

## Negative Workflow from Capture to Print

**Mark D Segal and Todd R Shaner**

No, this is not about the power of negative thinking applied to your workflow; rather, we are rethinking the already trodden path of digitizing, converting and processing negatives using a camera rather than a scanner for digital capture. While much has been written about this topic we make no apologies for revisiting it, the objective being to determine what we hope to be very easy, high quality procedures for doing this. We think we've succeeded and the purpose of this contribution is to share our findings.



Stained Glass, La Basilique Notre Dame de la Paix  
Yamoussoukro, La Cote d'Ivoire  
(Camera capture of colour negative)  
Photograph © Mark D Segal, 1997 & 2014

There are millions of people with many more millions of negatives in their family or professional archives. While they can sit intact indefinitely with appropriate storage,

these days if we want to do anything with them, some kind of digital process will be involved. There are few commercial labs making prints in chemical darkrooms, prices are high, and most people printing photographs at home use their computers and inkjet printers; or they don't print and simply want to share photos on their mobile devices or over the Internet. The digital revolution has been so quick and so thorough that even the mediating hardware of the 1990s – the high quality scanner – has been rapidly passing into history. Yes, you can still find some truly high quality dedicated film scanners, but the scarcity is real and prices range from several thousand dollars upward (really upward!). And for those of us who are fortunate enough to own these discontinued scanners, what happens when they expire? The alternative is to do without a scanner and capture the negatives with a digital camera. Even those who own functional high quality scanners may find the speed and efficiency of a camera-capture workflow relatively attractive.

What do we mean by “high quality”? To us, “high quality” means enough resolution, resolving power, sharpness, “colour credibility<sup>1</sup>” and smoothness of tonal gradations to make prints with fine photographic properties at least up to 13\*19 inches from good quality 35mm and medium format original media. This is judgmental and other people may have different needs and standards, but to set the context and the criteria, those are ours.

Before entering into the technical details, a bit about our research procedure. We worked independently but in close contact using different images and capture conditions described below, but we emerged with the same conclusions, which is indeed reinforcing. We tested a number of approaches involving different brands of software and ways of using it, but our focus in this write-up is on what we found worked best – the criteria being output quality, use of time and software usability. We came into this research with no agendas and no preconceptions, only the objectives<sup>2</sup>.

We provide here a relatively high-level overview of our preferred procedures, with enough process description to understand them; however, we do not provide detailed instructions on the general use of the software deployed. That is readily available elsewhere.

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<sup>1</sup> We don't think “colour accuracy” is a viable concept for a great many photographic purposes, hence prefer to think of colour in terms of “credibility” or artistic merit.

<sup>2</sup> We observe there are participants in forums who take passionate positions for and against various brands of software; for us, software is just a toolset, a means to an end, and we recommend this approach in any forum discussion our article may elicit.

## Resolution, Perceived Sharpness, Etc.

We begin with a brief discussion of resolution, because it is a fundamental underpinning of image size and quality that these techniques can deliver. Resolution – quite apart from perceived sharpness or focus – is “pixels per inch” (PPI). PPI of course can affect perceived sharpness. One of the optimum resolutions for Epson professional printers, for example, is 360 PPI. Therefore a print made at this optimum resolution needs a digital file of 3600 total pixels along one dimension for a corresponding 10 inch dimension ( $3600/360 = 10$ ). If the longest capture dimension were, say, 6000 pixels, at 360 PPI, you could reproduce that dimension at 16.7 inches with no resampling. If the aspect ratio (length/height) were 1.5, the corresponding smaller dimension would be  $16.7/1.5$  or 11.1 inches – let us say roughly 11\*17 inches of printed surface, which happens to nicely fit a 13\*19 sheet with a one each border all around. This also happens to be the aspect ratio of a 35mm negative, which is  $36\text{mm} \times 24\text{mm}$ , or  $36/24 = 1.5$ ).

Now, when you look at scanner specs and the manufacturer says the resolution is say 6000 dpi, they really mean SPI or PPI (dpi is dots per inch, but scanners don’t make dots, they make samples, which they render as pixels per inch). They are most likely telling the truth about what the sensor array can capture, but this doesn’t mean the resolving power of the imaging system (the extent of detail you can distinguish) is the same as the stated resolution. The same applies to cameras. Resolving power depends on lens quality, light handling and other factors. It is best discovered using a measurement target that reveals line pairs (alternating black and white lines) per millimeter and converts those observations into approximate PPI-equivalents. One such target is the SilverFast Resolution Target based on the USAF 1951, and accompanying instructions (Figure 1).

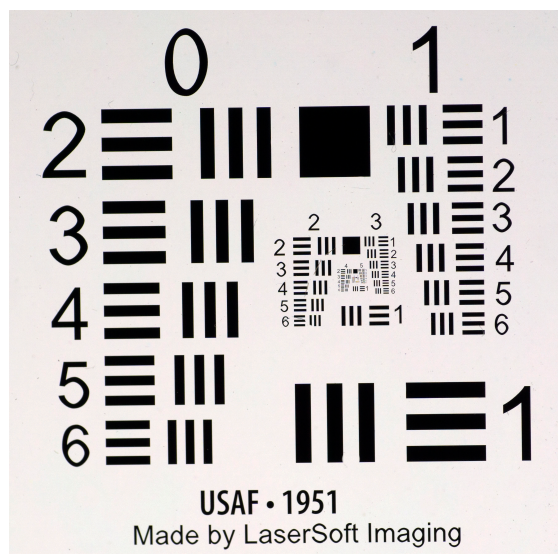


Figure 1 Resolution Test Target (cropped)  
(The “rubber hits the road” in the center areas you can hardly see!)



Mark tested his Nikon Super Coolscan 5000ED scanner, Epson V750 Pro scanner and Sony a6000 mirrorless digital camera using this target and determined that the resolving powers of each were equivalent to 2896, 2299 and 3251 PPI respectively. Surprised by these values, he looked at the target itself under a 30X microscope and found that all the lines in the very small Groups/Elements whose distinctiveness would indicate higher resolving power are indeed properly printed and separated in the target. So the results aren't constrained by the target quality<sup>3</sup>. Relatively speaking, the camera wins. But do you see the difference in reality? Mark checked, photographing and scanning (in the Nikon scanner) the same 35mm colour negative (ISO 100) and magnified the same small portion of the photo at 1:1 on his NEC PA 271 display (Figure 2).



Figure 2 Sharpness Comparison – Scanner versus Camera, Grain Adjusted  
(Figure 2A below shows the full photo)

The photo selected for this comparison has five relevant features: (1) it was from a roll of ASA 100 negative film Mark shot in 2002 for testing a new, highly recommended Nikon 28-135mm zoom lens, (2) the photo contains the conventional brick wall for judging line and texture sharpness, (3) the light was at a good angle for bringing out texture, (4) it also contains contiguous flat un-textured surfaces that are really good for showing film grain and (5) it has nice edges.

<sup>3</sup> Not clear, is whether our monitors and printers can reveal the full range of the very small line-pair distinctions in the SilverFast target even if the capture system could capture them distinctly. However, if the viewing conditions were the critical limitation it would apply only to the highest value in the comparison.





(Figure 2A – the full photo relative to the 1:1 snippet of Figure 2)

To make the comparison relevant to how a photo would be edited for viewing, Mark applied the same capture sharpening to each (starting from the “Scenic” sharpening preset in Lightroom). The grain pattern comes out very differently between the two technologies, whether before or after capture sharpening. Relatively speaking, in the Nikon scan it is harsher and more uneven. In the camera capture it is more diffuse and less uneven. This may very well be due to the differences in lighting between the two technologies, bringing to mind an analogy of the results produced between the condenser and diffusion enlargers of yesteryear.



(Figure 2B. Grain Comparison Before Processing)

The problem with grain, especially involving textured surfaces, is that one can easily mistake it for image detail when it is not and erroneously believe that the grainier looking photo is sharper (Figure 2B). Therefore it only makes sense to approximately equilibrate the appearance of grain between these versions for an apples-to-apples comparison of processed real image detail. This meant adjusting the Noise Luminance and Detail sliders in the Nikon scan to reduce its grain appearance to approximately that of the camera scan (as seen in Figure 2). Weaker capture sharpening could have been applied to the Nikon scan, but this preserved less detail than using the sharpening preset combined with noise mitigation for smoothing grain. Todd had the same outcomes and same considerations using another image and a Plustek 7600i scanner.

The upshot of this comparison is that at least for this equipment there is no unambiguous winner. The camera scan does emerge looking somewhat cleaner, but in respect of edge sharpness and detail retention, there isn't much difference when examined on a high-resolution display, and for that matter – nor in print. Mark printed both the camera capture and the scanned versions of the full photo at 13\*19 inches on Ilford Gold Fibre Silk in his Epson 4900, had his spouse “peer-review” the outcomes, and we agreed they are essentially equivalent. The good news is that with a good quality camera, lens and capture set-up (e.g. as discussed below), the resolving power of the camera can at least equal that of these better quality prosumer scanners.

### **Mark's Capture Set-Up**

(Mark speaking): My capture set-up is a Sony a6000 mirrorless digital camera (24 MP, APS-C sensor, 6000\*4000 pixels raw) equipped with the new and very high quality Zeiss Touit Makro f/2.8 50mm lens, e-mount. It has no image stabilization (or OSS in Sony-speak), but being used in a stabilized set-up (and usually stabilization should be turned off when photographing with a stabilized camera anyhow). Sony has a remote shutter release app (for iPhone and Android), that provides a “Raw + JPEG” format capability, and the camera can be set to a time-delay, allowing the camera to become totally still before exposure. For this lens, f/5.6 at about 1/25<sup>th</sup> second seems optimal, but for added depth-of-field f/11 at ¼ to 1/6<sup>th</sup> of a second works well too.

Using the equipment I already own, I mount the camera on a Gitzo tripod with the column rotated 90 degrees, using an Arca-Swiss Cube and a Revo 23” Track Slider (Figure 3 overleaf). This is an expensive set-up allowing extremely fine control over all angles of camera positioning; far cheaper set-up equipment would do fine as long as it can be steadied and leveled. I tested the leveling and sharpness of the whole set-up by photographing a 24\*36mm segment of a plastic calendar at 1:1 magnification, and the results (Figure 4 overleaf) are very satisfactory. Every fine detail of the lettering, dirt and surface imperfections show, perhaps less fully in this illustration, but seen on a 13\*19 inch print, the detail rendition is impressive.





Figure 3. Mark's Capture Set-Up (for 35mm film)

To backlight the media, I use a small light table providing near-neutral lighting (measured in  $L^*a^*b^*$ ).  $L$  is about 60;  $a^*$  and  $b^*$  don't vary from zero by more than  $\pm 1.0$  across the image. Measured in Lightroom, "As Shot" temp is 4800 and Tint +10.

At night, there are no special lighting precautions needed for the capture – I keep the room lights off. In daylight I have a black cardboard shield to keep daylight out of the set-up. I allow the light table enough time for its light to achieve full output and be evenly distributed before making the first exposure.

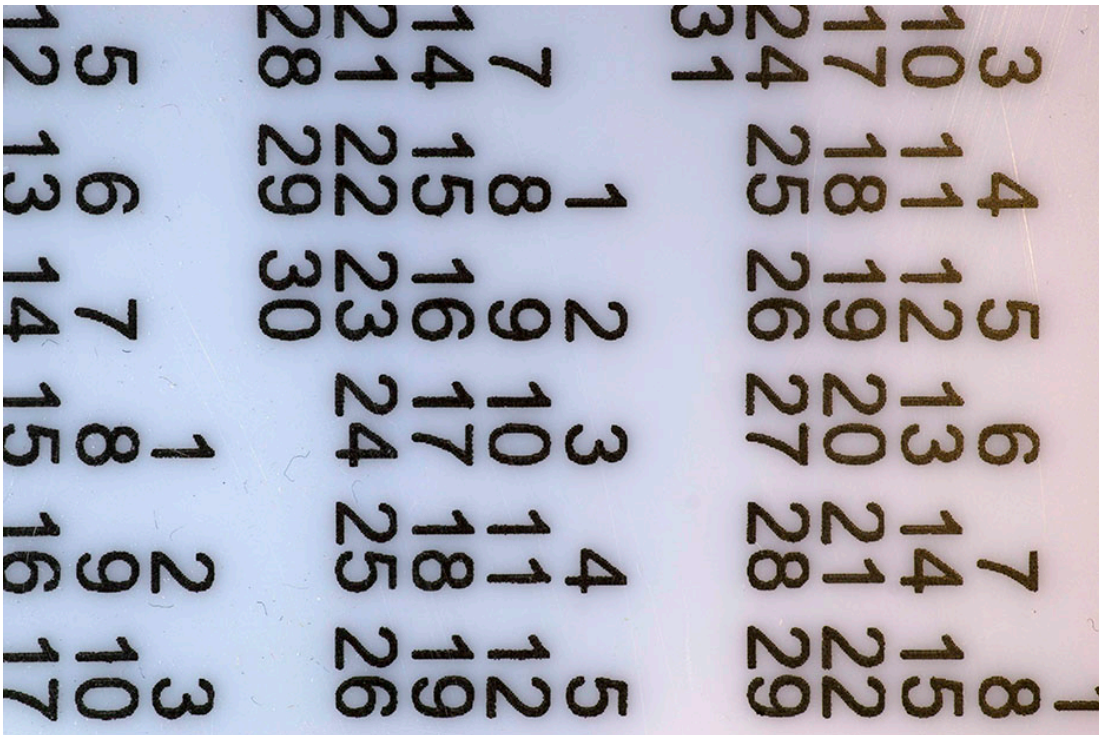


Figure 4. Sharp Test (lighting range intentional)



This camera/lens combination can fill the sensor with a 35mm frame as well as auto-focus and auto-expose the media properly. Typical histograms, as interpreted in Lightroom, for captured colour negatives are shown in Figure 5.

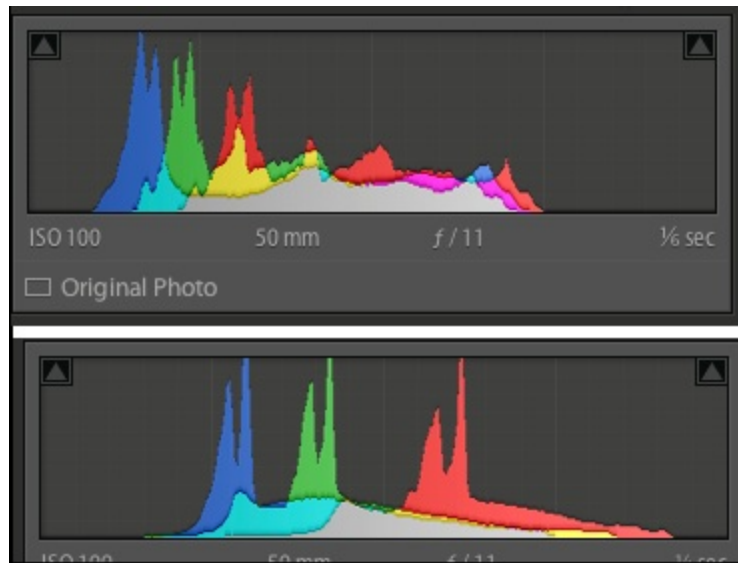


Figure 5. Typical Histograms – Camera Capture of Colour Negatives

To photograph medium format media, I slide the camera up the Revo Track till one of the dimensions hits one limit of the sensor frame dimensions. Of course, cropping a medium format negative simply means lowering the camera down the track and repositioning the media till the desired content fills the frame.

Good quality film holders from Epson or Plustek can hold flat-stored negatives flat enough for sharp focus at around f/11 (where appearance of adequate depth of field is in the range of one to two tenths of an inch for this lens and the short distance used in 35mm media capture). For curly media, the film can be affixed to the light table with film cleaner – then work rapidly before it evaporates!

Captured Raw files should be processed in 16-bit ProPhoto space.

### Todd's capture set-up

(Todd speaking): my capture setup (Figure 6) uses a Canon EOS 5D MKII body (21 MP, Full-Frame sensor, 5616 x 3744 pixels, CR2 raw) equipped with a Sigma 50mm F/2.8 EX DG Macro lens (1:1 closest focus) in Canon EF mount. The camera and lens do not incorporate image stabilization. I assure vibration-free exposures by using a Canon 430 EXII Speedlite (<1/1000<sup>th</sup> second Duration) and custom lens hood for blocking ambient room light from the film surface facing the camera. The camera is remotely controlled using the Canon EOS Utility with the camera in Live View mode. The EOS Utility provides remote control of the shutter release, live preview image, camera settings, and flash settings.

If required the images can be automatically imported into Lightroom real-time using a 'Watched Folder.' I normally use Lightroom's 'Synchronize Folder' function after capturing a group of images so that I can add metadata for film type, subject, location, date, and any other pertinent information that will be useful when editing, cataloging, and archiving the images. I also have RawDigger open for real-time monitoring of the image capture folder so that I can confirm actual raw data highlight clipping and under-exposure. Image exposure is adjusted using the manual flash-ratio setting on my Canon 430 EX II Speedlite (1/16 output power typical) with the wide-angle diffuser, ISO 100, F8, 1/200 Second (max. flash sync speed) on my copy setup.

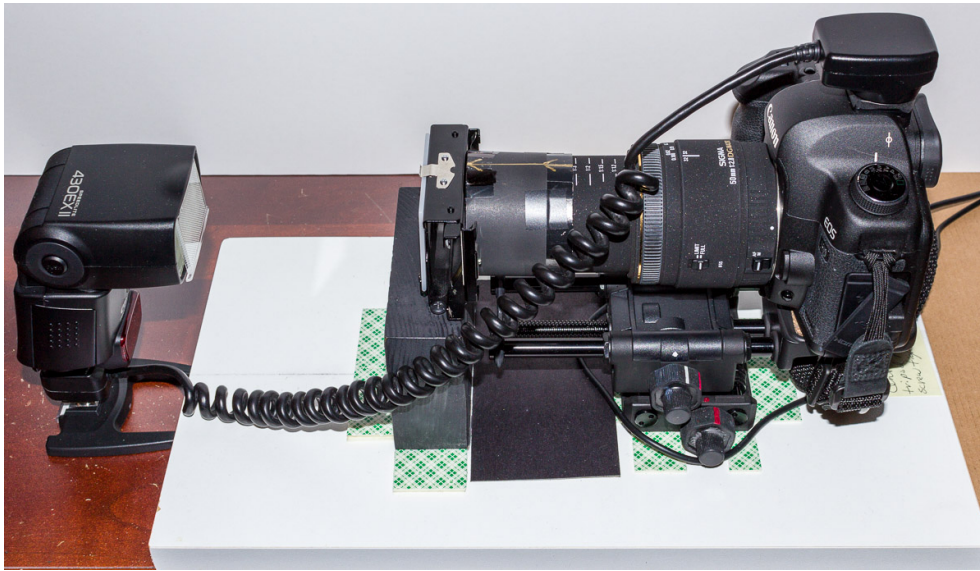


Figure 6. Todd's Capture Set-Up

The camera is mounted on a Velbon Super Mag Slider used for horizontal centering of the camera and real-time live-view focusing. A 35mm slide holder from a Spiratone Vario Dupliscopes is bolted to a  $\frac{3}{4}$ " particle board along with the Velbon camera mount. Negatives are accommodated using a 2" x 2" plastic slide mount modified to accept 35mm film strips. The Canon 5D MKII is powered by a Canon ACK-E6 AC Adapter Kit for unlimited shooting time in live-view mode. The Canon 430 EX II seems to run forever at 1/16<sup>th</sup> flash output using Panasonic Eneloop NiMH batteries.

For best results ambient room light should be blocked from the lens side of the film emulsion. I accomplish this on my copy setup using a lens shield made from thin cardboard that I sprayed with ultra-flat black paint, cut, and formed into a cylinder of the correct diameter to fit over the lens (see figure 6). The Canon Speedlite flash colour temperature is high at ~6200K, but the light diffuser on the back of the slide holder lowers it to near 5200K Daylight setting, as seen in Lightroom.

Eliminating vibration is necessary for sharp captures. Some Canon, Nikon and other camera models implement an 'Electronic First Shutter Curtain' (EFSC) that can be enabled in 'live view' mode. This provides vibration-reduction when using longer exposures with tungsten, halogen, or fluorescent light sources. A Canon Speedlite can only be triggered by the mechanical first shutter curtain, which prevents using EFSC mode. However, the short electronic flash duration ( $<1/1000$  second) prevents vibration from affecting image quality. With a flash light source it is important to keep the ambient room light low, use a low ISO setting, and the highest shutter flash sync speed. It is also important to block ambient light from hitting the lens side of the film, which may "fog" dark areas of the image.

A further comment on the relationship between the lighting set-up and the rendition of detail: Mark and I noticed our camera scans had fewer visible dust spots and scratches compared to our scanner output and as discussed above, film grain was less pronounced. Figure 7 shows a 100% crop of a Fujifilm Super G100 color negative scan from a Plustek 7600i (3600ppi) and Canon 5D MKII 21 MP camera copy with similar resolution. Both have the same sharpening and noise reduction settings applied in Lightroom. The scanner provides harsher rendering of grain and dust and scratches. Once sharpening and noise reduction are applied to reduce the grain it becomes apparent that the camera capture holds real resolution and edge detail, as well as reduces dust spots and scratches. Hence, especially because infra-red detection/removal of dust and scratches is not available in camera capture as it is for a number of film scanners, we both recommend using a diffuser with the light source in order to eliminate a lot of manual clean-up.

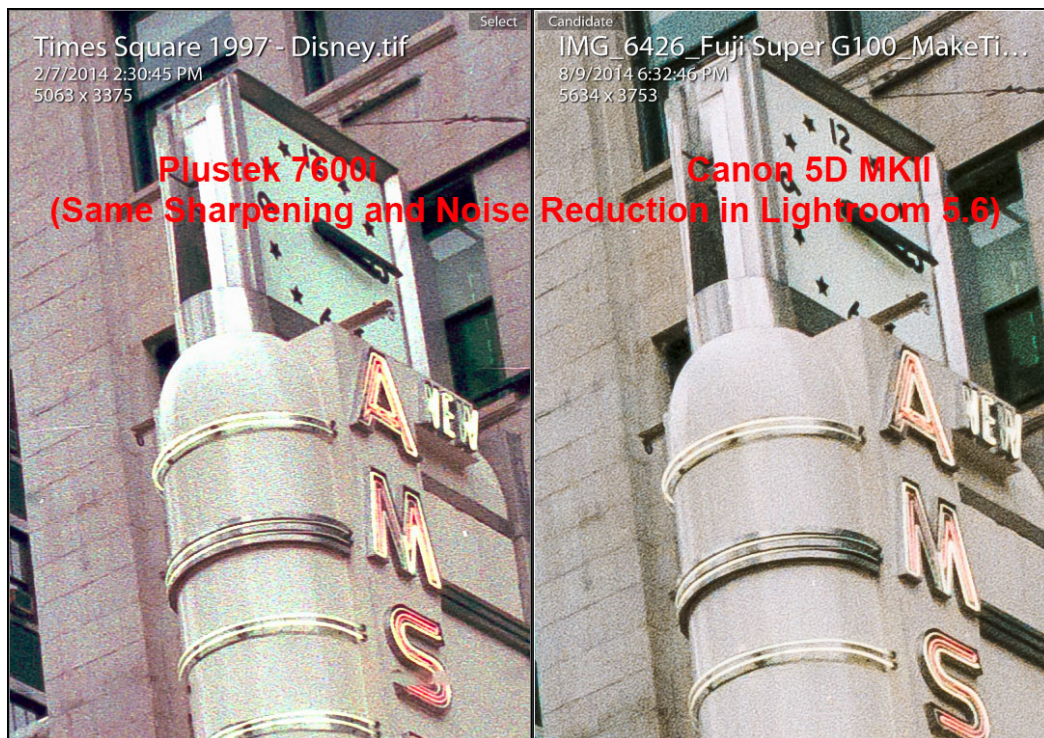


Figure 7. Grain and debris, scanner (left) vs, camera (right)



## Processing Colour Negatives (Mark: “The MakeTIFF to HDR8 Approach”)

A good part of the story here is the need to neutralize the orange mask, invert the colours and achieve satisfactory contrast. We both put a lot of time into trying this with Lightroom, because it would have been nice to have a highly satisfactory “one stop shop” keeping the whole workflow in raw parametric editing mode from ingestion to print. But it wasn’t very satisfying. The “orange mask” (not all of them are orange) distorts white balance and affects contrast. Lightroom was not designed for this kind of process. While inversion from negative to positive can be done by reversing the Tone Curve in Lightroom, doing this step first affects the malleability of other tonal adjustments, and the orange mask removal stresses the application’s range of colour control quite severely for that one operation, is very finicky to get right, and presets are not universally helpful, hence “Lightroom alone” is not a preferred approach.

Based on the need to both “render and invert”, the reasoning guiding our research through other options was that (i) the raw file would be rendered into a 16-bit/channel linear TIFF file, and (ii) the best inversion from negative to positive would be obtained using software that has bespoke algorithms for converting gamma = 1.0 TIFF negatives into properly de-masked positives. Hence there would be a two-step procedure beyond capture: (1) make a linear TIFF of the negative capture, and (2) invert it and de-mask it.

One option is to do most of this in Photoshop as Todd describes further on. Mark, however, developed another route altogether, which is, to say the least, eclectic; but has few steps and works well. ColorPerfect<sup>4</sup> (CF Systems) has a sister application called “MakeTIFF”. It does exactly and only that: all you do is drag a raw file (or any number of them) over its interface (Figure 8) and it makes linear TIFFs – period. It provides very few options and can be mastered in about 30 seconds. The resulting file it produces looks like a dense useless mess (Figure 9 center), but don’t be fooled – it’s golden.

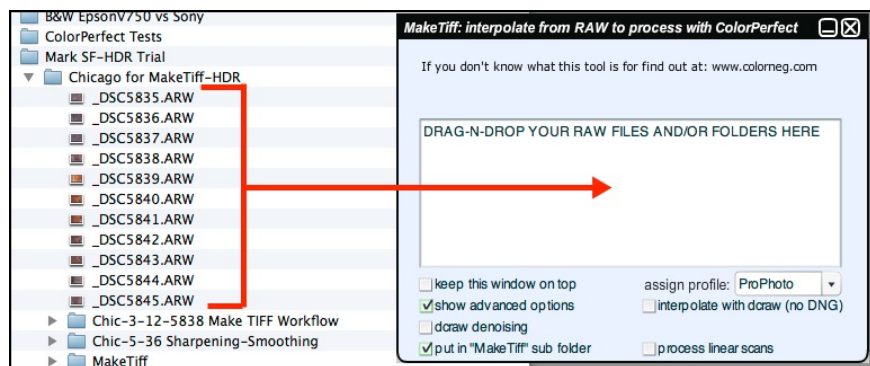


Figure 8. RAW file to MakeTIFF (Does batch processing.)

<sup>4</sup> CF Systems recommends NOT using their ColorPerfect application for treating colour negatives captured with digital cameras. MakeTIFF, though, is VERY useful.

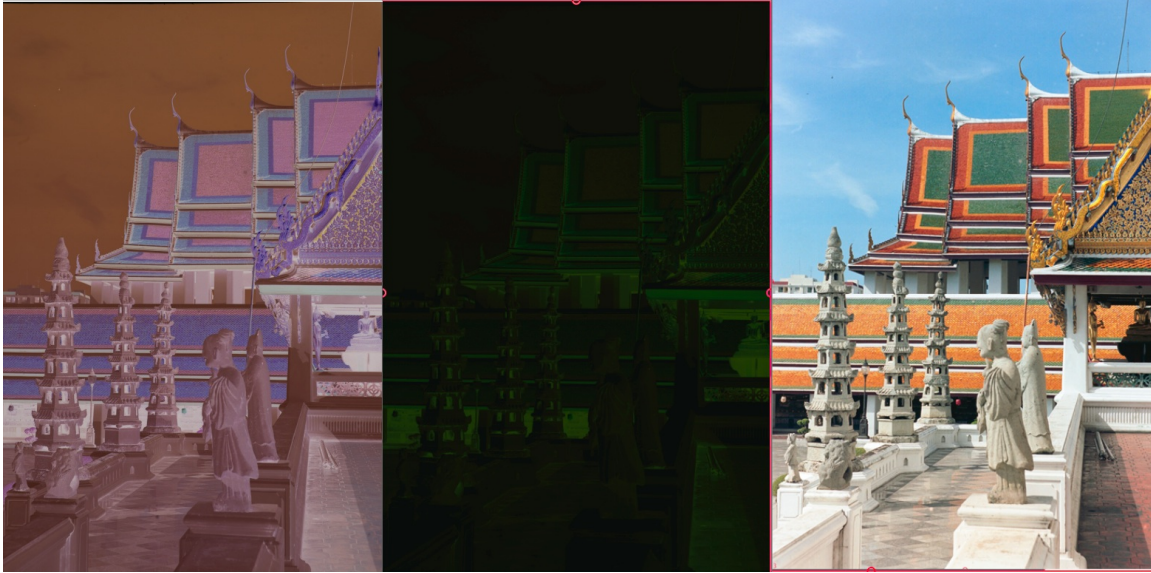


Figure 9. Sony ARW raw (left) to MakeTIFF (center) to HDR8 Processed Positive (right)  
(Wat Suthat, Bangkok, 2004; Fuji Realia ASA 100)

The TIFF file created with “MakeTIFF” is then opened in SilverFast HDR8 (Figure 10); make sure it is set to Negative mode when it finishes opening from the VLT.

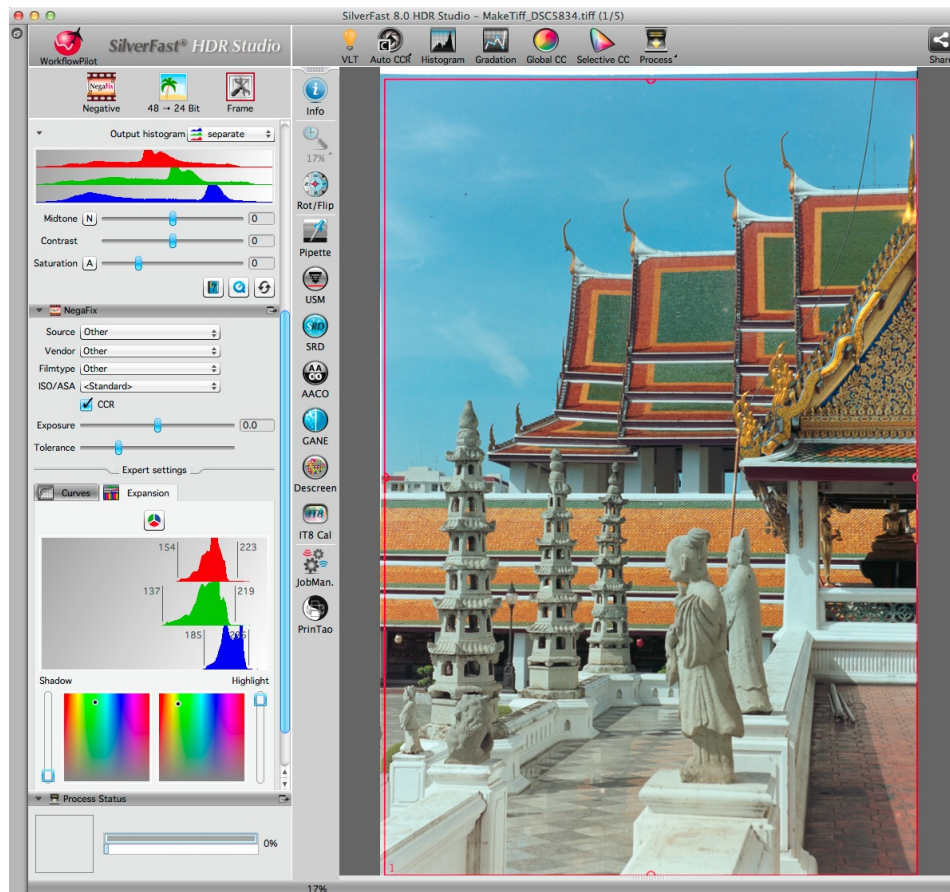


Figure 10. “MakeTIFF” file opened in Negative Mode in SilverFast HDR8 - Unadjusted



This triggers SilverFast's NegaFix tool (Figure 10, left side, bottom), which produces good inversions and demasking of negatives to positives. There is a default setting in the NegaFix profiles called <other>; it uses none of the custom film/scanner profiles in NegaFix, (perhaps not relevant to camera capture anyhow); this default set does a decent first pass at inverting and demasking the MakeTiff file all by itself. From there, one may refine it in different ways. An amazingly effective, instantaneous approach is to simply click on the "Auto CCR" button in SilverFast HDR8 and this often sets everything just about right (Figure 10A, compare with the opening conversion in Figure 10).

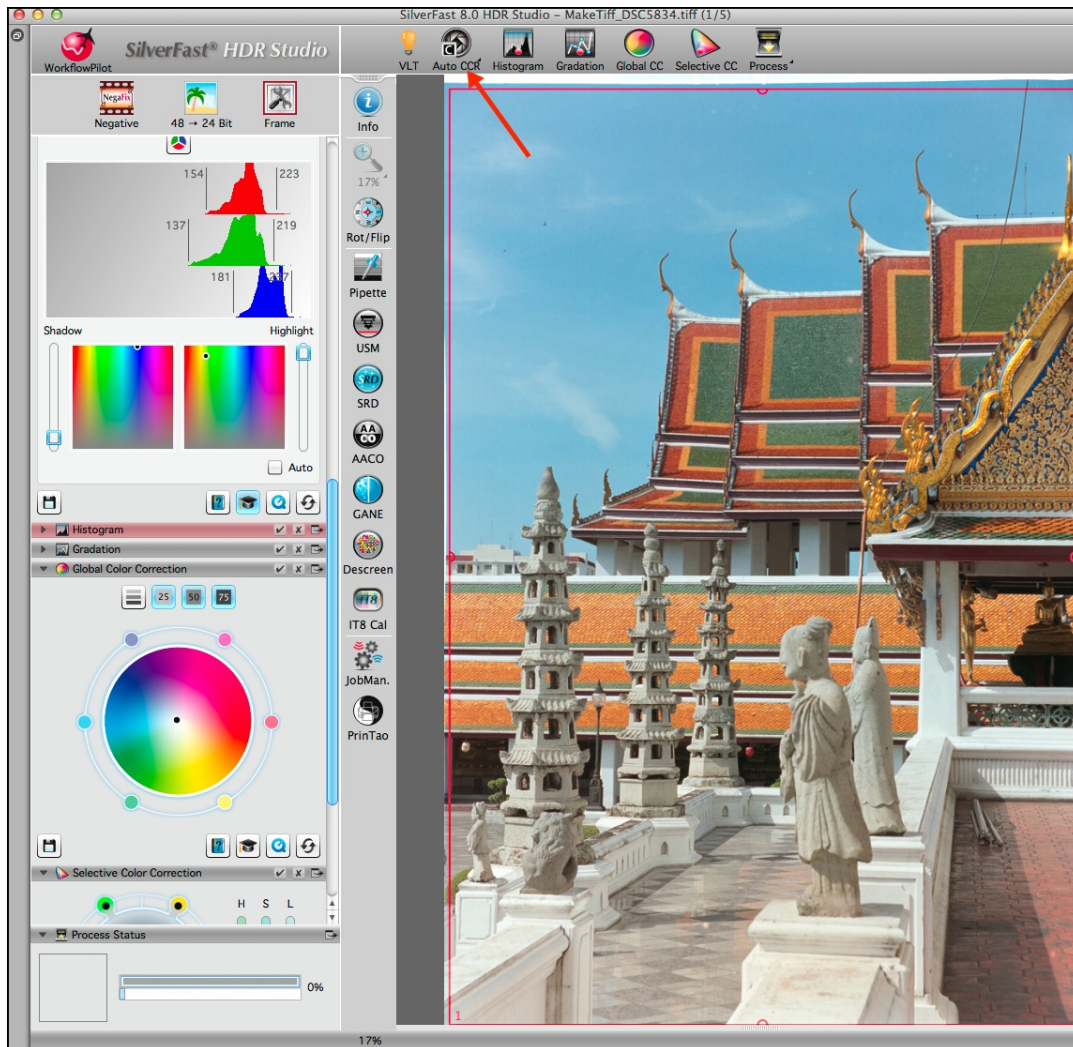


Figure 10A. Largely Corrected Colour Balance with one click of "Auto CCR"

If this seems too easy, or if the inverted result emerges from Auto CCR still with a **general** colour cast, there are very effective additional correction tools in HDR8 :

**(1) NegaFix:** test the various NegaFix profiles, or use the granular controls provided in the NegaFix tool interface. The real strength of NegaFix in SilverFast HDR8 is not only the decent "opening inversion", but also the very effective toolset it provides for adjusting results or crafting custom profiles for film that has identical properties.



GENTLY tweaking either the individual colour curves or the end-points of the individual colour histograms in the Expansion tab of the NegaFix Expert dialog (Figure 10, left side, bottom) can neutralize a cast.

**(2) The Neutral Pipette:** Click the Neutral Pipette on any part of the photo that is meant to be grey. Very much like the White Balance tool in Lightroom, this tool rebalances all the colours accordingly. However, the Neutral Pipette in HDR8 has a unique ability to fine-tune white balance by allowing the user to set four neutralizing points in the same photo.

**(3) Global Color Correction (GCC) Tool:** Click or drag the adjustors in the colour wheel (Figure 10A, lower left) to eliminate a cast. For tweaking the NegaFix curves, NegaFix Histograms or the GCC controls, the general rule is to either back-off the colour group having the cast, or back into the colour group that is the opposite of that causing the cast (“same difference”). The GCC interface makes these adjustments quite intuitive (e.g. drag the black dot in the center of the wheel away from the cast) and they can be independently implemented for highlights, mid-tones and shadow tones.

**Selective Color Correction (SCC) Tool:** If the inverted result emerges with **only one or several** colour ranges slightly “off”, deploying SilverFast HDR8’s SCC tool (Figure 11 overleaf) is a very quick, easy and effective way to edit those colours for hue, saturation and lightness. All you do is click on the colour that needs editing, and use the Hue, Saturation or Lightness sliders in the tool interface to taste. Getting the file “about right” in HDR8 and saving the positive version to one’s hard drive as a TIFF is easy to do and allows maximum editing headroom in successor applications (Lightroom, Photoshop, etc.) to which this file may be sent.

Speaking of which, if you wish to import the photo to Lightroom/Photoshop and edit further or print the photo from there, make sure that in HDR8 General Preferences Gamma 2.2 “for HDR Output” is checked (Figure 12).

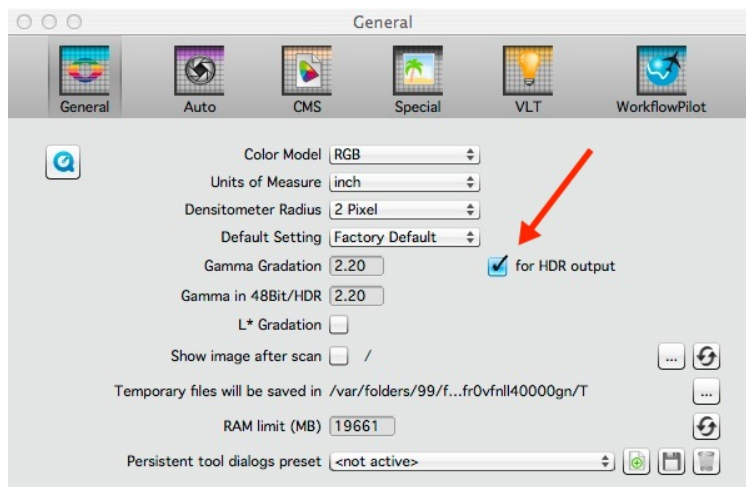


Figure 12. SilverFast HDR8 General Preferences

Finally, there are options for printing. Do the finishing touches in HDR8 and print directly from HDR8 using LaserSoft Imaging's directly accessible (Figure 13) PrinTao application; or open the TIFF file in, for example, Lightroom or Photoshop, making final image edits and printing from there.

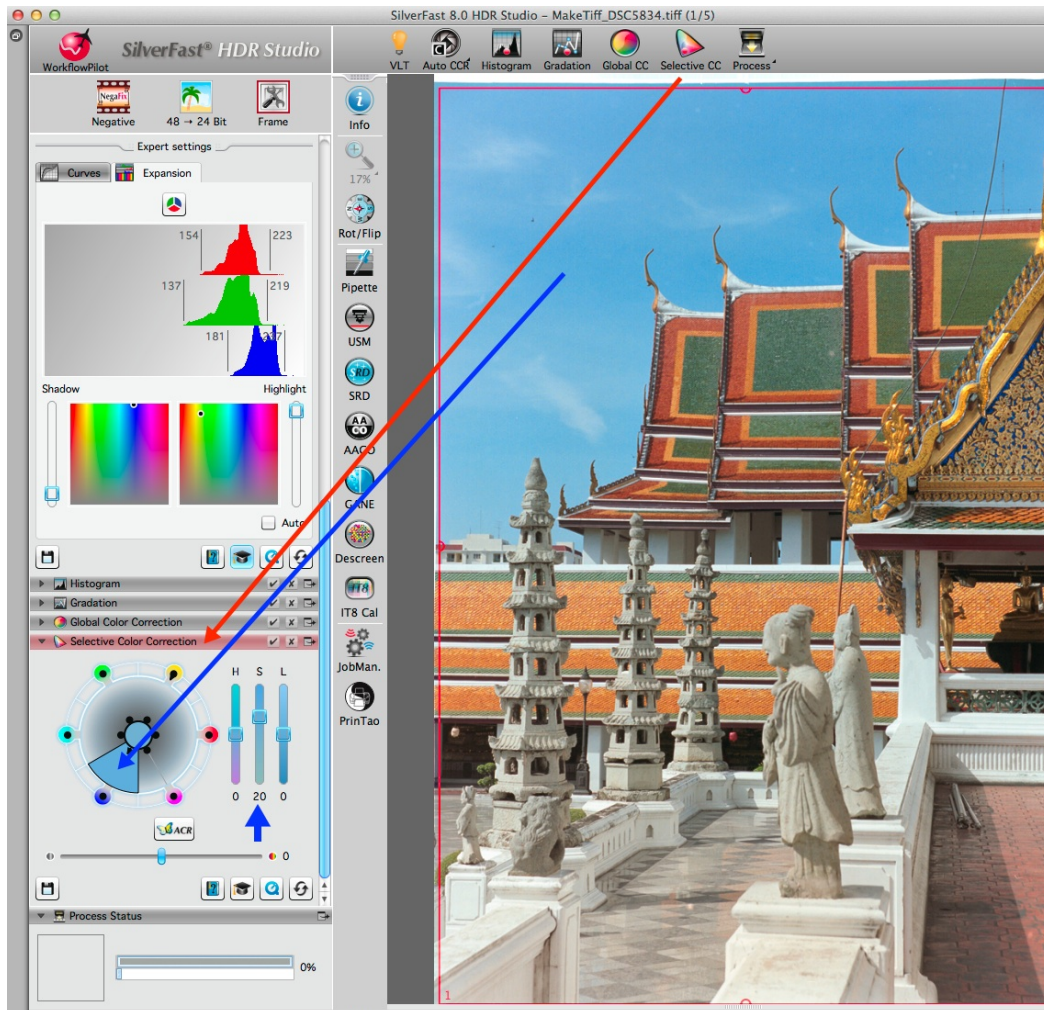


Figure 11. Selective Colour Correction: Increase Blue Saturation of Sky



Figure 13. Access PrinTao from HDR8 by Clicking the PrinTao Button, which opens the photo in the PrinTao application.

## Colour Negatives (Todd: Mainly Photoshop)

Is it possible to process color negative camera raw image files and SilverFast HDR 48 Bit archive scanner files using Photoshop and get good results? I'm happy to tell you there is a Photoshop processing procedure that provides very good results and is relatively easy to use. Photoshop adjustment layers are used for mask removal and color-correction to enable a non-destructive workflow. The Photoshop processed image files can be imported into Lightroom, edited, reopened in Photoshop for refining the negative image adjustments, and the edits will appear automatically in Lightroom after saving the file. I performed the following procedure and screenshots on a Windows 7 system, using Photoshop CS6 to process Canon 5D MKII CR2 raw files. Almost any version of Photoshop and Adobe supported camera raw files or DNG files will work with this processing procedure. You can also process SilverFast HDR archive image files using this Photoshop workflow.

### Photoshop Processing Steps

- 1) **Mask removal:** Levels Adjustment Layer> Gray Point Sample
- 2) **Invert Image:** Invert Adjustment Layer
- 3) **Color Balance and Set White & Black Points:** Curves Adjustment Layer> Auto Tone> Gray Point Sample

It is important to crop all areas of the Photoshop document that are not part of the actual picture frame (unexposed emulsion and film holder frame) and repair large scratches and dust spots that may influence the image histogram. This improves accuracy of the Levels and Curves controls when removing the orange mask and establishing White Point, Black Point, and Color Balance. It's very difficult to see the defects and sometimes the edge of the photo frame until the orange mask is removed and the Curves layer is applied adding contrast to the image. Hence, cleanup and framing is performed in step (5) in the below workflow procedure. I've created a Photoshop Action for establishing the required adjustment layers, which significantly reduces the number of processing steps. When using the Photoshop Action follow the instructions in step 1 below and then jump right to step 5.

(1) Open the camera raw color film copy image file inside Photoshop using Adobe Camera Raw (ACR) with the 'default' settings, Adobe Standard camera profile, ProPhoto RGB color space, and 16bit/channel. If you use the 'Auto' White Balance setting in your camera the ACR 'As Shot' settings will be incorrect. This will require manually entering the proper 'White Balance' settings for the shooting light source (Flash, Tungsten, Custom). If necessary adjust the ACR Exposure setting so that the image data is centered in the Histogram between the Black and White endpoints. Increase the Exposure setting until the image data barely compresses at the Highlights end (i.e. Image Adaptive Control Wall) as shown in Figure 14 below. If you have to decrease The Exposure setting the image is probably over-exposed and should be reshot for best results.



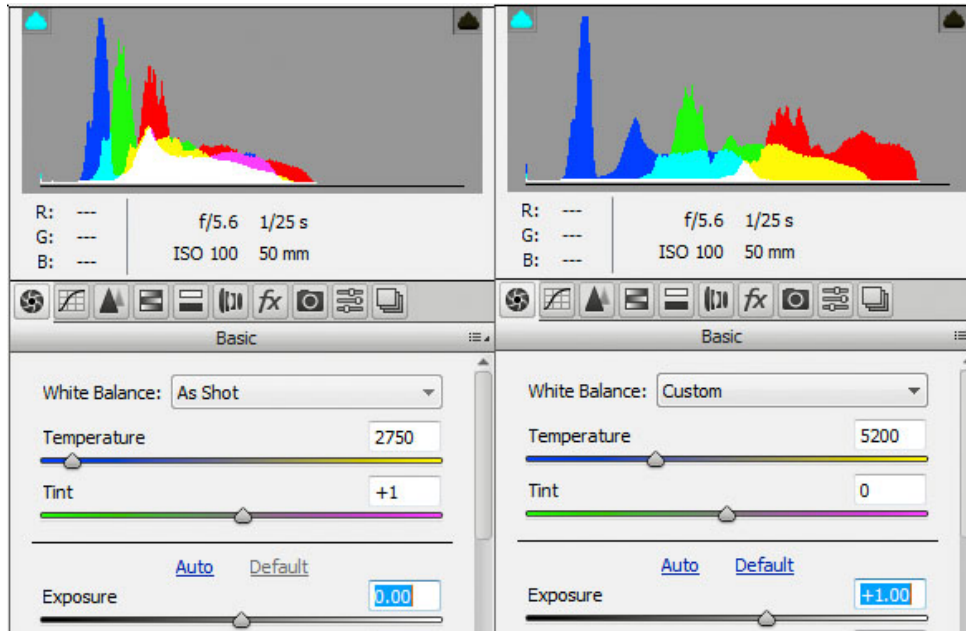


Figure 14. White Balance Adjustment (left, before; right, after)

(2) Create a New Adjustment Layer> **Levels** and click on a neutral color mid-tone area with the 'Gray Point' eyedropper to automatically remove the orange mask. Any image area that is neutral will work including the unexposed area between the negative frames or sprocket holes; however, I've found using an identifiable neutral midtone area provides the best results. When using film areas outside the picture frame you will need to shoot one extra camera image **for each set of negatives shot with that specific roll of film**. Film emulsion of even the same film type will vary from batch to batch, differences in wet processing, age, and storage conditions. If you haven't kept your negatives together for each roll of film then this method may not provide good results.

Make sure to set the 'Sample Size' in the upper left-hand side of the screen to '11 by 11 Average' or larger. Using the largest 'Sample Size' setting that fits inside the area being sampled will provide the most useful reading, as it averages "outlier" pixels that may otherwise be selected with smaller sample size.

(3) Create a New Adjustment Layer> **Invert**, which works best when placed **after** the mask removal step.

(4) Create a New Adjustment Layer> **Curves** with the 'Auto Option' settings of Figure 15 below. You have the option to set Shadows and Highlights clipping points separately, which may be beneficial for some images. A setting of 0.01% works well with most images and retains near maximum dynamic range.

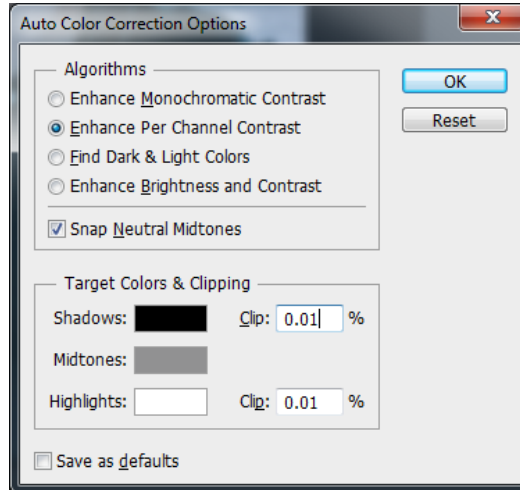


Figure 15. Auto Color Correction in Photoshop

(5) Use the Crop tool to remove all unexposed film border or film holder areas that are visible in the document frame. This is also a good time to repair large scratches and dust spots that may influence the Histogram accuracy. Once completed, the Levels mask removal and Curves color-balance controls need to be recalibrated with the cleaned histogram in the following steps.

(6) Use the Levels adjustment layer's 'Gray Point' eyedropper to remove the orange mask as outlined in step #2. When making this adjustment the Curves Color Balance adjustment layer must be turned off using the eyeball icon.

(7) Re-enable the Curves adjustment layer using the eyeball icon and click on the 'Auto' button to reapply color-correction with the new histogram. Next sample a neutral midtone area in the image with the 'Gray Point' eyedropper on the left side of the Curves panel. You can also try 'Enhance Per Channel Contrast' in the Curves Panel 'Auto Options' and resample the neutral midtone area with the 'Gray Point' eyedropper. If the area sampled with the Levels adjustment layer Gray Point' eyedropper is now not neutral it may be helpful to recalibrate it using a different sample area. **Remember to reset the Curves adjustment layer anytime a change is made to the Levels adjustment layer by clicking on the Auto button or using the 'Auto Options' menu selection and resample your neutral midtone area with the 'Gray Point' eyedropper.**

(8) To remove any remaining colorcast in the midtone area drag the respective Red, Green, or Blue curve at its midpoints. For greater control over the edits, make small adjustments at a time. For mitigating color casts, for example, if the image has a Cyan cast increase the opposite color curve, which is Red. If the image now has a Blue or Green cast decrease the respective Curve for that color. If the shadows or highlights now have a colorcast adjust the respective Red, Green, or Blue shadow or highlight curve end points to remove it. A small adjustment in one or two channels is all that should be required to remove shadow or highlight colorcasts. If more than that is required the curve midpoints need to be readjusted.

(9) You can also use the composite RGB curve to adjust Brightness by dragging its midpoint up or down and increase Contrast using a simple two-point S curve as shown in Figures 16 and 17 below. The White and Black endpoints can also be dragged inward to increase contrast. Holding down the ALT key while moving the endpoints will display clipping in the image. Even better is to add a second Curves layer for these toning adjustments and use its composite RGB curve. That way you can reset and make changes to the Color Balance layer without disturbing your toning settings. If using Lightroom for further editing you can make these adjustment using its controls, but the results will be slightly different. You can try both methods to determine, which works best for a particular image file.

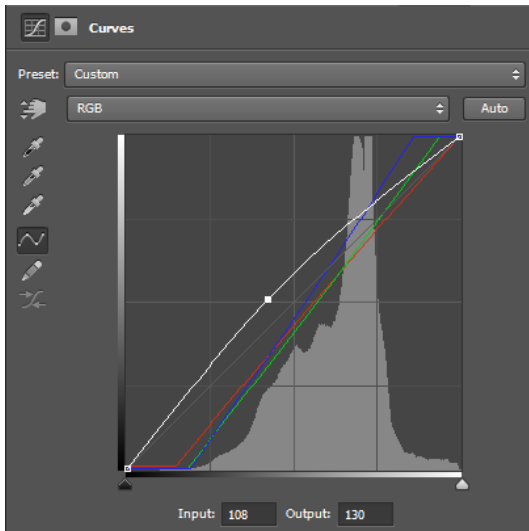


Figure 16. Luminance Adjustment Options

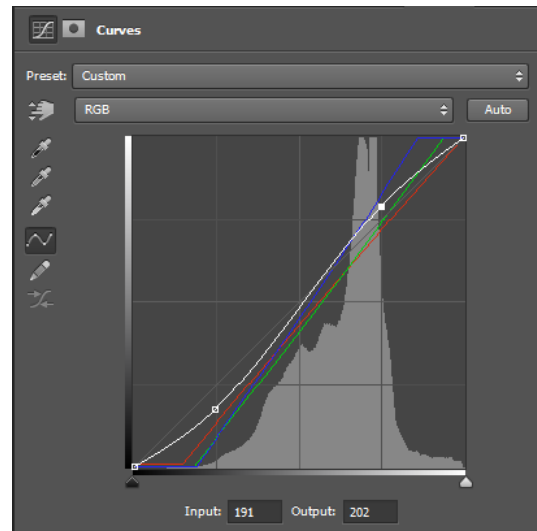


Figure 17.

(10) Save the image as a Tiff file with the previously assigned ProPhoto RGB color space and 16bit/channel mode.

### Manual Orange Mask Removal Procedure – For images with no neutral gray area

The 'Gray Point' eyedropper works well for orange mask removal with images that have an identifiable neutral midtone area. For color negative images lacking a neutral toned area the Levels mask removal adjustment can be made manually while observing the Photoshop 'Color' 'All Channels' Histograms as shown in Figure 18 below. Click on the eyeball icon to turn off the Curves adjustment layer and adjust the center slider of the individual Red, Green, or Blue levels to overlap the three channel histograms and remove the predominate color(s). An orange mask emulsion requires moving the Red channel midpoint slider to the right (value <1.00) and left for the Blue channel (value = >1.00). Adjust the Green channel slider last, which typically requires only a slight correction or none. When set correctly the individual Red, Green, and Blue histogram will overlap each other in the central (midtone) area of the RGB histogram. Typical settings for the Levels midpoint sliders are Red = 0.50, Green = 1.00, and Blue = 2.00.



The values will vary for each film emulsion type, so adjust them using the Photoshop 'Color' 'All Channels' Histograms for guidance as shown below in the Figure 18 Histogram Alignment example.



Figure 18. Histogram Alignment

**You must reset the Curves adjustment layer by clicking on the Auto button or using the 'Auto Options' menu selection anytime a change is made to the Levels adjustment layer settings.**

Further processing can be done using Photoshop's other tools, but all of Lightroom's Develop module tools are non-destructive and easy to use –the choice is yours! Open the image in Lightroom and process as a normal picture file. If the image has color or tonal issues that are not responding normally inside the Lightroom Develop module try readjusting the Tiff file Levels and/or Curves layers settings inside Photoshop. I suggest saving the edited Photoshop Tiff file with a different name (i.e. 'FileName\_Adjusted'), then synchronize the folder inside LR, and synchronize or copy and paste the Develop settings from the original file to the PS re-edited file. This is not normally necessary, but may be helpful as a learning aid.

If happy with the results inside Lightroom you can delete the other Photoshop file versions and flatten the master Tiff file to save disk space. I suggest keeping the original camera raw files with the Tiff files so you can try alternative processing in the future. The camera raw file size is small compared to the Tiff file, even when using Tiff ZIP compression.

You can create a Photoshop Action to simplify the Photoshop processing workflow. Here's one I created:

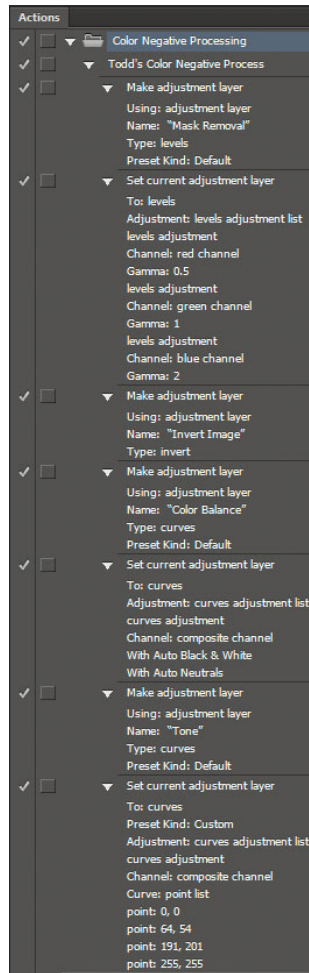


Figure 19. Photoshop Action

This whole process can be performed in less time than it takes to read the above 10 steps! Let's look at two examples using this Photoshop processing workflow.

### Example 1

The first example is a portrait shot on 35mm Kodak Royal Gold 100 Generation 2 color negative film, circa 2003 (Figure 20). The image presents a few challenges since it was shot in partial shade with a very bright direct sunlit area that is at Dmax.

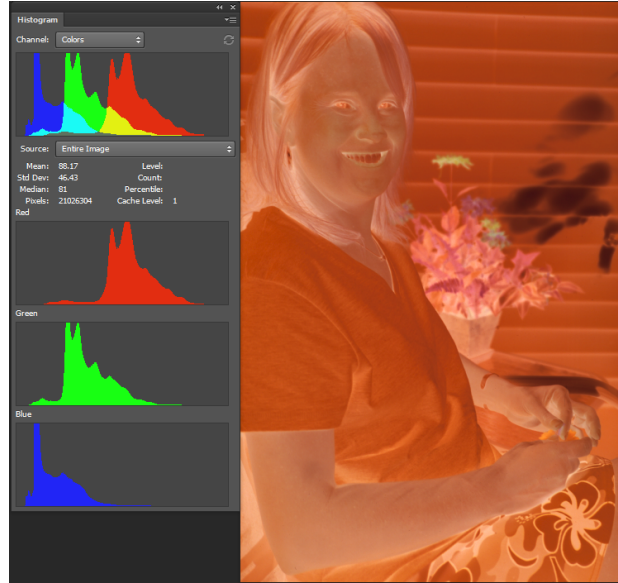


Figure 20. Initial Capture of the Negative Opened in Photoshop

Figure 21 shows the image only the Levels adjustment layer, 'Gray Point' eyedropper sampled on the model's teeth, and Invert Adjustment layer active. Alignment of the 'All Channels View Histogram Red, Green, and Blue Channels is a good indicator of proper mask removal (Figure 21).

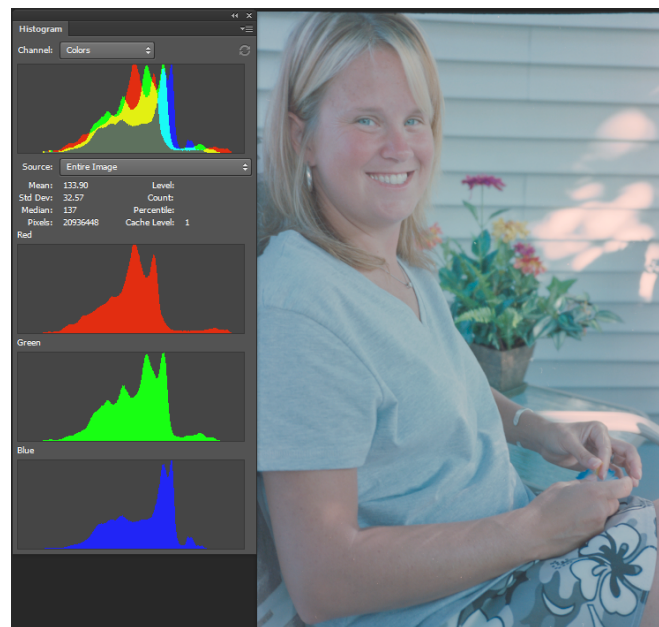


Figure 21. Inversion and Initial White Balance

Next I press the 'Auto' button in the Curves adjustment layer to apply the settings from step (4) above.



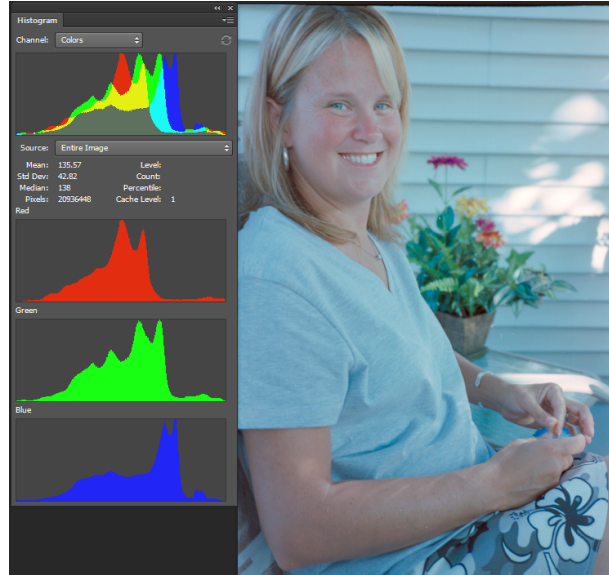


Figure 22. Auto Adjustment in Curves from Step (4)

The image (Figure 22) has taken on a blue colorcast due to the lower color temperature lighting in the shade area. Let's sample the teeth once again, but using the 'Gray Point' eyedropper in the Curves layer. The overall color balance is good (Figure 23), but the image has low contrast.

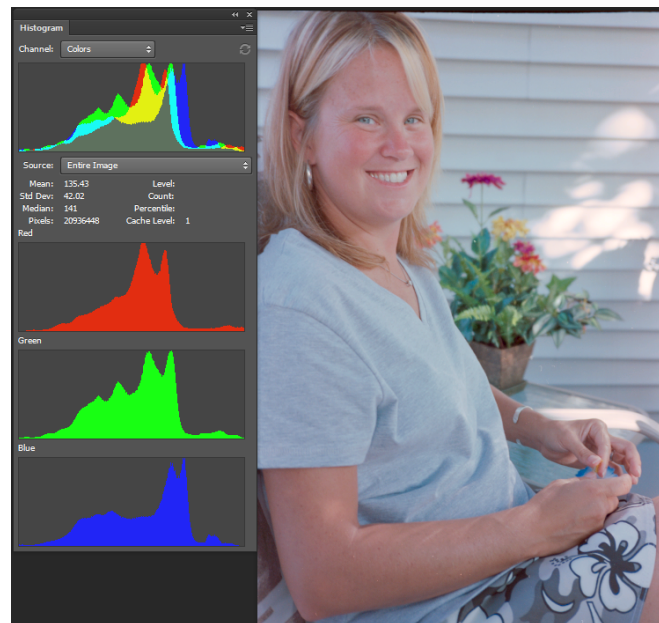


Figure 23. Teeth Resampled in the Curves Layer

I increase contrast by applying a two-point S curve (Figure 24).

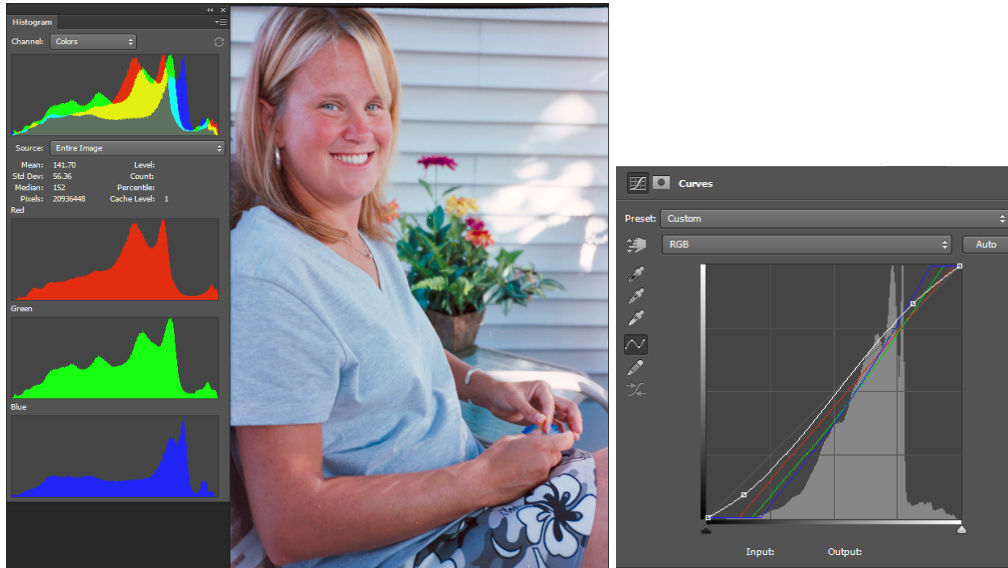


Figure 24. Contrast Improved with an “S” Curve

The photo is nearly correct, except for a slight Cyan cast in the midtones and Blue cast in the shade shadow area, due to its lower color temperature lighting. This has nothing to do with the “accuracy” of the Photoshop workflow process, but simply the existence of highly varied temperature of the lighting in the different image areas. To remove the midtone Cyan cast I moved the Curves’ Red Channel midpoint very slightly from 120:127 to 120:130. To remove the remaining shadow colorcast I moved the Red channel’s Black slider from 22 to 12 and the Green channel’s Black slider from 30 to 20. This was all done “visually” and effectively removes the colorcast without causing an undesirable color shift in other areas of the image (Figure 25).

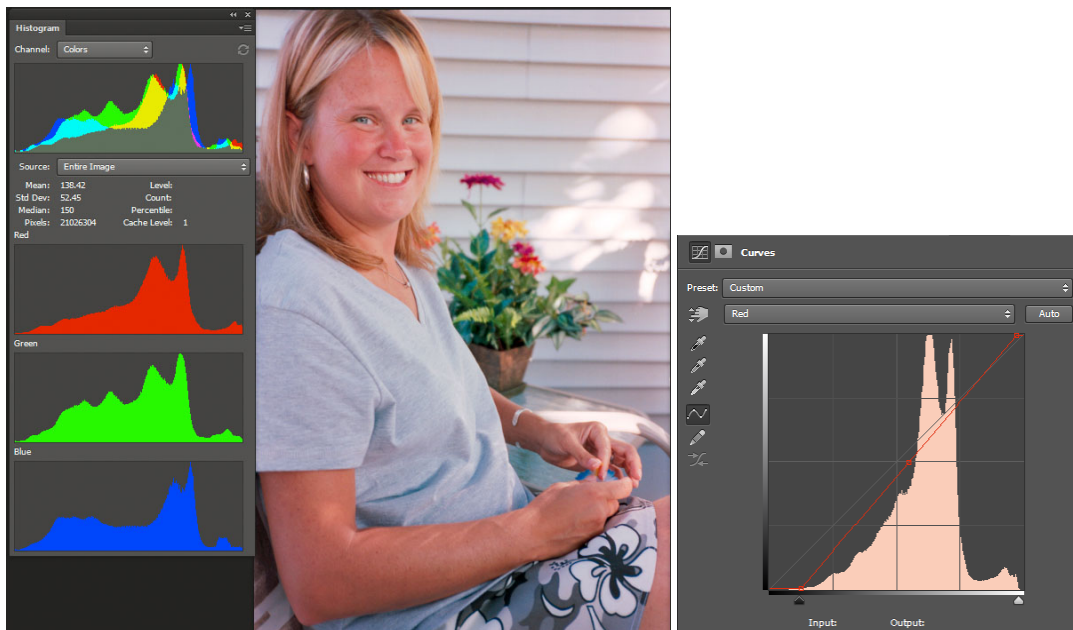


Figure 25. Removal of Cyan Cast with Red Curve Adjustment

Next I processed the image in Lightroom 5.6 and found it required the following settings (Figure 26). The HSL Saturation Targeted Adjustment tool (bulls-eye icon) was used to tone down the sunburn in the models face and arms. This is an "artistic" adjustment and not a deficiency of the Photoshop processing tools. Simply lowering the Basic panel Vibrance slider to -15 without the HSL adjustment works equally well with this image as it targets areas with the most saturation.

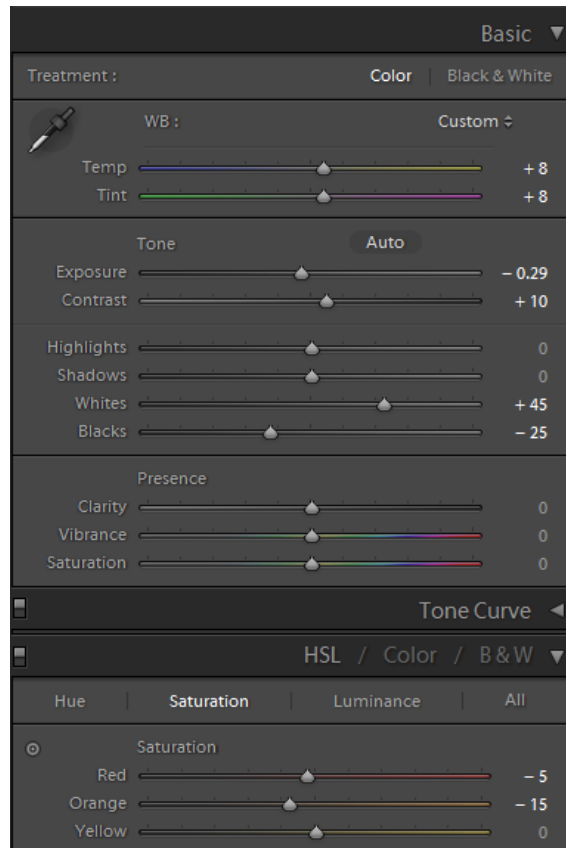


Figure 26. Luminance Settings in Lightroom

This produces an accurate rendering of the portrait (Figure 27), which was taken in the late afternoon with the sun low in the sky and very warm in color. The model had sunburned arms and face, which are rendered accurately. The colorcast in the warmer highlight and cooler shadow areas has also been effectively corrected by the Photoshop Curves adjustment layer settings.





Figure 27. IMG\_6432\_Kodak Royal Gold 100-2\_  
PS Levels+Invert+Curves For Article.jpg

## Example 2

The second example is a picture of Time Square shot on Fujifilm Super G100 color negative film (circa 1997) with a very bright overcast sky area and colorful marquee lights. Let's see how well the Photoshop process handles this image and different film type.



Figure 28. Camera Capture of Negative Opened in Photoshop

Figure 29 shows the image with the Invert Adjustment layer active and Levels adjustment layer 'Gray Point' eyedropper sampled American Express billboard background, which is gray.



Figure 29. Photo Inverted and Initial White Balance

The midtones are neutral, but the sky area has a red colorcast and the histogram Red, Green, and Blue curves are not aligned very well. Let's see if the Curves adjustment layer will correct it.





Figure 30. Curves Adjustment Layer Applied

The red colorcast in the sky area is corrected (Figure 30) and the histogram Red, Green, and Blue curves are better aligned, but we now have an overall Cyan colorcast.

Next I'll sample the American Express billboard background once again, but using the 'Gray Point' eyedropper in the Curves layer.



Figure 31. Levels and Curves Settings Recalibrated



The Curves 'Gray Point' sample adjustment has completely corrected the color balance for highlights to shadows (Figure 31), with only a very small red colorcast in the bright sky area remaining.

To correct the red colorcast I moved the Red channel's White slider from 244 to 252, which now looks and measures 228, 2228, 228, perfectly neutral (Figure 32).



Figure 32 Red Highlight Cast Removal

The image is very satisfactory without any further processing, except perhaps noise-reduction to remove grain and sharpening. The Fujifilm Super G100 color negative emulsion is somewhat different than other film types, such as in the first example, and therefore may need more attention using the suggestions provided.

Figures 33 and 34 show the final image with its Lightroom settings, which accurately capture the wide-gamut marquee lights and night sky area with very little adjustment.



Figure 33. IMG\_6426\_Fuji Super G100\_PS Workflow Example.jpg

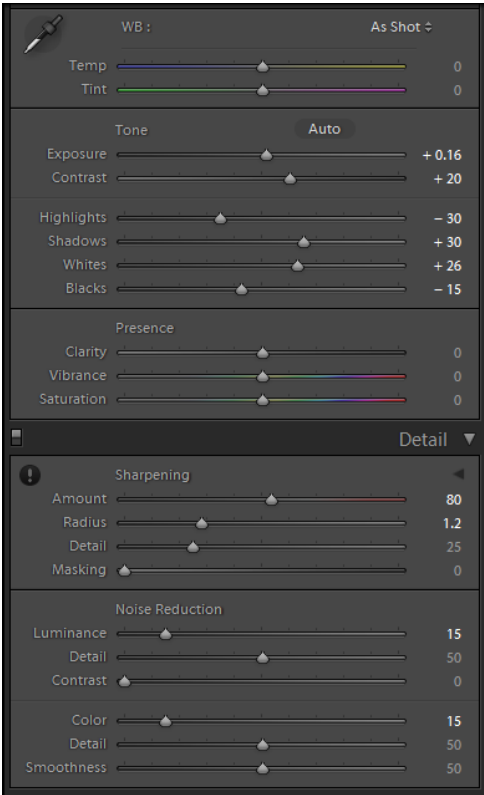


Figure 34. Lightroom Settings for Figure 30

## Summary

In this section of the paper I have sought to demonstrate how Photoshop can be used in a quite streamlined manner to produce good inversions of colour negatives and achieve pleasing colour balance and tonality.

Between the approaches Mark showed and I have shown, we're both of the view that which to use is not necessarily determinate on the basis of image quality, because either can produce very good results, and at the end of both workflows there is always Lightroom or SilverFast HDR8<sup>5</sup> to take-up the finishing touches with aplomb. The determinative factor is primarily workflow and software preference, which is personal.

The key point we want readers to retain from all of this is that as the availability of high quality, affordable scanners passes into history, the use of cameras with viable software techniques can fill the void very satisfactorily.

## Black and White Negatives (Mark)

Given the important survival/revival of B&W photography, and my archive of black and white negatives going back over six decades, of which the medium format ones from the early 1970s in East Africa are of great interest to me, I was eager to also assess the options for camera capture of these negatives, and I was not disappointed.

My first preference would have been to handle the whole workflow from capture to printer within Lightroom because of its seamless operation, excellent image editing algorithms and lean demands on storage (one never saves anything more than the raw file and a few kilobytes of metadata). Hence I figured that by reversing the Tone Curve I would convert the image from negative to positive and then make any residual adjustments using the usual controls.

Well, I tried that with good quality, well-preserved medium format negatives shot on Ilford FP4 (125 ASA) film in 1970/71 (developed in a fine-grain developer back then – I forget which one) and it wasn't satisfying. Firstly, after making the tonal inversion, all the luminance controls work in reverse. OK, not a show-stopper, one can become accustomed to that. The more substantive issues I had with it, however, were: (i) The tonal adjustments were a lot more finicky (by this I mean small movements of controls produced large changes of outcomes) than I usually experience in a normal Lightroom workflow editing the usual raw files of conventional scenes from my Sony a6000. (ii) There was less granularity in the adjustments I made – for example, using the shadow

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<sup>5</sup> While SilverFast HDR 8 is a complementary application to SilverFast's scanning software, it is also an image editing application in its own right, and not really constrained by the fact that the files it can handle do not come from scanner output. The exception to this is the included NegaFix profiles, which are calibrated to scanner output, and not the output of film captured with a DSLR using different lighting and sensor technology than prevail in scanners. However, this factor does not affect its overall usability for present purposes.

and highlight sliders, I found a greater than desirable impact on the mid-tones, somewhat undermining the contrast effects I was trying to achieve. Again, this may be the result of the workflow problem noted above when the Tone Curve is edited before using the other controls, inevitable because converting the negative to a positive must be the first step.

The two alternatives I tried were (i) exactly the same MakeTIFF to SilverFast HDR8 approach I described for colour negatives above, and (ii) a Lightroom to Photoshop procedure, similar to but shaken down from Todd's approach with colour negatives (shaken down because there is no colour balancing to deal with).

No need to repeat the steps of option (i), except to note that once opened in SilverFast HDR8, because it is a B&W image, one has the option of processing it as a 48-bit (RGB) TIFF file preserving all the colour information under-the-hood, or reducing it to a 16-bit (monochrome) file. If the file is to be imported into Lightroom or Photoshop for further processing and printing, I found it advantageous to retain the full 48-bit information for two reasons:

- (1) There is a very subtle additional tonal adjustment capability using Lightroom's HSL sliders once the photo is brought into Lightroom for final edits and printing, and
- (2) There is a pronounced advantage in being able to use these sliders to cure any discoloration that may have happened on these negatives in very long-term storage. I provide an example in Figure BW1 (overleaf), where this negative had developed a blue spot that converted to an orange spot when the negative was inversed; I was able to completely eliminate it with the orange slider in Lightroom's HSL panel.

However, if the file is to be completely edited in HDR8, given it was captured as a monochrome image with 16-bit pixel depth, there will be no perceptual difference in a print whether the file is kept as a 48-bit or 16-bit image, save for consideration (2) just above. In this circumstance, saving the file as a 16-bit mode image triggers the SilverFast "Selective Colour to Grey" (SCG) toolset, which provides the colour spot neutralization capability (Figure BW 1A).

The option (ii) procedure is easy enough:

- (a) Import the file into Lightroom as usual, then without doing anything to it,
- (b) Send it to Photoshop using the Photo>Edit In.....Photoshop command sequence.
- (c) Once opened in Photoshop, add an Invert Adjustment Layer, flatten the file, save it as a TIFF or PSD and
- (d) Revert to Lightroom where the new positive version will be ready for complete neutralization to B&W, final editing and printing. For neutralization of B&W (as the camera captures the hue of B&W films that are not totally neutral) I click on B&W in the HSL/Color/B&W panel, as this preserves the underlying colour information while rendering a completely neutral B&W photograph.





Figure BW 1. Orange spot neutralized Using Lightroom HSL panel

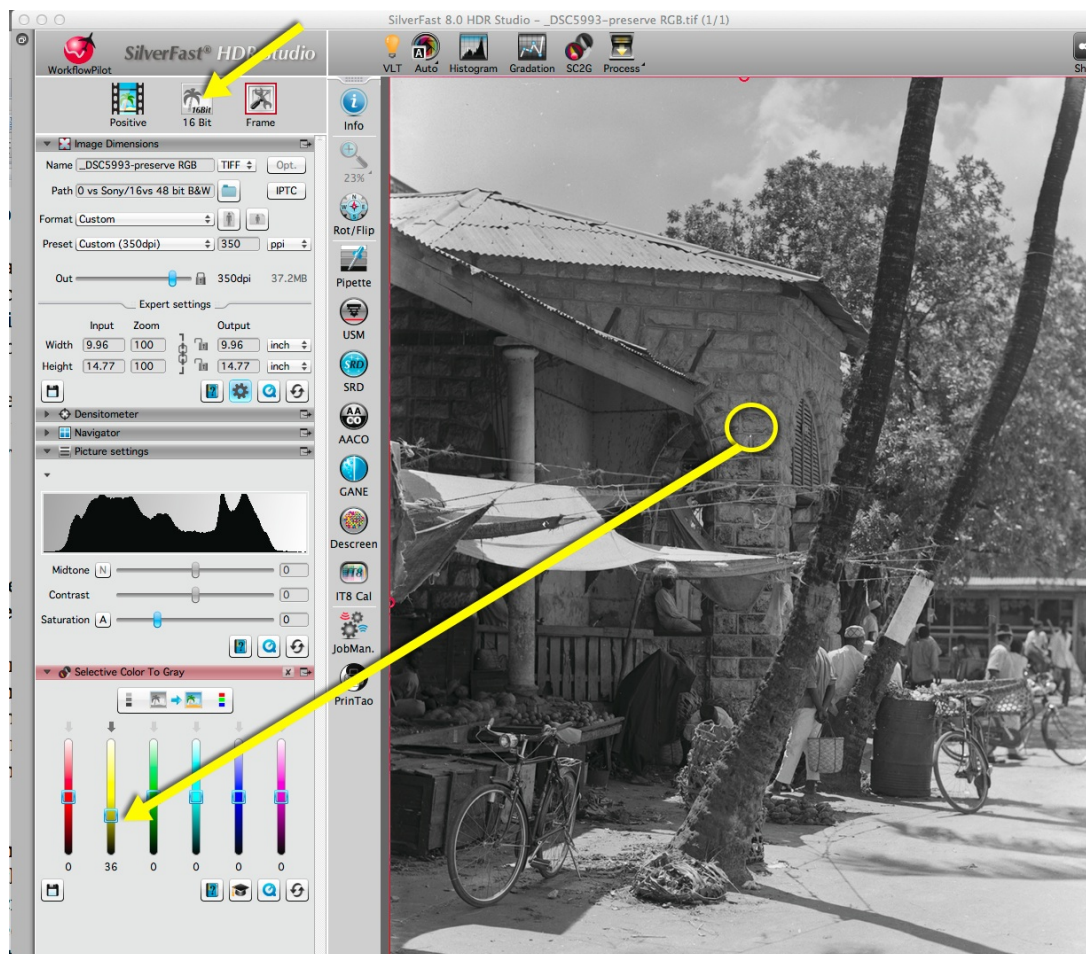


Figure BW 1A. Spot neutralized using HDR8 SCG Tool, Yellow Slider

Comparing Options (i) and (ii) (Figure BW 2), I find both work well and can be fine-tuned to match each other quite closely; that said, the option (i) approach of MakeTIFF >HDR8>Lightroom, to my eyes, offers subtly richer tonality, more easily.



Figure BW 2. Three Treatments for B&W Negative Rendering and Inversion  
Zanzibar, 1971; Ilford FP4 film, ASA 125  
(Photograph copyright Mark D Segal)

Finally, of interest to those (like me) who happen to own an Epson V750 scanner that can scan medium format negatives at “high resolution”, just how well does this scanning process compare with camera capture using a Sony a6000 and macro lens? Figure BW3 pretty much tells the story.



Figure BW3. Epson V750 Scan and Camera Captured Compared



Seen at the Lightroom “Fill” magnification, these screen-grabs don’t show that much difference of apparent sharpness between these technologies; however examining the files of the full photo on display (Figure BW4), the camera capture is preferred. This in itself is valuable information, inciting me to look further by making 11\*17 inch (excluding borders) prints of both renditions (scan and camera capture). And just to add some flavour, I also happen to have retained the similar size enlargement of this photo from 1970, made on Ilfobrom Luster paper, using a Beseler condenser enlarger equipped with a Schneider Componon enlarging lens (this was real good stuff back then). The camera was a Graflex with roll film back and a Kodak Ektar lens.



Figure BW4. Zanzibar; full frame capture of DSC5993

Examining the three prints, it’s a close race. The Sony a6000 camera capture comes out the winner, but not “hit you in the face” – it’s slightly sharper and cleaner. Digitization, whether in a scanner or by camera, given our present day editing tools, certainly improved shadow detail relative to that in the historical darkroom print. But this doesn’t tell the whole story.

The remainder of the story is what needs to be done with the Epson scanning process. One needs to scan at full optical resolution of 6400 PPI to trigger the finest detail this scanner can render. This produces a 570 MB file of a 2.25\*3.25 inch negative BEFORE any other processing, and takes 6 minutes to scan (compared with a click and download

doing a camera capture). The pixel dimensions are 20800 \* 14400 and the linear dimensions at 360 Output PPI are about 58 inches by 40 inches. Hence when making an 11\*17 inch print, Lightroom does a large down-sizing. Unless one is making very large prints, this process wastes a considerable amount of time and disk space, and doesn't produce better quality output relative to the camera capture of the same negatives for the size range of interest. Once again, my general conclusion is that the camera is *at least as good* as a high-end prosumer scanner for making prints within the target size range.

### **Annex – Mark's Observations on Workflow Preferences**

This regards my procedure and begins from where my process description above (MakeTiff to SilverFast HDR8) left off. Readers of my previous articles on LULA and my ebook "Scanning Workflows with SilverFast 8, SilverFast HDR8, Adobe Photoshop Lightroom and Adobe Photoshop" know that I'm quite agnostic about software – I "mix and match" till I find what I like best for the tasks at hand.

I did not recommend any grain/noise reduction or sharpening at the MakeTiff-HDR8 phases. That is because I do not think it a good idea to bake these in at the capture stage. They should be "undoable and repeatable". For this, I have tried two options: (1) importing the TIFF emerging from HDR8 into Lightroom and using its tools for both noise reduction and sharpening (both of which have improved a lot with successive versions of Lightroom), or (2) opening the TIFF in Photoshop and using a combination of Neat Image and PK Sharpener Pro 2 in that order. Neat Image should be applied to a Background Copy layer so it can be trashed and redone as desired. PKS2 makes it own layers. Of the two approaches, I find (2) provides more flexibility and, in the end, somewhat better quality results, but it also creates very big image files. In one experiment I applied both Capture and Creative (Narrow Edge 2) sharpening in Photoshop before importing the file to Lightroom, where I tweaked Vibrance and Contrast under soft-proof before printing with the default Output sharpening in the Print module. The printed result looks sharp in a natural, unforced way. And all is reversible.

Turning to the basic colour and luminance edits, there are options – SilverFast HDR8, Photoshop and Lightroom can all be used. I find SilverFast HDR8's colour correction tools are very effective and easy to use in a well-controlled manner. However, for luminance adjustments, Lightroom is second to none, so I do most colour adjustments to these "camera scans" in HDR8 and my luminance adjustments and soft-proofing with associated adjustments in Lightroom.

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