

## Time to shine - print the best out of your photos

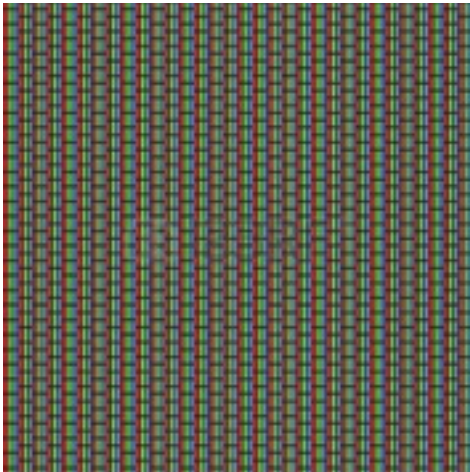
Before printing your photos, we should consider three important issues: **quality**, **resolution and colors**.

Why quality? Because if the quality of your photo isn't sufficient right from the beginning, no amount of post-processing, expensive materials, prayers or miraculous printers will be able to make it look good in the end. If you provide low-quality data, you'll degrade your image. Keep in mind that as you process your image, you're moving away from the original — you're throwing away pixels. Therefore: always shoot at the best of your camera's possibilities; always choose RAW files with the maximum bit-depth; always opt for the maximum quantity of pixels available; always shoot with the lowest ISO possible, the correct exposure, the correct focus and the proper props (tripods, tabletops & co).

Now that you have a great pic, drop it into your RAW processing program and feel free to work on it as you wish, but try to keep the colors and density from going outside the histogram. Clipping highlights or shadow detail affects your ability to color-correct as well as print with detail in the extremes. When processing your RAW file, keep in mind not to pump up your contrast, density, or saturation too high because you're going to refine everything when the time has come for softproofing.

Once you're done, you can export your file to ProPhoto RGB, 16-bit color, TIFF. That's mandatory! Why? And why ProPhoto, why 16-bit and why TIFF?

One thing at a time. We know that our photos are big, fat grids full of pixels, tiny little squares that contain a certain amount of red (R), green (G) and blue (B). **RGB** is the color language of light and devices that emit/transmit light. This includes cameras, television, projectors, monitors, and cellphone screens. It is the color language of digital devices.



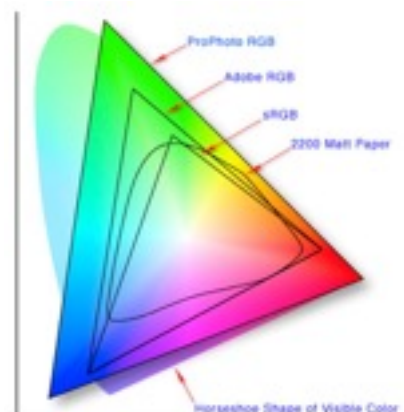
If you open up an image in Photoshop you can use the eyedropper tool to select a color and view the image's color information. This range is designated per channel as 0 to 255. Zero is no light and 255 is maximum light. If R=G=B at 255/channel you get white. The different colors you see are merely different number combinations.

The RGB color space has three main categories: **ProPhoto RGB, Adobe RGB and sRGB**.

Each of these color spaces is represented by 0-255, an absolute value of light output, but the range of their output varies greatly. This range is called **gamut** and some gamuts are wider than others.

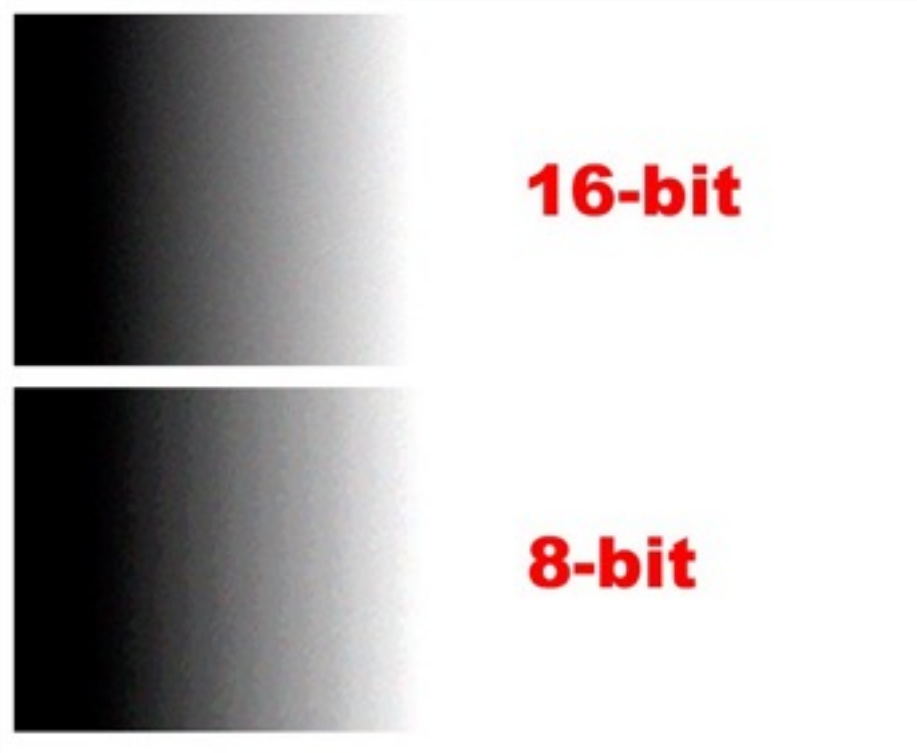
ProPhoto RGB has the largest gamut (range), Adobe RGB is in the middle, and sRGB is the smallest, but most commonly used. Most digital cameras offer to capture and represent color in both Adobe RGB and sRGB. The wider gamut of Adobe RGB allows for more color to be available as well as increased flexibility in manipulating color. If you shoot in sRGB, you've already limited your color rendering ability by at least 30%.

If you have the option, set your camera's color space to Adobe RGB or the color space with the widest gamut available. This will give you more color information to work with in post production.



For the same reason, use ProPhoto RGB as your working space when you use Photoshop CameraRAW, and keep it also when you're going to export your file for archive or printing purposes: as you can see on the previous image, the gamut of the 2200 Matt Paper (just an example) can represent colors that are not included in both sRGB and Adobe RGB. And you don't want to leave any of them out!

Then, **16-bit colors** give you **more depth** than 8-bit. The **TIFF** file format is **more robust** than JPEG, especially for heavy image manipulation. This translates to more leeway, better color, and smoother tonality. Of course, the downside to TIFFs is that the file size is much larger than a JPEG due to the low compression of the data. Be sure to choose JPEGs only if you can't handle TIFFs, but always in 16-bit: once you start editing the 16-bit image can withstand it way better.



Once you've exported your file, make a copy and open it with Photoshop. Why a copy? Because you're probably going to export a different photo from the one you've just saved. Remember that before printing a photo, you need to know your final support. Papers, inks and other materials (like canvas, aluminium dibond and so on) are not the same: in order to keep the colors as close as they appear on your monitor (which is, hopefully, well calibrated), you will need something called **color profile** (usually .icc or .icm files). A color profile is, let's say, a special recipe that takes into account the printer-ink-paper combination and tries to represent the colors on your monitor in the best possible way.

So before doing anything else, please choose your material, call or email us and ask for the proper color profile. Once you have it, it's time for some soft-proofing. Upload your color profile into your profile library (just do some google magic if you don't know where it is) and go to "View > Proof Setup > Custom...". A window will pop up with a few drop-down menus. Select your ICC profile, and in the other menus, select the options needed to properly render the softproofing.

This will simulate your output device: your image should change in appearance, usually by colors and density flattening. To find out which colors are out of gamut, turn on your "Gamut Warning" and it will highlight which colors are outside the output device's gamut.

This information is really helpful in determining if you'll need to do a spot color plate or if you need to adjust that specific hue's density or color to bring it back in gamut.

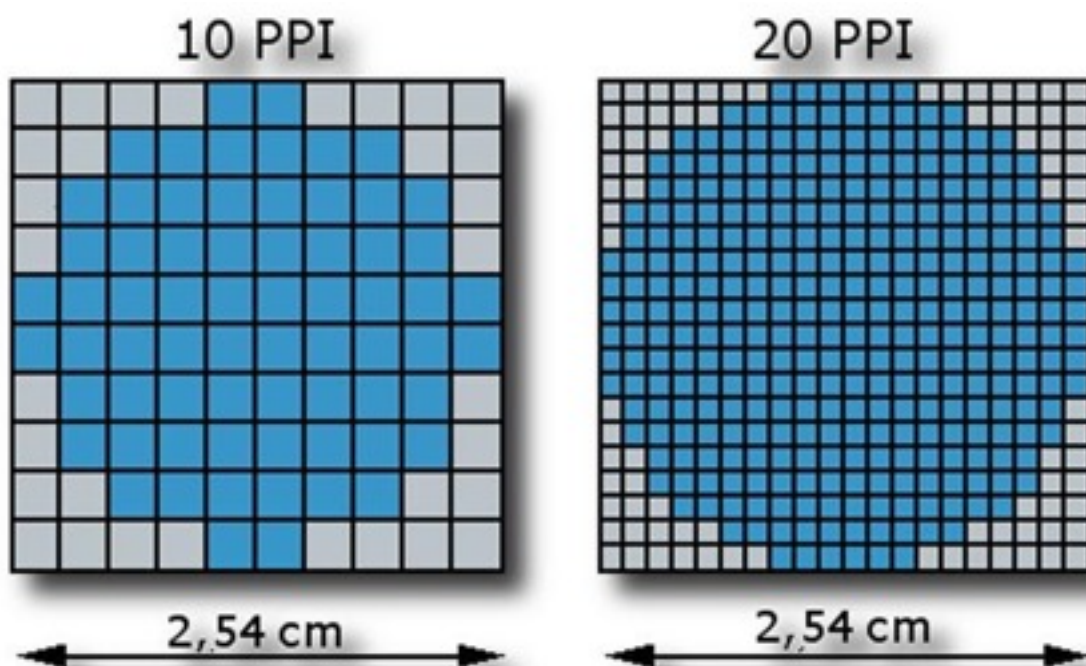
Adjust your color, density, saturation, and other edits to try and fit within your softproof's gamut, toggling your previews until you're as close as you can get. Once all that is done, look at your white point and black point. If the RGB values aren't equal, they aren't neutral and any remaining color cast will only intensify when printed. Use a separate curves or color balance tool to equalize those numbers as best you can.

The final two things you'll want to do are work on approaching the maximum ink densities of your output, keeping in mind dot gain, and sharpening. For the densities, you can adjust saturation, levels, and/or curves to help mitigate the flatness of your image. Softproof often when doing this. Finally, apply sharpening after you've resized the image to it's final output size. Doing it this way ensures that the sharpening you see on screen is the sharpening you'll get in your print.

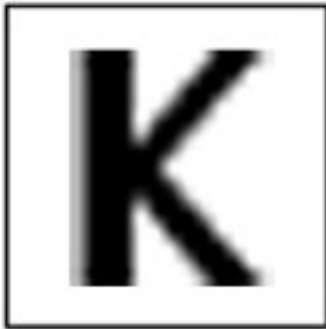
Now save and get ready for the next step. You chose the support, now you have to choose the size of your print. We already know that digital images are made of pixels, millions of pixels, actually. For example, an image of 2.000 x 3.000 pixels needs 6.000.000 of tiny squares to be represented.

At the very moment I'm writing this tutorial, I'm looking at my iMac monitor, that - according to the ruler - is 51,8 cm wide and 32,3 cm high. If we convert the measures in inches, my monitor becomes 20,4" wide and 12,7" high: let's keep that in mind. Now, if I take a look at "System Preferences > Monitor", I'll find out that my monitor shows 1.920 x 1.200 pixels. Doing the math, we'll discover that 1.920 pixels / 20,4" means that we have 94,1 pixels per inch. Same way, 1.200 pixels / 12,7" means that we have 94,5 pixels per inch. I can tell for sure that my monitor has a resolution of 94 **pixels per inch**, or 94 **PPI**.

On this number that shows the density of pixels per inch depends the printing quality of your photo. How come? Because the more pixels are contained in a squared inch, the better defined and sharp your photo will be in the end.



96ppi



192ppi



384ppi



On this number also depends the maximum size you can print your picture without losing in quality. In this case one can rely on the following indications:

**< 150 PPI = poor quality**

**150 - 240 PPI = acceptable quality**

**> 240 PPI = excellent quality**

So let's say we have a photo that is 5.184 x 3.456 pixels big.

$5.184 \text{ (pixels)} / 240 \text{ (excellent quality PPI)} = 21,6'' \times 2,54 \text{ (cm/inch)} = 54,864 \text{ cm}$

$3.456 \text{ (pixels)} / 240 \text{ (excellent quality PPI)} = 14,4 \times 2,54 \text{ (cm/inch)} = 36,576 \text{ cm}$

Basically, our photo can be printed in the very maximum quality in a size of 54x36 cm. In order to print it bigger, we should decrease the PPI amount and print it in a lower quality.

Keep in mind that the bigger the prints are, the less PPI you will have, so at a closer look you will clearly see all the tiny pixel squares. But of course, it's unlikely that you will look at a 150x130cm print putting your nose at a distance of 10 cm. If we think about an A4 picture, it's clear that looking at that pic at a distance of 3 cm doesn't make sense. Similarly, looking at it a distance of 3 meters makes no sense either. The optimal observation distance (or better, a range of distances) can be obtained calculating the picture diagonal (36 cm for an A4 pic) and multiplying the number for 1,5 (lower limit) and 2 (maximum limit). So:

$36 \times 1,5 = 54 \text{ cm}$

$36 \times 2 = 72 \text{ cm}$

We can see that between 54 and 72 cm observation distance is optimal for a picture that is printed 29,7 x 21 cm big.

A good formula to calculate the least resolution for a print is the following:

**resolution (PPI) = 8.733 / observation distance in cm**

For example: we need to print a picture that should be 100 x 75 cm big. If we multiply the diagonal size (125) per 1,5 and 2 we obtain 187,5 cm and 250 cm, which is our range for optimal observation.

If we decide for 187,5 (which is the lowest limit for optimal observation), we can easily do the math:

$$8.733 / 187,5 = 46,5$$

46,5 would be the minimum amount of PPI required for a 100 x 75 print that can be looked at without problems from a distance of 220 cm. Of course we know that the more, the better, so if we can keep the resolution number higher and between the range listed in the previous page, your prints will look better even from a shorter distance.

But what do you do when you have a picture you want to print in a certain size but the resolution is not high enough to have good results? You have two options:

- 1) Print it smaller (and frankly, this is the better option)
- 2) Interpolate (Upsampling)



**Upsampling** is an image-editing process that enlarges your original photo, making up (or interpolating) additional pixels to fill in the gaps. This creates more resolution but can't create more detail or sharpness. This is why resampling from the high-quality original image always works best: adding more pixels won't do miracles. As we said at the very beginning, you need quality pictures. Now, what makes for a good pic when we talk interpolation?

- **No noise (low ISO)** : Once arrived at 200 ISO (double of 100 ISO, usually the base sensitivity of your sensor), the quality starts to decrease. You will have higher contrast, lower gamma and saturation. When we use denoising filters we reduce image quality and it's like having less pixels;
- **Correct exposition** : correcting exposition in postproduction can lead to noise;
- **Perfect shooting** : no shaking hands, use of tripods, remote control and so on;
- **No JPG artifacts** : start from TIFFs;
- **Correct sharpening**

Photoshop offers several upsampling methods. You choose one in the General panel of the Preferences dialogue or in the Image Size dialogue. The resampling method you choose in the Preferences dialogue matters when you resample outside the Image Size dialog, such as when you use the Free Transform tool. Each method has its strengths and weaknesses for different situations.

1) **Nearest Neighbor** is the most basic, and it's very fast: To create a new pixel, Photoshop simply looks at the pixel next to it and copies its value. Unfortunately, the results are usually lousy for photographic content. Nearest Neighbor works best when the image has hard, straight edges and when you only want to make the existing pixels look bigger.

2) **Bilinear** is more complex and produces better quality: The program sets the color or gray value of each pixel according to the pixels surrounding it. Some pictures can be upsampled pretty well with bilinear interpolation, but one of the bicubic options usually looks better.

3) **Bicubic** creates better effects than Nearest Neighbor or Bilinear. Like Bilinear, it looks at surrounding pixels, but its equation is much more complex and calculation intensive, producing smoother gradations.

4) **Bicubic Smoother** is specifically designed for upsampling. As its name suggests, it gives a smoother result that handles subsequent sharpening better than the Bicubic sampling method does.

5) With the new **Preserve Detail** algorithm (on Photoshop CC) - which you can apply directly from the Resample popup menu or apply passively by leaving the Resample setting on Automatic for any enlargement - Photoshop does a much better job of preserving the edges, so I would recommend this feature for any upsampling work.

