

Varis PhotoMedia Tutorials

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Welcome

This tutorial has been prepared for the photographer who is striving to learn digital imaging. I make an effort to supply current information about digital imaging techniques and general information about computer technology that is pertinent for today's professional photographer. This information is based on my personal experience down in the trenches at the front lines of the digital revolution that is sweeping the photographic industry.

One thing is certain: all of the information contained herein will be obsolete in a fairly short time - how short, I can't say. Be forewarned that things are changing very rapidly and the only way to stay competitive is to keep learning. I devote a good percentage of my time learning new things and I am attempting to share what I learn with you but this information will go out of date so you should be flexible and not take this tutorial to be the ultimate statement on the subject.

I consider the knowledge contained in any of my tutorials to be public domain but the form in which this knowledge is presented is copyrighted as are all the photographic images used as examples. Unless otherwise noted all imagery is copyrighted by Lee Varis and any use of these images without permission is forbidden. You are permitted to use this tutorial for your personal education - you are not permitted to sell or otherwise distribute this material. Please contact me for any other use.

I maintain a web site where I post additional information, examples and tutorials. You are invited to browse various portfolios as well as download free material and purchase additional tutorials at:

<http://www.varis.com>

I hope you find the information contained in this tutorial helpful. Please let me know if you find any errors or omissions - I'm always trying to improve these materials! You may contact me via E-mail at:

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best regards, Lee Varis 2006

Calibrating for Digital

Testing and Calibrating DSLRs Using Adobe Camera Raw

The first step in designing any digital capture workflow is testing our photographic hardware/software system. The professional photographer must test every component of his system before an assignment to avoid any surprises on the shoot. In the past, this meant shooting film tests to determine the color bias of emulsions and the best processing procedures. Digital capture offers the possibility of much greater precision but testing is still necessary for optimum results.

The following tutorial outlines the procedures that I use for my DSLRs. This is a rigorous but evolving process that utilizes Photoshop, Adobe Camera Raw and Bridge to test for the native E.I. of the camera chip and the best calibration settings for optimal color. It is important to realize that any capture system relies on several components: lighting, camera, lens and raw file processing. If any of these individual components change significantly then you have to re-test to calibrate the system. We are calibrating a system not an individual component – the camera is not separate from the system in which it is used.

I offer you this testing procedure with the understanding that it represents my personal preferences at the time I'm writing this. This is not necessarily the absolute best way but it is a method that I know to work for me. Remember, your mileage may vary! Take this as a general outline upon which to base your own procedures once you understand the principles. Photoshop and ACR are constantly being updated and newer versions may make some of the steps outlined herein obsolete – I'm using Photoshop CS2, ACR v 3.3 and Bridge v 1.0.3 – please take this into consideration when going through this tutorial.

Now, let us roll up our sleeves and begin...

Setting up and Shooting the Target

The testing procedure involves a series of steps:

- build a standard test target
- establish lighting for conditions you wish to test
- shoot a series of exposures to determine E.I.
- download image files and view in Bridge
- apply zero-slider ACR defaults to files
- identify best exposure
- calibrate ACR color to target standard
- save ACR settings subset
- save new Camera Raw Default

A good calibration target will have :

- 24 patch Gretag Macbeth Color Checker
- light trap/black box
- diffused highlight
- written E.I. reference for the exposure
- skin tone

The example at the upper right contains these elements – the box in the corner has a hole cut in the lid, the inside lined with black velvet. This acts as a light trap for an absolute black reference. At the lower right I'm using the Styrofoam lens packaging – this is highly reflective, very white and acts as a diffused highlight to check for pink highlight transitions. A piece of paper has "100" written to represent the E.I. for the exposure of this particular shot – this means that you meter for the expected E.I. of 100 and set the camera's controls accordingly.

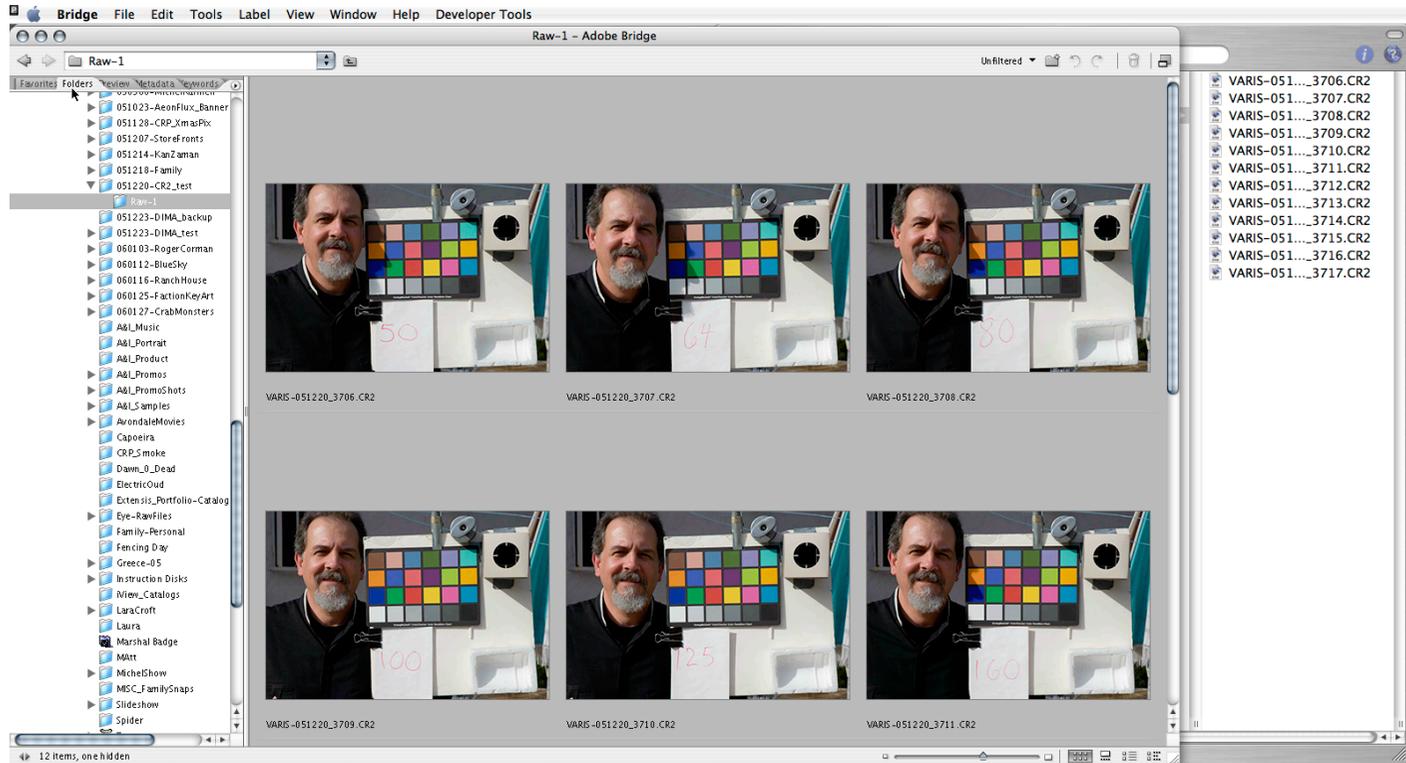
To shoot the test you will increment the exposure in 1/3 f-stops. Each time you open the f-stop the expected E.I. will increment down (i.e... 100, 80, 64, 50, etc...) You will be able to identify the correct E.I. by the shot that looks the best from the sequence after equalizing the processing parameters in Bridge. Exposure has to be determined manually and only the f-stop changed for this to work!



The best method to determine the exposure is through the use of a hand-held exposure meter, ideally a reflected spot meter. Take a reading, from the camera position of the mid-gray patch (3rd patch from the right) at the bottom of the Color Checker. Since we are going to be establishing custom raw processing using ACR, the LCD display on the back of the camera will have no utility – we can't rely on either the preview or the histogram to give us anything even remotely accurate because it can only show how the camera will process a Jpeg directly.

Once you shoot the exposure range you need to set up ACR defaults to accurately preview the files in Bridge...

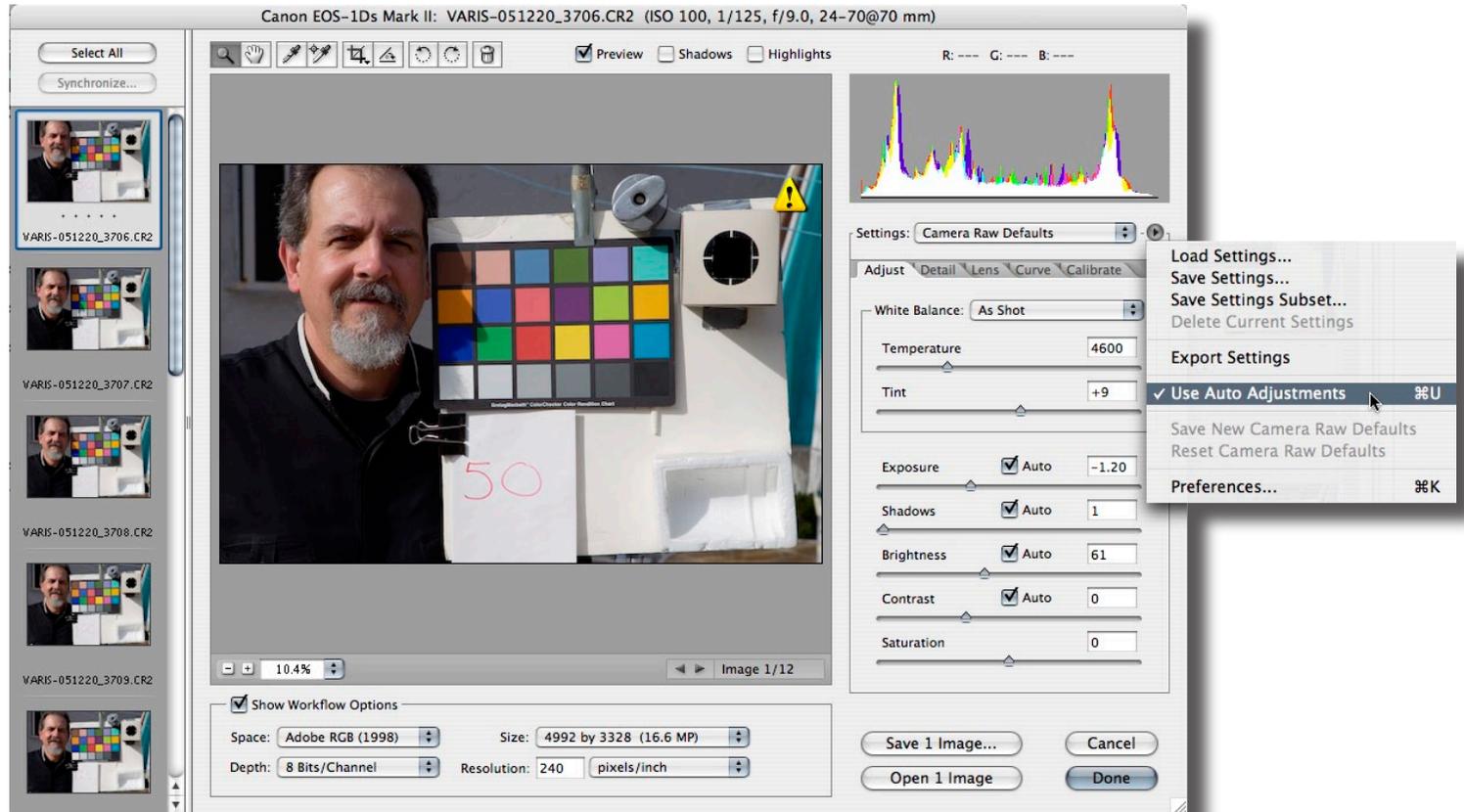
Setting up Bridge and ACR defaults



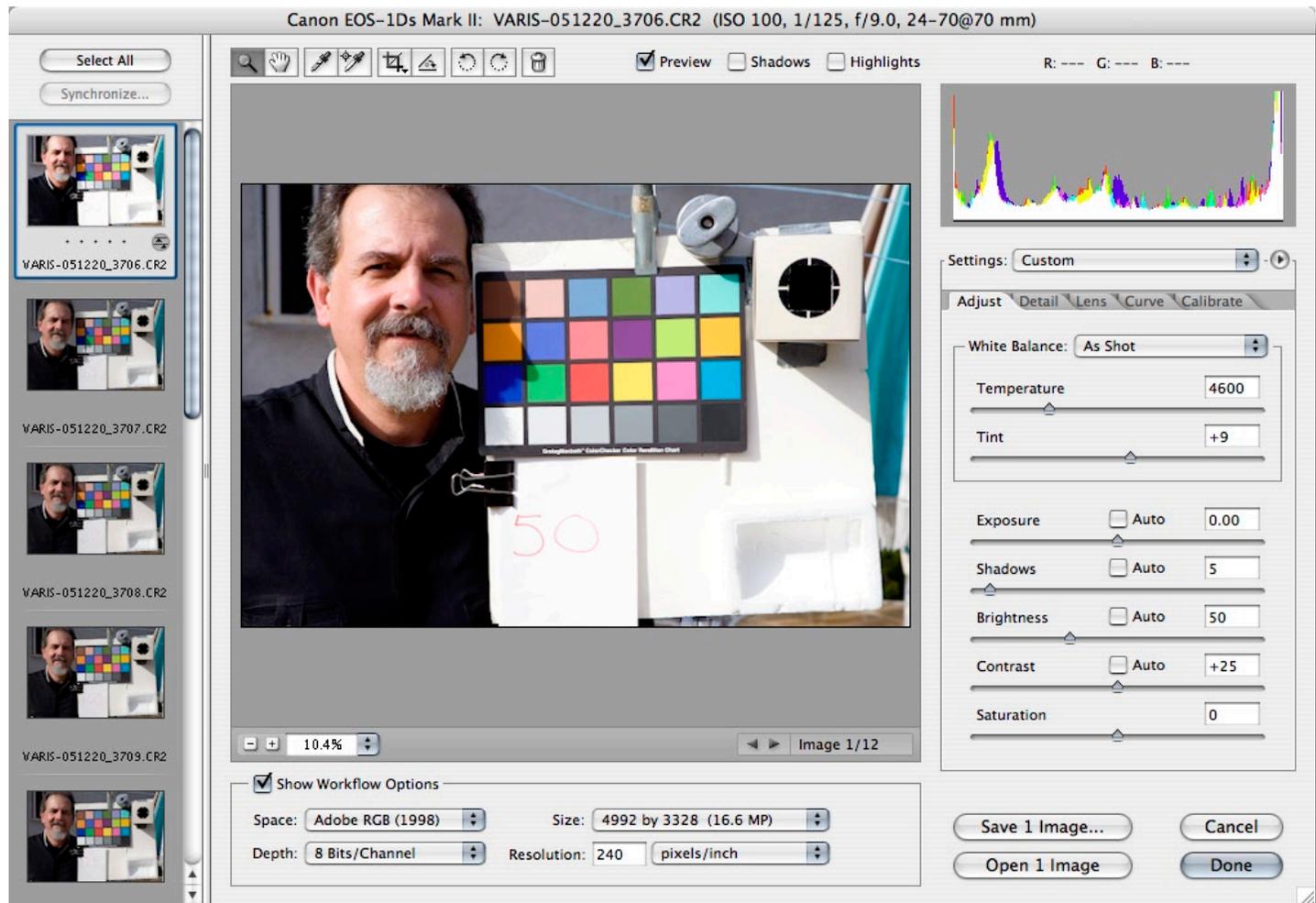
Here we have the Bridge window open with a finder window behind it showing the downloaded files.

If you haven't changed the ACR camera default, you will notice that all the thumbnail previews will look, more or less, the same. This is because ACR is using auto adjustments to equalize the exposures. We have to turn off auto adjustments and zero out all the sliders before we can get a good idea about the best exposure. Select all the thumbnails and from the File menu, open in Camera Raw...

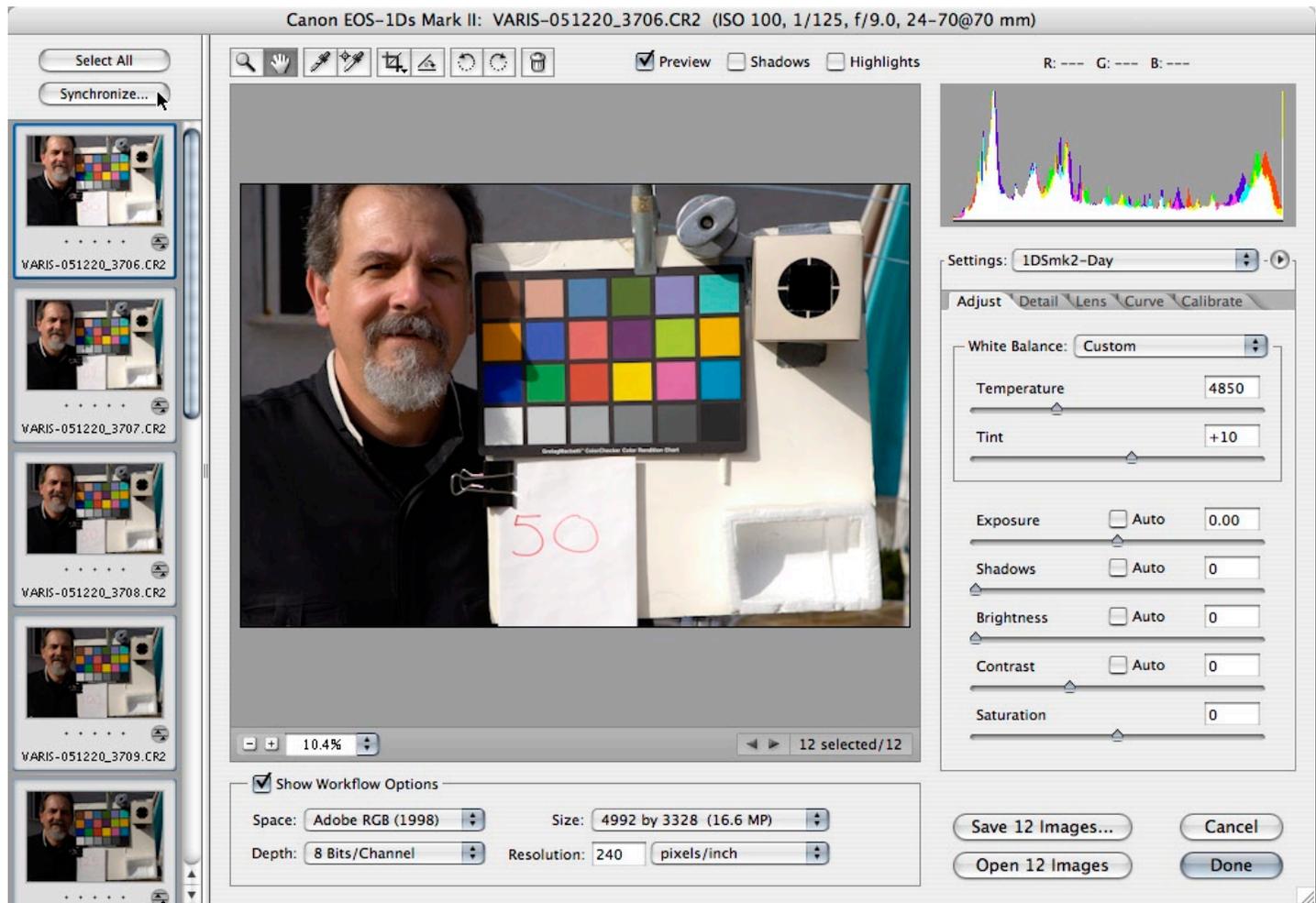
Turn off Auto Adjustments



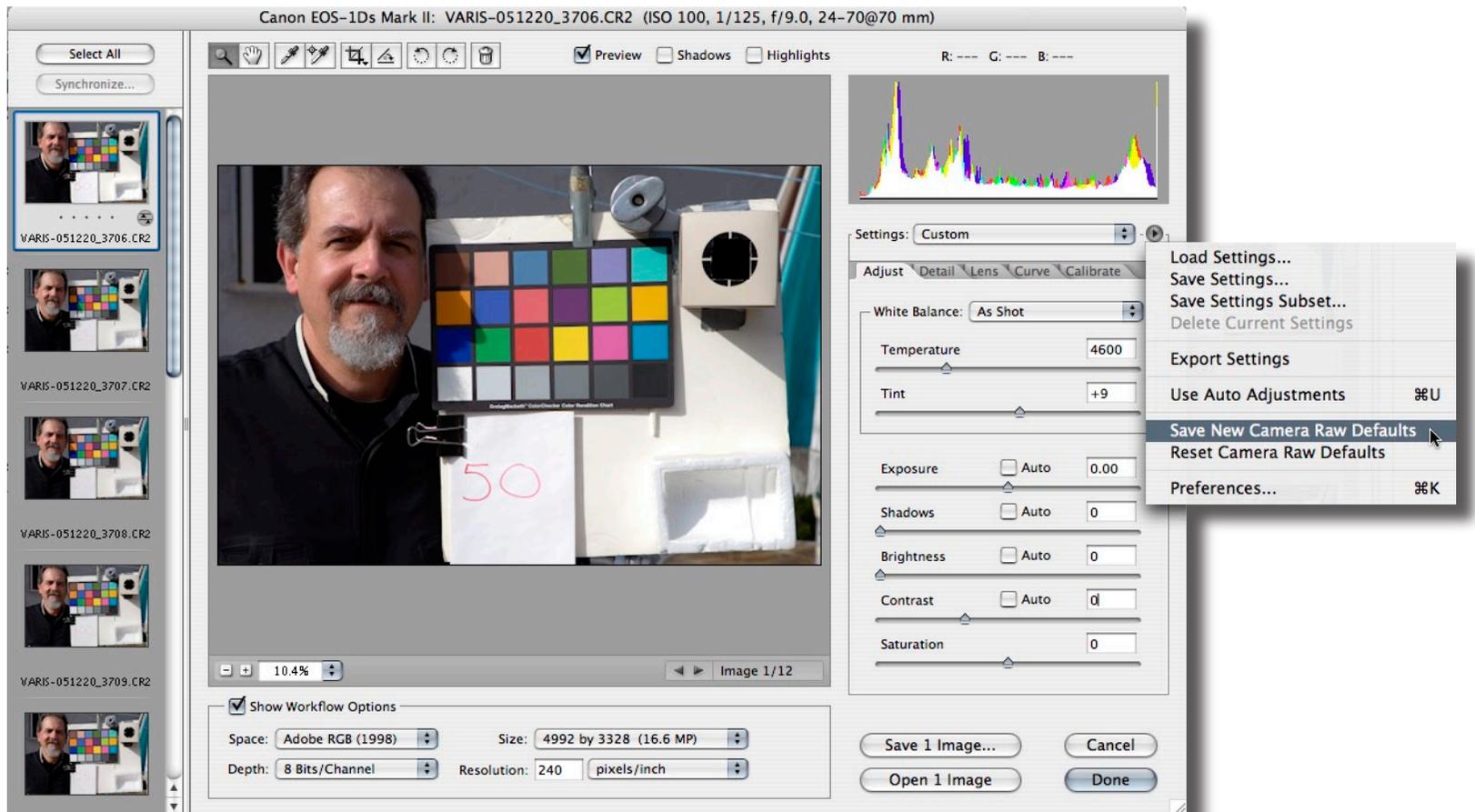
Un-check "Use Auto Adjustments" from the "Settings" fly away menu



The preview will update to reflect the current Camera Raw default settings for this camera. You will note that the Exposure, Shadows, Brightness and Contrast sliders all have positive values. We need to zero out all the sliders to see what the native performance of the chip is like without any processing enhancements...

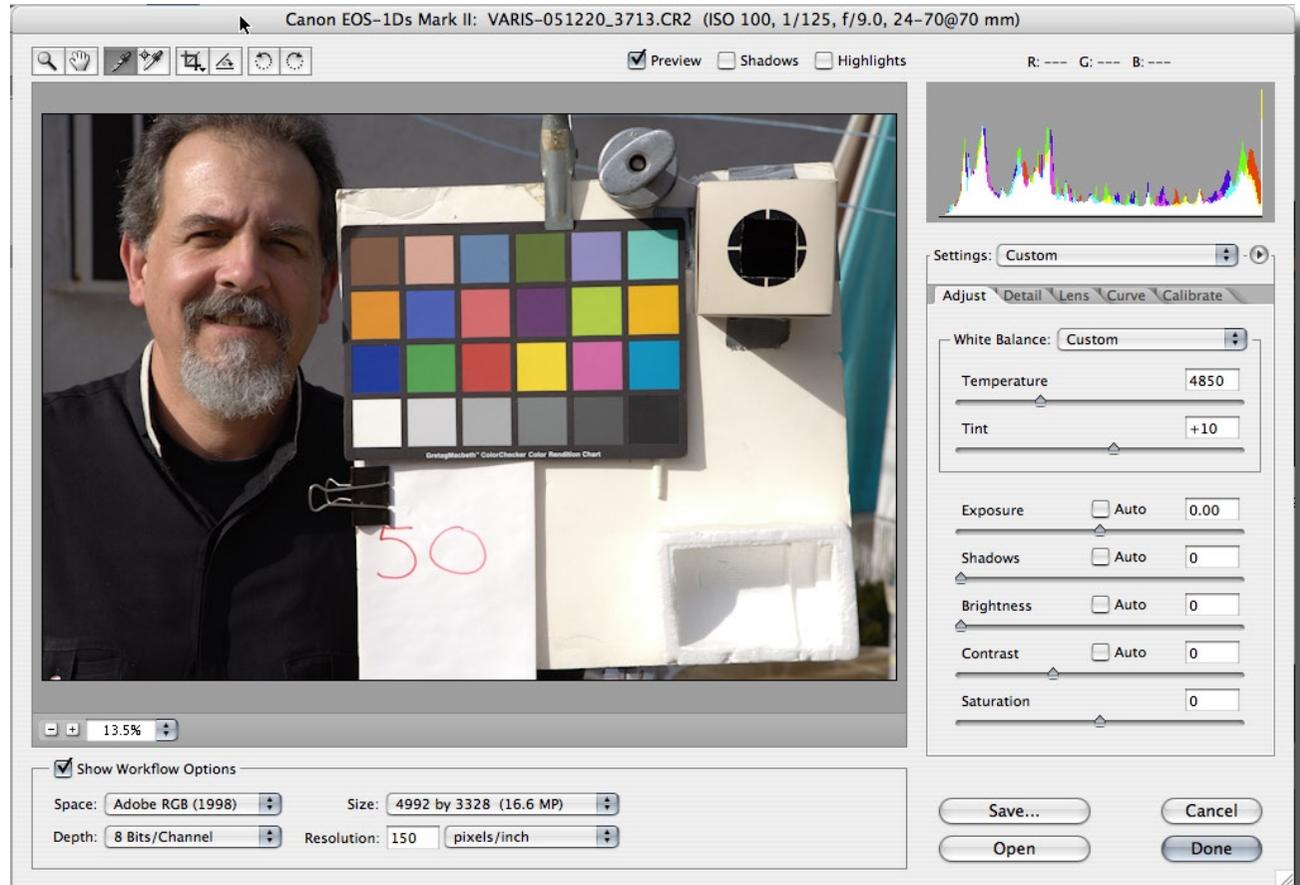


Once the sliders are at zero, click the “Select All” button at the upper left and then click “Synchronize”. The thumbnail previews will change and you will most likely find that the expected E.I. now looks too dark. My camera looks best exposed one f-stop higher than normal, meaning that I have to rate it at E.I. 50 instead of 100...



You may want to Save New Camera Raw Defaults now at the zero slider settings. This certainly is necessary for future tests and it will guarantee that the thumbnails in Bridge will give you a better, exposure accurate view for all future files from this camera. We will continue to adjust the best file to get the most desirable color using the Calibrate Tab and we will save settings – you might want to save the optimal color settings as your default as well.

Setting White Balance

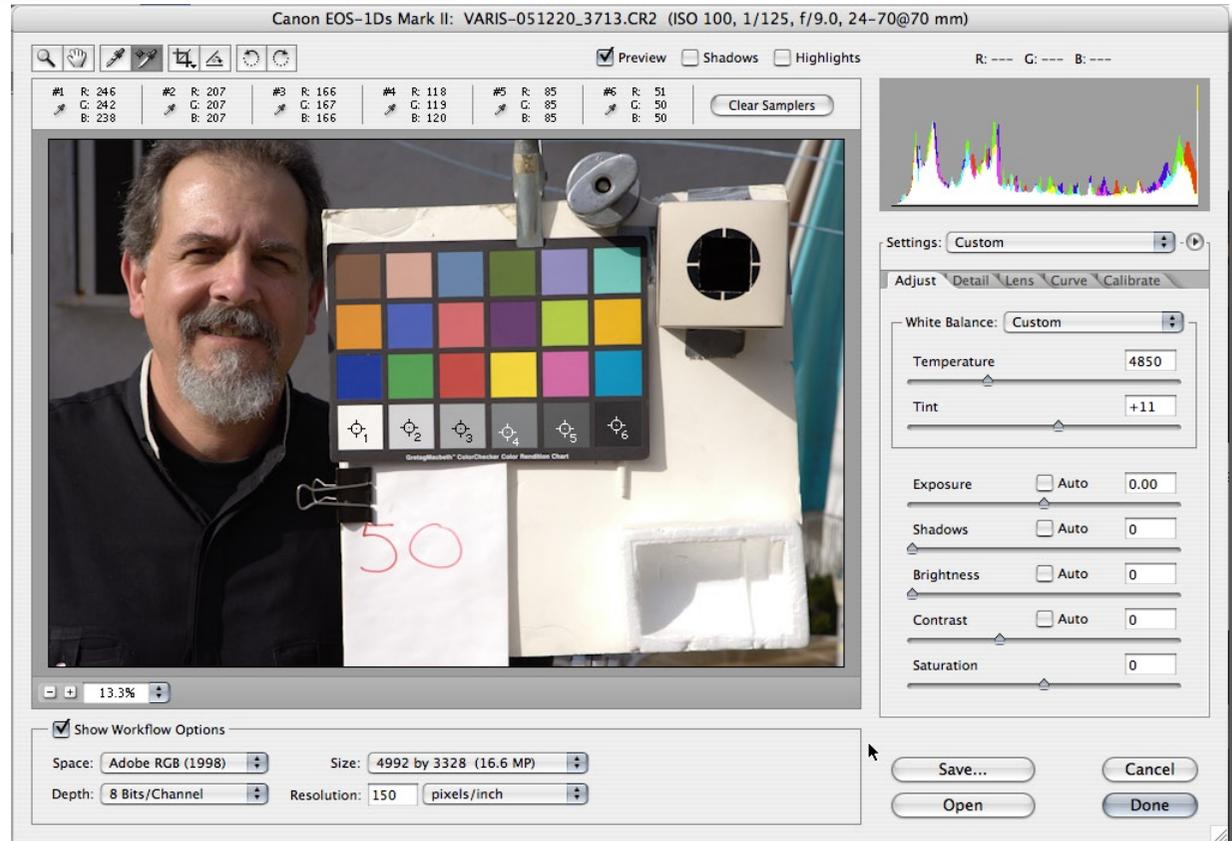


Right now we will concentrate on the best exposure. Select the White Balance eyedropper tool and click on the 2nd gray patch from the left (lightest gray next to white). The "Settings" drop down will change from "As Shot" to "Custom" and the "Temperature" and "Tint" sliders will change to reflect the new white balance...

Placing Gray Samplers

Next select the “Color Sampler” eyedropper and place samplers for the 6 gray patches on the Munsell chart. Take note of the RGB numbers for the patches. With any luck all the gray patches will be fairly neutral – the RGB values will be within 1 unit of each other. The white patch is usually the only exception and typically it will read a little warm – the “B” value will be slightly lower than R&G.

If you notice that the gray patches vary more than 2 units or so, re-select the “White Balance” eyedropper and click on a different patch. Sometimes I find that the next darker patch works better. If the darkest



patch is slightly off you may find that it gets fixed in the next step so don't worry too much about it right now.

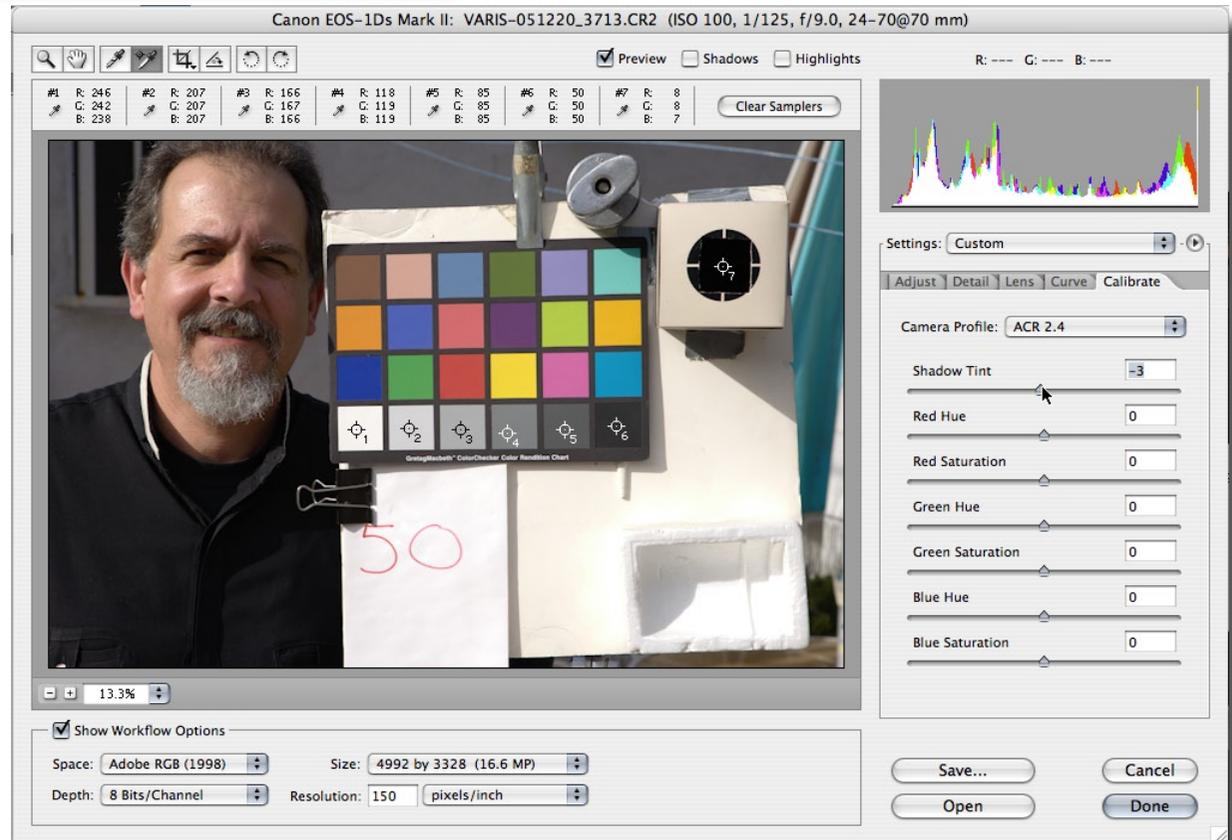
Once you have verified the white balance you can begin fine tuning the color...

Black Point Sampler

Switch over to the “Calibrate” tab and place one more sampler in the light trap black hole. You may need to move the sampler around a bit to find the darkest point if you notice some variation in the RGB numbers based on placement.

All lenses have a certain level of flare that can cause a subtle bias in the lowest values. Typically zoom lenses will exhibit this more than primes. The sensor can also have more noise in one channel or another and the blackest areas are where this shows up.

If you are lucky the black point will be fairly balanced (R=G=B) but if not, you can use the shadow tint slider to balance the numbers. Moving to the right will shift towards magenta, to the left towards green.

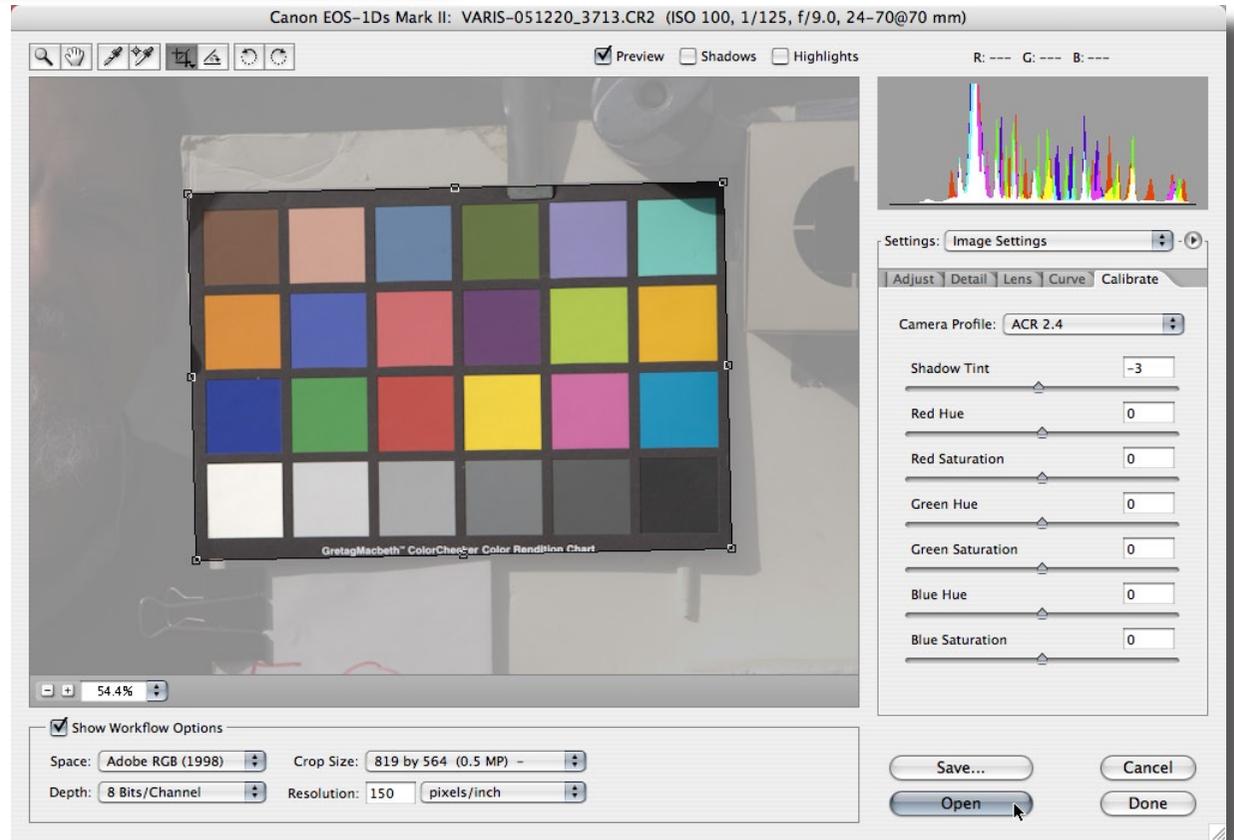


Sometimes you can have some difficulty getting all three numbers to match. In that case try to get the highest 2 to match - its usually better to get R & G to match and let blue go lower. Don't beat yourself up if the numbers are within 2 points of each other – look out if one channels ends up being 5-10 units higher!

Crop to Color Checker

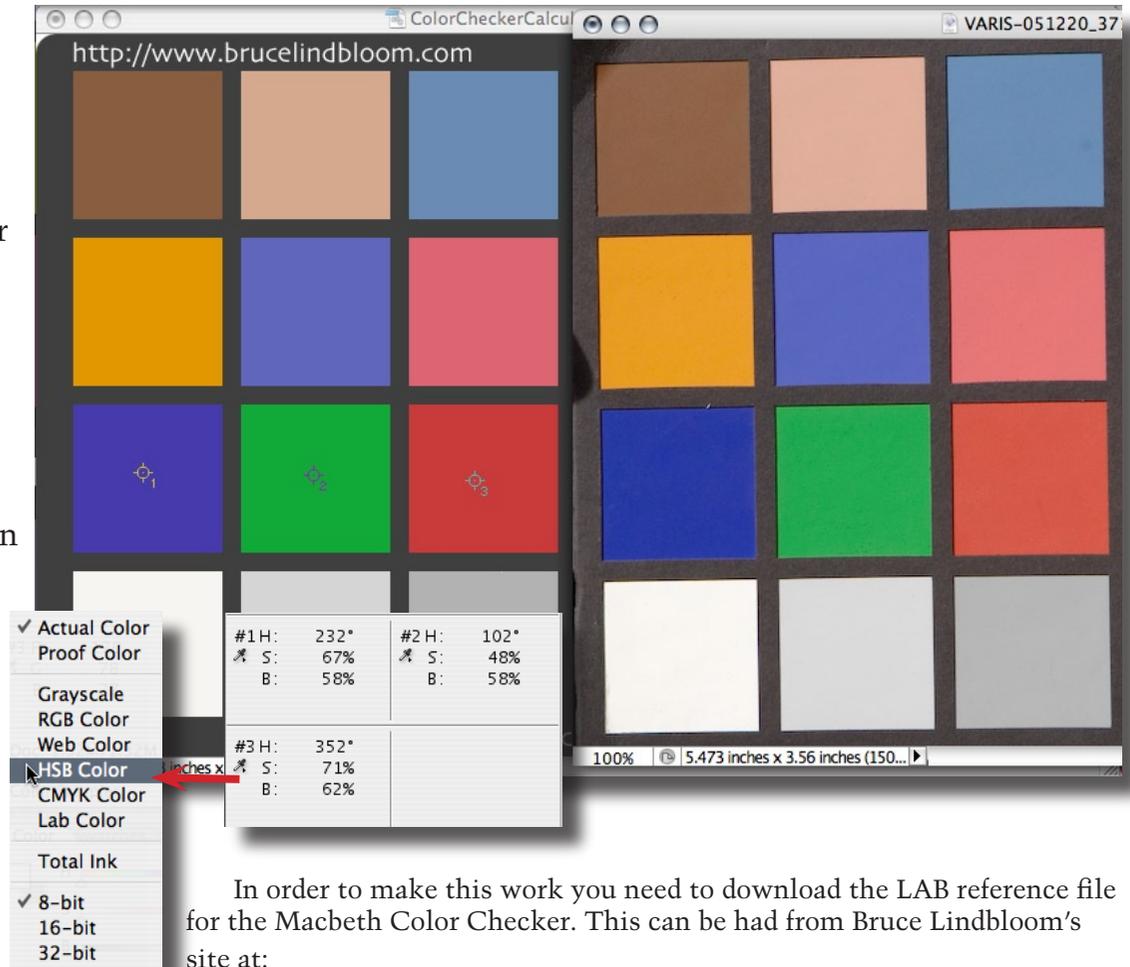
Now the fun begins. We are going to adjust the Red, Green and Blue sliders to get the patches on our Macbeth Color Checker to match the hue and saturation of the ideal values. Unfortunately, ACR doesn't give us HSB numbers, only RGB so the easiest way to figure out how to set the sliders is to process out the file and read HSB (Hue, Saturation and Brightness) numbers in Photoshop. Bear with me now because this gets a little tricky...

First, set up a crop with the Crop tool – try to aim for a Crop Size close to 800 x 600 (select from the "Crop Size" drop down in the Workflow options portion of the dialog). Click on Open to bring the image into Photoshop...



HSB Samplers in Photoshop

The idea here is to compare our real world Color Checker against an artificially generated “ideal” chart that has the official LAB values for each of the color patches. Set up Color Samplers for the Red, Green and Blue patches then change the read outs to HSB numbers. You can do this by clicking on the little eyedropper icon next to the numbered sampler readouts in the Info palette and selecting from the fly away menu. Place samplers in both the real world file and the LAB reference file...



In order to make this work you need to download the LAB reference file for the Macbeth Color Checker. This can be had from Bruce Lindbloom's site at:

<http://brucelindbloom.com/downloads/ColorCheckerCalculator.tif.zip>

Compare Samplers

Write down the numbers and compare. We are only interested in the hue (H) and saturation (S) numbers. Now you need to figure out how much to add or subtract from the real world numbers to get to the LAB file numbers. Make sure you're reading *both* files in HSB numbers or you will get seriously messed up!

In our example we need to add 4 to the H and S values for blue, subtract 5 from H and add 9 to S for green AND subtract 9 from H and add 16 from S for red.

ColorCheckerCalcul VARIS-051220_37

http://www.brucelindbloom.com

| | |
|------------|------------|
| #1 H: 232° | #2 H: 102° |
| #1 S: 67% | #2 S: 48% |
| #1 B: 58% | #2 B: 58% |

| | |
|------------|--|
| #3 H: 352° | |
| #3 S: 71% | |
| #3 B: 62% | |

100% 13 inches x

ColorCheckerCalcul VARIS-051220_37

| | |
|------------|------------|
| #1 H: 228° | #2 H: 107° |
| #1 S: 63% | #2 S: 37% |
| #1 B: 54% | #2 B: 58% |

| | |
|-----------|--|
| #3 H: 1° | |
| #3 S: 55% | |
| #3 B: 67% | |

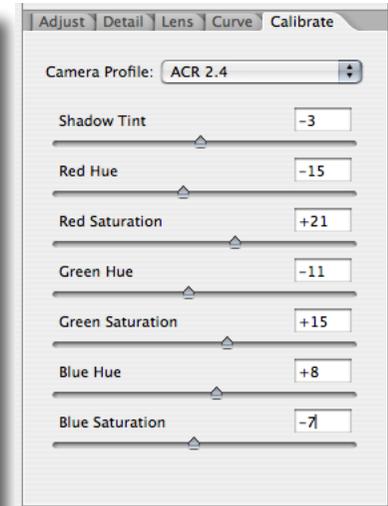
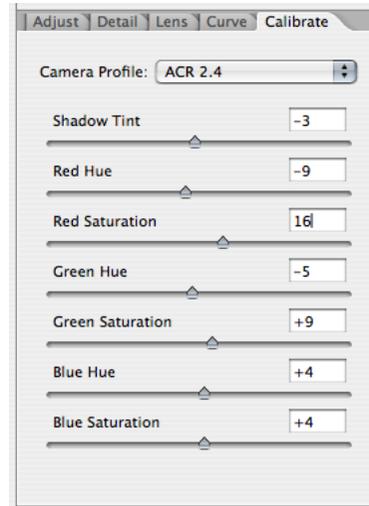
100%

Adjust Sliders

Now re-open your RAW file and put the calculated values into the Hue and Saturation sliders for Red Green and Blue in the Calibrate tab. Re-process and re-open in Photoshop. Compare the values again. They probably won't match up yet – you usually have to do this at least 3 times. Compare the values and figure out the difference. Add the difference into slider position values and re-process. Compare again and repeat until you get within 1-3 units of the ideal.

You may want to experiment with the contrast slider in the Adjust tab – this can have an impact on the overall saturation. So, if you notice that saturation for R, G and B is extra low, try raising the contrast or the saturation slider just a bit. Mostly I like to keep these sliders at zero and reserve their use for creative purposes – I prefer to get the color as close as possible using the Calibrate sliders with all adjustment sliders at zero

The screen shots at the right show the first and last iterations of the Calibrate slider settings and the LAB sampler numbers with the final adjusted RGB sampler numbers.



| | |
|------------|------------|
| #1 H: 232° | #2 H: 102° |
| S: 67% | S: 48% |
| B: 58% | B: 58% |
| #3 H: 352° | |
| S: 71% | |
| B: 62% | |

LAB

| | |
|------------|------------|
| #1 H: 233° | #2 H: 103° |
| S: 68% | S: 48% |
| B: 57% | B: 61% |
| #3 H: 353° | |
| S: 70% | |
| B: 68% | |

RGB

Once you have the numbers matching as close as possible you need to visually compare all the color patches in Photoshop...

Visually Compare

At this point you want to critically examine both files in Photoshop – colors should match very closely BUT it is very common for there to be a brightness difference between the charts. Pay special attention to the “Flesh” color patch. It is likely that this one patch may appear a little redder in your real world ColorChecker. This is a deficiency inherent with Bayer pattern chips and has to do with the overlap in frequencies between red and green filters on the chip. Skin tone lives right in this overlapping region and its almost impossible for de-mosaic algorithms to resolve this. This is the reason we find over-red skin tones in digital captures. If people are your primary subject matter you might consider moving the Red hue slider to the right a bit in The Calibrate tab. This will bias red towards yellow and take the “red curse” off your skin tones. Obviously this will come at the expense of deep saturated reds in other subjects but you are entitled to make some creative calls with your color interpretation... aren't you?



In essence, what we've accomplished here is to build a custom camera profile in Adobe Camera Raw without using additional third party software. The next step is to make this “profile” available for general use in our photography.

Save Settings Subset

Re-open your RAW file – the Calibration setting will be where you left them. Before doing anything else, select “Save Settings Subset” from the Settings flyaway menu. You will be presented with a dialog where you can select a subset that you wish to save – choose “Calibration” from the drop down menu. Name your settings for the situation you are calibrating for – in our example I chose “CR2-Daylight”.

This setting can be recalled and applied to any future shots taken with this camera in daylight. You only want to save the Calibration settings because white balance can vary somewhat from scene to scene and you want to maintain some flexibility. If your primary subject matter is shot in daylight you might consider incorporating this calibration in your camera default. Otherwise you will have to apply it separately when processing your files.

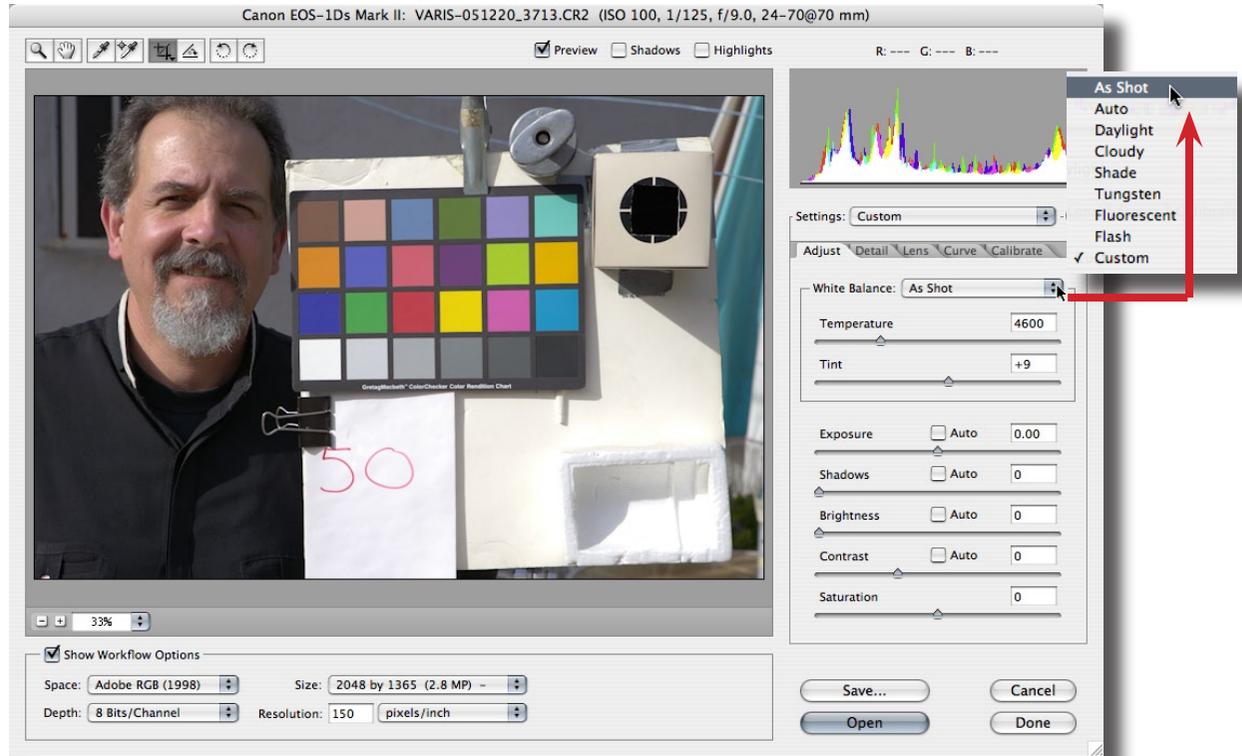
The screenshot illustrates the process of saving a subset of settings in Adobe Lightroom. The main window shows a photo of a man with a color checker chart. The 'Settings' panel on the right displays various calibration adjustments. A 'Save Settings Subset' dialog is open, showing a list of settings with 'Calibration' selected. A red arrow points from the 'Save Settings Subset...' option in the Settings flyaway menu to the 'Save Settings Subset' dialog, and another red arrow points from the 'Calibration' option in the dialog to the 'Save Settings Subset' dialog.

Establishing a New Camera Default

OK... follow along carefully here. If you want to incorporate this calibration in your camera default settings you will need to carefully set the rest of the settings in the various tabs appropriately.

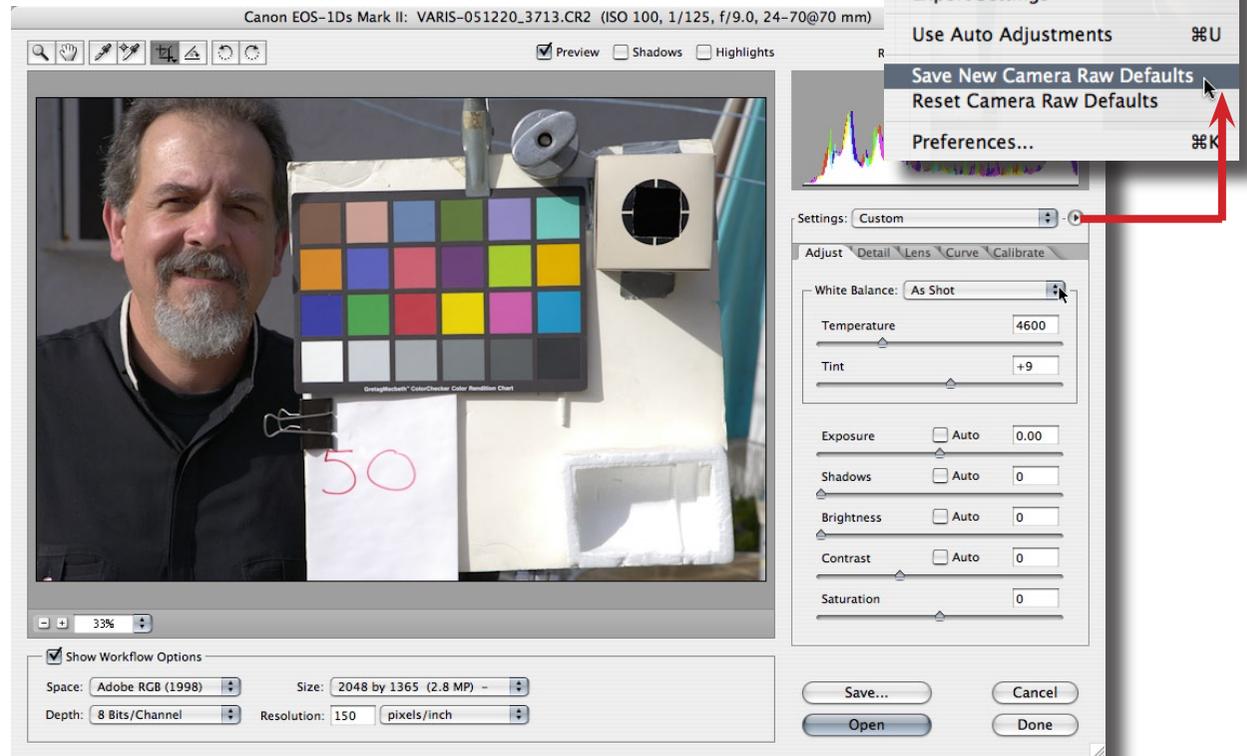
Step back through the tabs and make sure they are set at your desired defaults. The Curve tab should probably stay at "Medium Contrast". The Lens tab sliders should be left zeroed out. The Detail tab should be set for the level of sharpening and noise reduction you desire (I set everything to zero). Finally, very important, you should re-set the Adjust tab White Balance back to "As Shot".

The Camera Raw Default will save all the slider positions in all the tabs. The only way to leave the white balance out of the settings is to save that



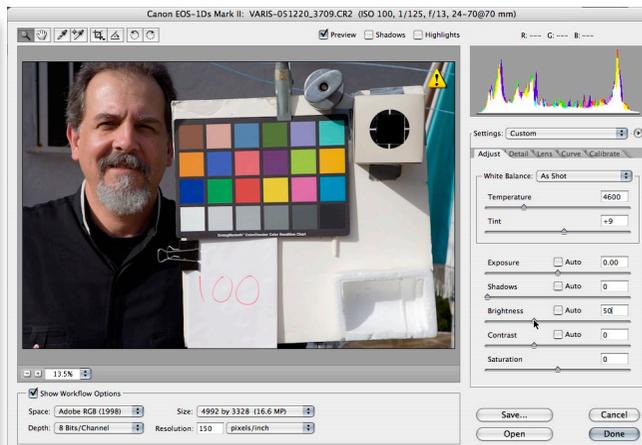
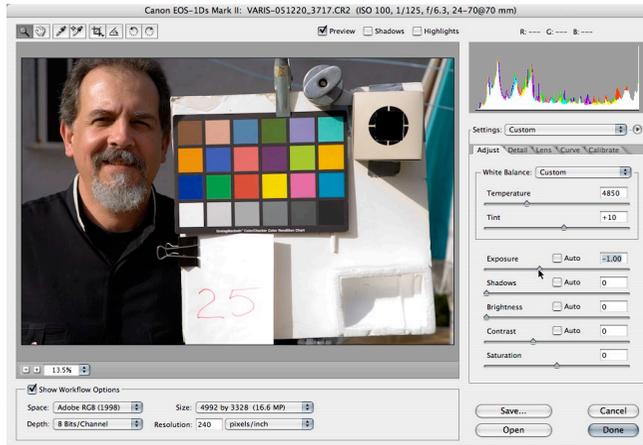
slider at "As Shot". If you leave your camera set to auto white balance ACR will pick up the setting and adjust the slider to match. This will mostly insure that the initial previews generated in Bridge will be reasonable.

Save New Camera Default



Once everything is set you can select “Save New Camera Raw Defaults” from the Settings flyaway. Now the first time you open a new RAW file from this camera the dialog will be set up as you see here and you can adjust for creative purposes without worrying about color integrity.

The New Calibration in Practice



When you calibrate this way you maintain the best possible quality and retain the most flexibility for processing your RAW files. Establishing a calibration with zero slider positions insures that the RAW data is recorded at the highest signal level without encountering serious white point clipping. It's pretty much like "exposing to the right of the histogram" but with greater precision. The only drawback is that the previews on the camera LCD might seem a little bright. Adobe Camera Raw is the only RAW processing software I know of that allows for true zero or linear defaults in all settings so this calibration strategy won't work with the camera software or something like Phase One's Capture One software.

Overexposed files can be easily rescued by using the Exposure slider in minus positions as seen on the left above. Underexposure is usually best dealt with using the Brightness slider as this will insure that you don't clip the highlights – a +50% position equates to plus one f-stop. Contrast and Saturation start off at zero but can be adjusted for specific subject and lighting easily and logically.

Conclusion

Taming The Digital Beast

I have had great success using this calibration strategy. I test every new camera this way and establish calibration settings for Daylight and Tungsten light. The beauty of using the HSB numbers for establishing color fidelity is that you can use any RGB workspace you like. There is no need to use ProPhoto RGB at 16 bit for testing purposes and for the most part, I recommend sticking with Adobe RGB or sRGB for the bulk of your commercial work anyway.

I encourage you to tweak your calibrations to suit your personal preferences though. You shouldn't necessarily accept the numerically accurate HSB renderings of the color patches – most of us don't sell pictures of ColorChecker targets. Think about how you prefer your color. More contrast? More saturation? Put these into your calibration so you don't have to tweak every file every time.

If you are so inclined and you have a lot of calibrations to do you might consider the automatic Javascript routines that Tom Fors has created. Check out his ACR script here:

<http://fors.net/chromoholics/download/>

Tom's script works pretty well but it takes a while to execute and I still prefer my method as it allows for more personal judgement in the calibration process.

Remember, you are calibrating a complete capture system that includes the lens. You can usually count on lenses from the same manufacturer to have the same color bias but as soon as you switch to a different manufacturer (a third party lens) you will likely affect the subtle color bias and you'll need a different calibration. For that reason I recommend staying with the camera manufacturers lenses if possible.

Finally, calibration is no substitute for creativity. You should feel free to break away from rigidly accurate color renderings to suit your creative needs or the needs of your client. Your calibration settings are only a starting point from which you are obligated to depart on a journey to your personal vision. You should also save out creative renderings as presets that you can call on for different purposes. The calibration method outlined here should be considered a tool to allow you control over your photography not an end in itself.

Varis PhotoMedia Tutorials

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Thank you

I hope you enjoyed this tutorial. The techniques outlined here represent just the tip of the iceberg. Photoshop is a very deep application - a person could spend years studying it and there will always be more to learn. If all this seems a little overwhelming, take a break, do what you feel comfortable doing in Photoshop and return to this tutorial again later on. Often, it takes several weeks for a particular technique to sink in so give it time.

I have other tutorials available online (navigate to the methods section), some are free and some are available for a modest charge. See tutorials and some examples of my work at:

<http://www.varis.com>

There are many learning resources available on the web - here are a few other sites with good information:

<http://www.russellbrown.com>

<http://www.creativepro.com>

<http://luminous-landscape.com/>

<http://www.imaging-resource.com/HOWTO.HTM>

<http://www.photoworkshop.com/>

<http://www.adobe.com/misc/training.html>

<http://studio.adobe.com/expertcenter/photoshop/main.html>

<http://www.ledet.com/margulis/articles.html>

<http://www.steves-digicams.com/>

<http://www.photoshoper.com/>

<http://www.handson.nu/>

<http://photoshopgurus.info/>

These last two links are typical of the majority of Photoshop tutorial sites - they are focused on cool graphics effects not photography. You might want to look over this material anyway - sometimes you can learn a lot about basic functions in Photoshop.

I'm always trying to improve these materials and I'm always open to your feedback. You may contact me via email at:

varis@varis.com

best regards, Lee Varis 2006