least 3-4 spare cards and a data wrangler who can offload the CF Cards to a laptop with an external hard drive. Treat this work-flow like you would a film shoot where by each CF Card is like a re-usuable film roll but only gives a limited shooting time.

REDCODE 36 is a different story. This codec is only to be used if you have RED-DRIVE or RED-RAM with your camera configuration. This codec should not be used if you are shooting to Compact Flash cards. The data rate is too high and you will run out of space in a minute or less. REDCODE 36 uses a larger data rate for your footage and breaks down as the following:

• 1min of REDCODE 36 @ 2K = 1.4GB
• 1min of REDCODE 36 @ 3K = 3.1GB
• 1min of REDCODE 36 @ 4K = 5.5GB

While on the American Salesman shoot here in Austin Texas, we used the RED-RAM 120GB Hard Drive with our RED Configuration. We chose to shoot at the highest quality and decided to go with REDCODE 36 @ 4K. You might think that a 120GB Hard Drive is plenty for this kind of shoot, but oh how wrong we were! After the first 12 hour day, we had shot over 200GB of RED Footage and had only completed half the scenes for the production. We had to offload the Hard Drive twice in one day and it took some time to do.
Setting up the Shot

By the time we finished the entire production, we had shot over 350GB worth of footage. Did I mention that this was all going to be edited down to a 10min short film? Be sure you are always looking at the Hard Drive indicator on your RED Camera and always make sure that you have at least 90min to 120min for offloading time (Yes, it took us almost 2 hours to offload a full hard drive using firewire 800 on our Mac computer).

9. Choose your RED Workflow wisely.

REDCODE to ProRes 422

There are three different work flows that you can use when working with Final Cut Pro. You can either edit from the proxy files that the RED Camera leaves in all of your clip folders, or you can log & transfer your footage and transcode it to Apple ProRes 4:2:2 HQ. These work flows are recommended for anyone editing REDCode footage with a single Quad-Core Processor in their older MacPros. I would highly recommend you don’t even try to edit REDCode with an old G5 machine. If you still own a G5 MacPro, it’s time for an upgrade.

Here is the work flow that I chose and that I recommend for MacPro users that have Dual 8-core Processors and lots of RAM for editing REDCode with Final Cut Pro. By using Log & Capture and setting the RED Plugin to transcode the RED footage natively, FCP will re-wrap the RED footage as QuickTime clips which eliminates the transcoding to ProRes step. In
other words, I won’t be converting any of the raw footage into Apple ProRes 422. Allow me to explain the advantages and disadvantages of this work flow.

- **Advantage** - This is an efficient workflow that skips the need for transcoding, and gives you access to high-quality image data when you grade in Color. Ingesting RED QuickTime media is fast when compared to transcoding. This is a good workflow for projects such as short films and commercial spots.

- **Disadvantage** - RED QuickTime media is very processor-intensive when editing.

### 10. Color Correction with Apple COLOR

Since I primarily work with Final Cut Studio 2, I’ll go ahead and discuss the color correction process with Apple COLOR.

*RED ALERT! 10 Things RED Camera Users Need To Know | The MindWarp Blog*
The RED camera writes raw, linear light image data to the R3D files that are recorded. The controls found in the RED camera’s Audio/Video menus in no way alter the way the image data is written within each R3D file. Instead, whatever settings were chosen at the time are stored within each recorded clip as metadata that determines how these media files are displayed.

This metadata can be overridden during the Log and Transfer process. For clips that were imported with native color metadata, the RED tab provides access to the clip Color, Color Temp, and View metadata originally written by the RED camera. However, this metadata can also be overwritten during ingest using a custom color processing option in the Log and Transfer window (1 of the 5 options I mentioned above).
These parameters are provided so that you can begin grading each clip in the state at which it was originally monitored during the shoot, or at which it was ingested using the Log and Transfer window.

Below you will find the process I went through for each of these clips. They began as RAW and Unprocessed, then were given an overall color correction when ingested into Final Cut Pro, then Color was used to get the desired look.

Unprocessed Image from RED Camera

Daylight Correction given in Final Cut Pro

Final Color Correction given in Apple Color
If you would like to see the Uncompressed images from above, download them here:

Download RAW RED Images Zip file

I know this article got a bit long, but I hope I was able to fully explain what I think is critical for any filmmaker to know before they step into a RED Production. I’d like to thank my friends Andy Bragdon, Charles Nwachukwu, and John Handem for letting me use their American Salesman production shoot as a reference to many of the points made in this article.
Call me crazy but, Condensation and 4k camera don’t seem like the best of ideas. It would be great to hook up a PC like liquid cooling system or radiator style off camera.

Don’t the DI that most films do help preserve the original quality of the 35mm? If you shoot, do a 1k scan for editing then go back and pull a 4k of just the timecode/frames you need you can pull in a 4k from the original and do a darn good laser print or go to digital format for DLP/Digital projection systems.

Do you have any shots of night footage and or handheld? What is the latitude like? I find that usually the quality of images degrades fastest with night shots, exposure of light sources/blown out areas and action shots shot with a long shutter.

Oh and 120 minutes to download the drive!?!?!?

I think the digital is impressive…but they aren’t there yet. Budgeting aside, I’d still go 35mm for a feature.

Yeah, that’s why we used just a few ice cubes and very tight zip lock bag. We actually changed the Ice Bag out several times in order to avoid water from leaking the bag. Surprisingly though, there was very little condensation. I agree, a PC cooling system would be ideal haha.

1K scan or editing and then going back to the film all over again? The whole reason of RED is keep everything simple with Log & Transfer in Final Cut Pro and having the ease of a digital copy right at your finger tips.

I haven’t seen any night footage yet of the RED, but remember that it does have a CMOS sensor which are very good sensors in low-light.

I think Digital will surpass film in the next few years as the technology of RED catches up.
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