

HIGH DYNAMIC RANGE (HDR)

There is an ever increasing demand by photographers to have more control over the digital processing of their images. This has resulted in the High Dynamic Range HDR option now being part of Photoshop CS2 and CS3.

HDR allows the combining multiple exposures of the same scene with precisely the same composition, magnification, and F-stop being used for the exposures. It is commonly considered that 5 exposures are quite satisfactory for HDR purposes. This allows for two underexposures, one accurate metered exposure, and two overexposures. At the risk of over simplification the HDR process uses the information from one exposure to fill in the blanks on yielding a record of a wider range of tones than can be recorded with a single exposure.

In the end analysis it all comes down to numbers. The number of colors available for viewing and printing each pixel is called bit depth or color depth. The higher the bit depth, the higher the number of individual colors available for manipulation, allowing far greater control and accurate color reproduction in the finished image.

How do bits and colors relate to one another? It's simple arithmetic. To calculate how many different colors can be captured or displayed, simply raise the number 2 to the power of the number of bits used to record or display the image. For example, 8-bits gives you 256 colors because $2^8=256$. Here's a table to show you some other possibilities.

Name	Bits per pixel	Formula	Number of values
Black and white	1	2^1	2
Windows display	4	2^4	16 colors
Gray scale	8	2^8	256 grays
Index color	8	2^8	256 colors
High color	16	2^{16}	65 thousand colors
True color	24	2^{24}	16 million colors

Black and white images require only 1bits to indicate which pixels are white and which are black (The values are 0 = black and 1= white). Gray scale images with a pixel depth of 8 bits can display 256 different shades of gray. Color images are displayed using 4 bits (16 colors), 8 bits (256 colors), 16 bits (65 thousand colors) called high color, and 24 bits (16 million colors) called true color. Multiple channel images use a grayscale image to represent each color.If each of three channels uses 8 bits per pixel, then the total pixel depth is 24 bits. The total number of colors available for RGB would be RED 256 x Blue 256 x Green 256 = 16,777,216. YES that is correct; over 16 million colors available for an RGB picture with an 8 bit per pixel per channel depth. Now imagine and you do the math to calculate the total colors available for an RGB with a 32 bit per pixel per channel depth. HDR has a 32 bit depth. It is all in the math: The higher BIT DEPTH number = Higher number of colors = greater control.

Dynamic range

Dynamic range is the ability of a channel (RGB 3 channels) to capture information from black to white, from the dark to light portions of a photograph.

The dynamic range of an 8 bit channel is 256:1

16	65,536:1
32	4,294,967,296:1

Photoshop has a very limited ability to make adjustments to an image with a 32 bit depth. The image must be converted to 16 or 8 bit depth to use most of the adjustment tools. Even though Photoshop has a limited ability to work with a 32 bit image, the HDR has been captured and the desired portions of the tone range can be represented at a lower bit depth.

This thing called HDR sounds really great. I do not want to put water on your campfire, but be sure before you start such application that your computer successfully completed calculus. Remember, I said it was all in the numbers. Your computer will understand that even if you don't. I have tried some experiments with three computers. Two of the computers use dual processors. Both dual processor equipped computers completed the HDR process in just over 1 minute 12 seconds. The single processor completed the process in 1 minute 15 seconds. On the single processor computer, I turned off the virus protection and closed all programs which run in the background, reconfigured the

computer to most efficient operation. At this point I ran the exact same HDR process with the following result: completed in 1 minute 9 seconds. Please keep in mind: all of the computers had 64x processors or better and 2+ gigs of ram. The single processor computer also has an 80 gig hard drive that is dedicated exclusively as a buffer for Photoshop. All this gibberish translated, it will take a while.

A few thoughts regarding the capturing process. Please place the camera on a tripod and lock tightly into position. It is very important that the camera does not move. Focus the lens and never readjust (if using an automatic focus lens, set the lens for manual and the camera for aperture priority). Select the aperture and do not readjust it. Start with a shutter speed about two stops under the correct exposure. Very delicately change the shutter speed for each successive exposure. Continue this process until 5 exposures have been taken. If you are making 7 exposures then the 4th should be the correct exposure.

HDR may be accessed from within Photoshop and from within Bridge. Even though there are a few more controls available when opened within Photoshop I still prefer the Bridge procedure best. In Bridge, select the folder that contains the images to be used in the HDR. From within Bridge select the first exposure. While holding down the control key (Mac = Command key) select the remainder of the exposures to be used. On the Bridge menu bar select Tool and point to Photoshop then to Merge to HDR. Click ok and the show begins. Photoshop will load each selected exposure and compute the camera response curve. After completing this process, a single exposure is presented with a histogram on the right top and a thumb nail of all of the exposures used in the HDR in a vertical column on the left. The histogram has a slider to adjust the photograph. However, it does not change the photograph. It is for visual examination of the

photograph. There is also a bit depth window just above the histogram that has three options 32, 16, 8. I normally retain the 32. Click the OK box and the file will be created with a 32 bit depth. At this point you can make adjustments to the 32 bit depth file using the exposure and the channel mixer. To access these go to image > adjust> exposure or image >adjust>channel mixer. The adjustments available in the exposure sub menu are exposure, offset, and gamma. The adjustments in the channel mixer are sliders for all three colors (RGB) and contrast. It is not necessary to make these correction at this time, however no further adjustments to a 32 bit file can be made at this point. Convert the file to a 16 or 8 bit file by pointing to image > mode and select the desired bit depth.

Photoshop automatically opens a sub menu titled HDR CONVERSION for converting the file to a lower bit depth. The options on this menu are Exposure and Gamma. Click ok and the file is now accessible to all of Photoshop's controls and adjustment tools.

Congratulations, that was not so tough. Making the exposures now that is a different story. The HDR process will not tolerate any movement at the camera or at the subject. Let us know of your successes.