From One-Light To Final Grade

This article discusses some of the different terms and workflows used by colorists. The terminology varies, and the techniques evolve but the concepts remain the same.

Color grading has always been an essential part of using film for video. Consequently the tools have become increasingly sophisticated, and expectations have risen. Now these same tools are being applied to film finished projects, where they are not essential, but they are expected. Color grading has huge production value. Yet with all the new tools and features, session times have remained much the same. Colorists have therefore had to discover better, more efficient workflows.
To begin at the beginning, there is no such thing as a one light. Of course I could set a single grade and let the film run, but most clients would reject it. If a one light transfer really worked, there would be fewer colorists, and color correctors would be less sophisticated. Usually the people that believe in one-lights also believe that it takes 60 minutes to transfer an hour of film, even if it's on 6 rolls, without cores and tails out.

The problem is dynamic range. The dynamic range of original camera negative (OCN) is simply too great to capture as high quality video with a single setting. It is also the reason that the auto correct buttons on telecines disappeared decades ago.

There are good reasons to do one-light transfers, but creating any sort of a master copy is not one of them. One-lights provide useful exposure information for the cinematographer, and can be used instead of a rush print. A rush print is a balanced film print, with a print out of the red, green, and blue printer light values used. A one-light telecine grade has no print out, but still shows differences in exposure. There have been attempts to mimic the RGB print out in telecine, but none have been commercially successful. A test chart shot specifically to set-up the one-light grade makes this type of evaluation more effective. Suitable charts vary from a simple Kodak card with black, 18% gray and white strips, or GretagMacbeth color patches, to more engineered products such as those supplied by Gamma & Density. Other than the rush print, the one light is the only way of checking exposure that has stood the test of time.

Ideally, when the final grade is *not* going to be from the original negative, there should be no colorist intervention at the initial transfer stage, and the tape or disk based copy should be an accurate digital copy of the negative. However, because of the dynamic range issues**,** this workflow generally uses a **technical grade** or a **calibrated scan**.

If the reason for requesting a one-light transfer is cost based, a colorist can gently ride the controls during the recording. If the material is consistent to start with, this produces a reasonable copy for offline editors. A best light is preferable for multiple location shoots, available light shots**,** cut negative jobs and finished programs.

Often the Director of Photography (DP) will prefer to do a best light to achieve the intended look early in post-production. This ensures that even early viewing copies look “correct”.

Tech lights: grade and record

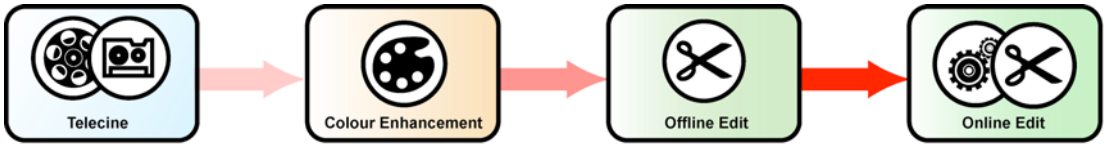
Actually, what most clients want when they ask for a one-light is a tech light. In a tech light the material is carefully balanced with blacks lifted about 5% and whites around 5% below clip. This grade avoids clipping out any important negative detail, and provides a good base for tape or disk grading later on. It can be pretty quick; a colorist will often search through multiple takes at high speed, checking and grading each new scene as necessary, then rewinding, and recording the material. No decision on the final look is made and it is common to only use the basic setup controls.

Nevertheless, the process has its limitations. It does not take into account deliberate in camera effects; it does not guarantee any sort of consistency, and in some cases of high dynamic range might be just as impossible as the one-light. Ideally, tech lights from any telecine or facility should match. This can be achieved up to a point, but is rarely attempted.

Gray scales, Macbeth charts, and Gamma and Density charts all add accuracy and control to a tech light. They do work well when used correctly, which is not as often as we might wish or expect.

Best Lights: record and grade

To grade both tech lights and primitive forms of best lights in a short time, the colorist can simply set a grade and record until it needs changing. This technique is great for large quantities of rushes, which contain many takes of the same scene. However, changing a decision later on is complicated, and the possibility of in-context grading is minimal.



Best Light Grade

A best light is a full grade of all the material. It is very common for music videos, and is still the preferred method for commercials in Japan. It is also making a come back among feature film directors and DPs because it ensures that the material is always seen as it was intended and because the offline edit then shows both the edit and the grade. In today’s global economy it is also popular for international campaigns. All the material is graded once and then distributed to other countries for local versions. The edit and language changes but the look remains consistent from country to country.

There are disadvantages though. Clearly more grading is necessary and even though the grade for a selected take can often be applied to several minutes of unused takes, the transfer time is much longer. Moreover, best light transfers are often done before there is an offline edit, so there is no opportunity to grade in context, and a lot of time can be spent on out-takes.

Calibrated scans

Nowadays it is possible to calibrate scans on telecines and scanners. Data-only film scanners are generally slow, and have few controls. They rely on the concept that it is possible to digitally capture all the useful information on a negative. While discussing one-lights, I intimated that this was not possible, but relatively recent developments have altered the situation. There are two methods of calibration:

i) Optimizing the scanner for the film
ii) Calibrating the scanner so that it can capture any film at a single universal setting.

The difference is important, and not emphasized enough.

Typically the scanner is optimized for each transfer. It means analyzing the actual film densities and adjusting the scanner to capture those densities within the working dynamic range. Simply put, it is calibrating for the minimum and maximum density. The advantages are that the scanner performs at its best, avoids noisy scans and can often automate the process. The disadvantage is that, by definition the scan setup is not always the same, and therefore cannot necessarily be duplicated without some knowledge of the first transfer. It can also mask valuable information about the original exposure. While it produces good results, it also implies that the scanner cannot truly capture the theoretical dynamic range of the negative, and is therefore selecting the important information and discarding the rest.

That may or may not be true, but in my view the universal approach is preferable if it is achievable. It means setting up the scanner to capture the theoretical minimum and maximum densities, so that any negative must fall within the capture range. Calibrating a scanner properly also requires that intermediate densities be mapped to known values in the digital range. This setup is always the same and therefore easier to repeat and as a bonus the scan accurately shows any variations in exposure and balance. The potential downside is that these scans will be flatter and might show up limitations in the scanning device.

At this point it is worth explaining that not all scans are done the same way. For example, bit depth determines how many steps the capture format can distinguish. 8 bit formats can reproduce over 16 million colors, but only 256 shades of true gray since true gray must have equal amounts of red, green and blue. 10 bit formats have over a billion colors and 1024 shades of gray. Film is credited with between 4000 and 16000 shades of gray so unless the data is scanned and recorded at 14 bits or greater, there will be some loss. In practice the loss at 10 bit is not as dramatic as the 15000 steps suggest, because a large number of those steps record only noise (unwanted

information). In order to minimize the loss of useful information however, many prefer logarithmic rather than linear scans.

Log and lin have nothing whatsoever to do with the differences between video and data or hardware and software, as might be assumed. It is just a different way of mapping the scan densities to digital numbers. Basically logarithmic scanning captures a greater dynamic range, and more detail in the darker regions.

Both log and lin assign a numeric value to a density step. For a linear scan each step is a uniform change, whereas in a log scan each step is twice the size of the previous one. The difference in dynamic range is easily illustrated with a chessboard. Imagine a grain of rice on the first square of a chessboard, and an extra grain of rice on each consecutive square, resulting in one grain on the first and 64 on the last – this is the difference between density steps when mapped linearly. Now imagine one grain on the first square and double the number on each adjacent square, which results in one grain on the first and over a quintillion (9,000,000,000,000,000,000) on the last; such is logarithmic mapping. The number of squares, or bit depth, is identical, but the difference in scale is enormous.

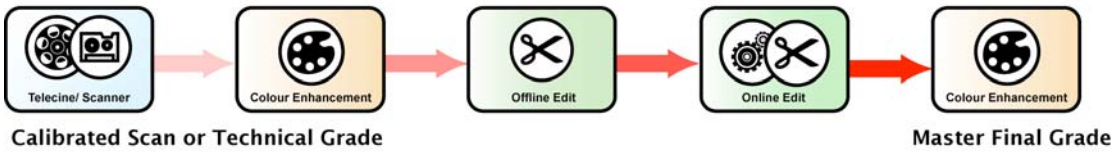
Log scanning makes it possible to capture the full dynamic range of any negative with 10 bits of information, but it is a form of compression and not lossless. There are still only 1024 steps. To capture the full range of film without loss, 12-14 bits are needed. Scanners that can achieve this support 16 bit output formats, but none of the hardware color correctors have 16 bit inputs. The latest Digital Intermediate (DI) scanners, telecines and software color systems do support 16 bit formats and I believe that these will improve post-production in due course. Unsurprisingly, Kodak has been a pioneer in exploiting the quality of film in digital systems.

Final Grades

The best light could of course be the final grade, but generally the term “Final Grade” is reserved for grading selected takes, and therefore paying more attention to detail. Final grades of selects are more likely to include dynamic changes and window tracking since the colorist knows exactly which frames will appear in the final edit. The client provides an edit decision list (EDL), preferably in source code order (C mode), which the colorist then grades and transfers with time code that matches the offline. In a telecine final grade, it is very time-consuming to shuttle and search for scenes in anything other than source order, so it is hard to visualize the final juxtaposition of scenes. Some colorists make an assembly edit as they go along, or at least use a reference store, in order to avoid surprises. However, as a result of these difficulties it is becoming increasingly common to tweak grades in the online edit.

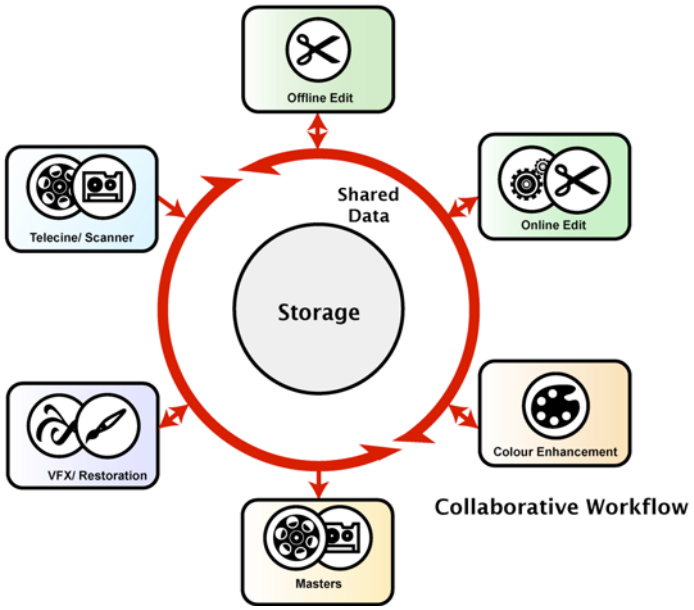
In Context Grades

Thus the trend now is to color the material as a conformed program, known as grading in context. This has always been the standard for long form, and indeed film labs, but it is rapidly gaining popularity in other markets.



The nearest a telecine can get to grading in context is to cut the negative. There are lots of reasons why this is now rare. There is the risk of damage and dirt, the original time code cannot be matched, it is time consuming, and anyway there are fewer neg. cutters offering the service. Today's in context grading is done from disk or tape. There are still differences between long form and commercial methods. Long form projects grade and record a master or sub master after the online. Most commercial facilities grade in context before or during online editing, but record or export the graded selects with handles as before.

Some still question whether there is more scope grading from a telecine than there is from scanned data. Back in the 20th century I was among the skeptics, but now I am certain that the best results come from grading a calibrated scan with software color tools in context. It is more efficient and more flexible, so a steady transition to this workflow can be expected.



Happy Coloring!

Kevin Shaw is a freelance colorist, instructor, and consultant for film, video and data projects.

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 www.finalcolor.com kevs@finalcolor.com