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# The Photoshop High-Bit Advantage: Fact or Fiction

**When it comes to bit depth – maybe 8 is enough**

*by Jim Rich*

Some months ago, Dan Margulis made a challenge on the Applied Color Theory list to various subscribers who believe that you always need to work with 16-bit images in Photoshop to protect digital images from becoming degraded. In that discussion, Margulis stated that he believes it is not necessary to always work with high bit-depth images and that working with 8-bit images will provide results that are just as good. Basically, the challenge consisted of Margulis saying to certain high bit-depth advocates either put up or shut up, show me the difference between 8-bit and 16-bit images. His argument was so good, I took the time to create a test to either validate or nullify his tests.

**High-Bit Images**
The definition of a high-bit image technically relates to how 10, 12, 14 and 16 bits-per-pixel images are handled in Photoshop. Often a scanner or digital camera will create only 8-bit images and import them into Photoshop. Those types of images are typically used in the 8-bit Photoshop mode. Scanners or digital cameras that can import images with higher bit depths into Photoshop, such as 10, 12, 14, and of course 16 bits-per-pixel can only be used in the 16 bits-per-pixel mode. In Photoshop, an image that is above 8 bits, but below 16 bits, is still run in 16-bit mode, even though it is not a true 16-bit image.

**The 8-bit vs. 16-bit Argument and Photoshop**
In theory, high-bit depth advocates make a good case. The assumption is that there are more bits (and therefore more image details) in each pixel of a 16-bit image. 16-bit images are supposed to offer more flexibility during image editing. So when you apply image processing to a 16-bit image in Photoshop, you will have less quantization errors and therefore less potential banding and less overall image degradation.

Quantization is where mathematical errors take place because fractions are not used between whole numbers in a digital file. The whole number values that become fractions during image processing are re-calculated and then become whole numbers again.

In practice, when you ask the high-bit advocates to show you hard evidence, that is to compare the results of 8-bit prints to 16-bit prints with the same number of edits, they often provide a rational argument by reviewing an image's histogram. They also might point out that quantization is taking place.

**Key 8-bit Image Benefits**
One of the primary end-user benefits of using 8-bit images over 16-bit images is that Photoshop offers more tools, and therefore has more capabilities for adjusting and manipulating, 8-bit images. The 16-bit mode offers a very limited set of tools. 8-bit files are also smaller and take up less disk space. Because more Photoshop options are available in the 8-bit mode, this makes the workflow more efficient.

**Test Methodology**
In December 2002 at a color management conference, I set up and ran a test comparing 8-bit and 16-bit RGB images. For this test I printed 8-bit and 16-bit images via Photoshop (with profiles) from my Epson 5500 printer. Photoshop was set up for an RGB workflow. Nothing was done purposely to bias the test. Transparent and reflection images were scanned by various brands of scanners as 8-bit and high-bit images and then were converted into the Adobe 1998 working space.

The images used were at risk to posterize due to the combination of their image content and the extraordinary image processing that was applied. A majority of the images in the test had over 30 edits applied. A number of images were converted from RGB to L*A*B* modes two or three times. Some of the tone edits involved over a 25 percent change in both RGB and L*A*B*.

At the conference, I placed 28 Epson prints on a table and let a group of imaging experts (pre-press types and photographers) inspect and review them. The test was not for color accuracy between prints. Participants were given a form with yes and no response categories.

**BITter Results**
The initial feedback from the group of experts who did not choose to fill out the form but who took a few minutes to compare the images was that they could not precisely see any differences between the 8-bit or 16-bit images. They all went on to say that any response they would have would be a guess. This result was

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verified again with the approximately 20 test forms that were filled out. The overall outcome showed all participants were guessing (40- to 60-percent of the time they were wrong) at which images were 8-bit or 16-bits.

**Histograms Can Guide You But...**
In theory, an image might have a bad looking histogram (with lots of gaps), making one believe that the image will posterize. In this test, all of the 8-bit histograms looked bad. However, the number of visible gaps in these histograms was not the defining factor, it was how the final prints looked. Any other problems, such as banding or image degradation relating to too many image-processing edits, were indistinguishable. This indicates that the behind-the-scenes math applied in Photoshop is so sophisticated that quantization errors are very hard to see on final prints, even after an extraordinary image-editing session.

**Are More Than 8-bits Necessary?**
The test I have described and its results cover a majority of 8-bit images used in most RGB workflow situations. But, there are some exceptions. Some situations (though very few) require using 16-bit images in Photoshop.

One reason to work with 16-bit images in Photoshop is if your original image (film) has a harsh break or banding due to the way the image was originally photographed. Once the problematic image is scanned into the computer system, using 16-bits, the file will be processed with little degradation. If the same image processing is applied to an 8-bit image with this problem, the file will degrade and fall apart. Banding like this only shows up in a small percent (2 percent or less) of images. The most practical solution is to scan only those types of images as 16-bit. Then work in the 16-bit Photoshop mode as long as possible. The rest of the images (98 percent) can be worked in an 8-bit workflow.

**Quality Image Capture Technology is Critical**
What I have commented on so far is related to working in Photoshop. This bit-depth issue is sometimes confused with the technical details of a good scanner or digital camera that can deliver high quality images. It is well known that to obtain high quality images, a scanner or digital camera usually requires higher bit-depth options. Meaning that you often need more than 8-bits per pixel to be captured during the scan or capture phase. This input scanning or digital camera strategy allows the resulting file to achieve good shadow detail and maintain color saturation. It is very typical for an input device to capture over 8-bits per pixel and is a positive attribute to an imaging system. This can include high-bit scans sampled down to the best 8-bits or high-bit scans that are imported directly into Photoshop.

**The 16-Bit Myth**
Six or seven years ago poor implementation of scanning and digital camera technology caused lots of banding and posterization problems. One of the technical reasons for banding was poorly written scanner drivers. The problem typically was created by inadequate or incorrect math when the driver was developed and written. This problem influenced some experts to recommend working in 16-bits. At that time, it was probably the correct thing to do.

Times have changed. In the last few years, scanners and digital camera technology has matured. Photoshop image-processing has been refined. This test, and many others, verifies that imaging technology has become more accurate. It also points out that high-bit workflows are seldom necessary for editing images in Photoshop.

**Scanning and Image Capture Tips**
If you are skeptical because you are convinced that 16-bit images are the only way to work in Photoshop, consider these options for working in the 8-bit Photoshop mode.

• Use the scanner or digital camera to capture the best 16-bit data. Make a copy and work on that in the 8-bit mode. Use the 16-bit original as a backup.

• Work in the 16-bit image during the initial stages of your Photoshop working session. Apply tone adjustments, such as highlight, midtone, shadow and gray balance adjustments before converting to 8-bits. Technically this is where a lot of quantization takes place.

• Get a good scan. From an end-users perspective, the reality is, if you have a scanner that introduces banding with either 8-bit or 16-bit-images, fix the problem either by acquiring a better scanner driver or by getting a new scanner.

**What about CMYK?**
While this test focused on an RGB workflow, the information from this test is pertinent to CMYK workflows. In the last five years, I have not seen any problems related to the 8-bit and 16-bit issues such as posterization when applying a reasonable number of color edits to CMYK images. However, until I do a test like the one I have described, my advice is to work in RGB with 8-bit images as long as possible. Apply major tone edits with Levels or Curves before converting to CMYK. Then fine-tune the CMYK file if necessary.

**The Bottom Line**
Let me make this clear. The position I have taken on the 8-bit verses 16-bit argument is based on facts. It was the advocates of 16-bit images who did not back up their argument with hard evidence that peaked my interest to do this test. If I see that evidence I am willing to reconsider my position.

Since I have spoken about this test, I have met some high-bit end-users who will not believe a word of the results. My final comment to them is that the hard evidence indicates in most cases that you cannot see a difference between 8 and

16-bit image prints. In the instances where a difference was spotted, it was only a guess the majority of the time. **D**

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