Northallerton Camera Club

RGB vs CMYK Images

During one of our highly enjoyable, prints evening a discussion was started about RGB vs CMYK printing that might have been understood by a few members, but could just as easily have bamboozled many. With that in mind, the following article is an attempt explain the key facets of the arcane world of high-quality digital photo printing and, more helpfully, to guide those with less experience towards better and more consistent printing results.

For reasons that I'll explain the RGB vs CMYK issue is a bit of a misnomer and rather anachronistic, so let's put that one to bed before we move on.

It is correct that printers are CMYK, but that only holds true as a principle these days, rather than the practical process of printing photographic images well. To understand why, we need to go back to the origins of colour printing, when 4 rollers covered, in order, with inks of cyan, magenta, yellow and 'key' (normally black) were found to produce acceptable colours across a large part of the visible spectrum. Incidentally, black had to be added because mixing the other 3 produced a dark brown, rather than the expected black. Any special colours required (known as spot colours) required their own roller and specific ink. This is still the process used in commercial printing today and it still has difficulty in reproducing lighter versions of strong colours (and that's why photo printers with 6 or more inks often feature some 'light' cartridges). Modern photo printers still usually adopt inksets with their own versions of CMYK, but that's really where the similarity with traditional printing ends.

Why? Because the essential difference between screens and printers is not RGB or CMYK colours or profiles. It's down to what is called 'fluorescent' vs 'reflective' surfaces on the night. More properly in colour technology, this is 'subtractive' vs 'additive' colour – this is the essence of screens vs prints. A screen is a black background to which a blend of red, blue and green is added to create a pixel of a colour (additive), whilst paper is a white background to which a blend of inks is added to leave only the colour desired (subtractive).

The practical result is that the advanced software we now process our images through is automatically converting from what we call RGB colour values to, very broadly speaking, CMYK colour values as best they can, but they do it by actually converting from additive models to subtractive models – and use printer and paper profiles to do this as their preferred method, as it automatically takes account of paper colour, paper surface, and the specific inkset/printer combination being used. We'll explore this in more detail later. It's worth noting that Epson (and other print gurus) are clear that their inkjet photo printers expect an RGB file, which is then converted to the settings for that print. Sending a CMYK profile to the printer won't be a disaster, but your system will convert it to RGB and then reconvert it to the requested profile for the printer, with some colour variation likely.

Now let's take a look at a few basics when it comes to most people's print objective – a good quality print with colours and dynamic range that closely approximate those on the screen.

The Basics (or 'what things can really screw up colour consistency')

- **Consistent colour space.** We'll touch on colour space again in this article but, for now, let's just accept that it's important! By consistent, I mean the camera colour space and your editing software colour space (all your editing apps). Your camera is likely to be sRGB if you've not changed it, or AdobeRGB if you have changed it and print a fair bit – other colour spaces, such as ProPhoto, are available. The important thing is to keep it the same throughout. WHY? Because colour spaces contain differing ranges of colour and those colour spaces are generally embedded in an image. So, if you have an image with sRGB embedded in it, but Lightroom/PhotoShop/Affinity/etc. is set to AdobeRGB (or anything else) the colours will normally shift to the new colour space.

- **Screen Accuracy/Calibration.** This is the place you have to start if you want to achieve reasonable screen to print matching (or even matching between 2 screens side-by-side!). This is a tough one to understand and I've had many fraught exchanges with graphic designers who think their very expensive Apple monitor is colour accurate – it's not, despite the rich colours and 8k resolution – it's just more accurate than most if you set it up nicely, but without calibration.

It's a bit like trying to get your holiday suitcase exactly on the limit of 20kg using bathroom scales. You might get lucky, but you'll usually be under or over on the calibrated airport scales and will continue at every airport as you try to tweak the weight (e.g. colour settings, contrast, brightness) by taking things in and out of the suitcase. If only you'd had a calibrated set of scales at home!

How do you calibrate a screen? Unfortunately, the accurate way is with a calibrator (you don't say!), such as a Spyder or Calibrite unit, which you would use at least monthly (it's amazing how far even a good quality screen can drift in that time). If that's not your cup of tea, try using the colour controls on your screen (avoid HDR settings if you have them) and probably reduce your brightness, as most people have them too bright. Try halfway on brightness and print an image to compare. If you're a Windows 10/11 user, there is a basic calibration function in the display settings which is certainly better than nothing.

- **Paper Consistency.** During the evening, it was mentioned that another member calibrates his papers (as do I). What this means is he creates, or downloads from a paper manufacturer, something called an ICC profile. This is simply another type of colour space and colour instruction that is unique to a paper/printer combination. Essentially, it calibrates your system to take into account the ink set of your printer and the colour/texture/reflectiveness of a specific paper.

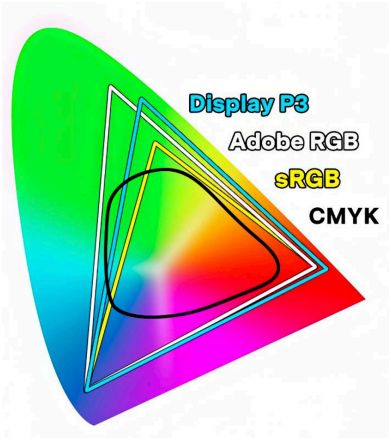
In practical terms, when I print from any of my editing software, I turn off the printer's control of the colour management and put the software in charge (most tools, such as PhotoShop, Lightroom, Affinity, DxO Photolab, etc. have this facility). Then I choose the ICC profile for the specific paper I'm using. Alternatively, you will have some generic profiles, such as 'photo matte' that should give a reasonable result.

Using a good quality profile will often affect the final screen to print colour accuracy more than whether you've used a CMYK or RGB setting.

Colour Spaces

This is a big subject, so I'll leave the reader to utilise the internet, where there are short and very long articles and videos on using and misusing colour space in photography.

To keep it simple and useful, use the smaller sRGB colour space if you most do screen-based and web image work (most 'normal' computer screens can't show the full sRGB colour space anyway), but use AdobeRGB colour space if you print a fair bit as it's a larger colour space and suits print work well. Here's the difference in the visible colour gamut of 5 colour spaces – the human eye, CMYK, sRGB, AdoneRGB and Apple's DP3:

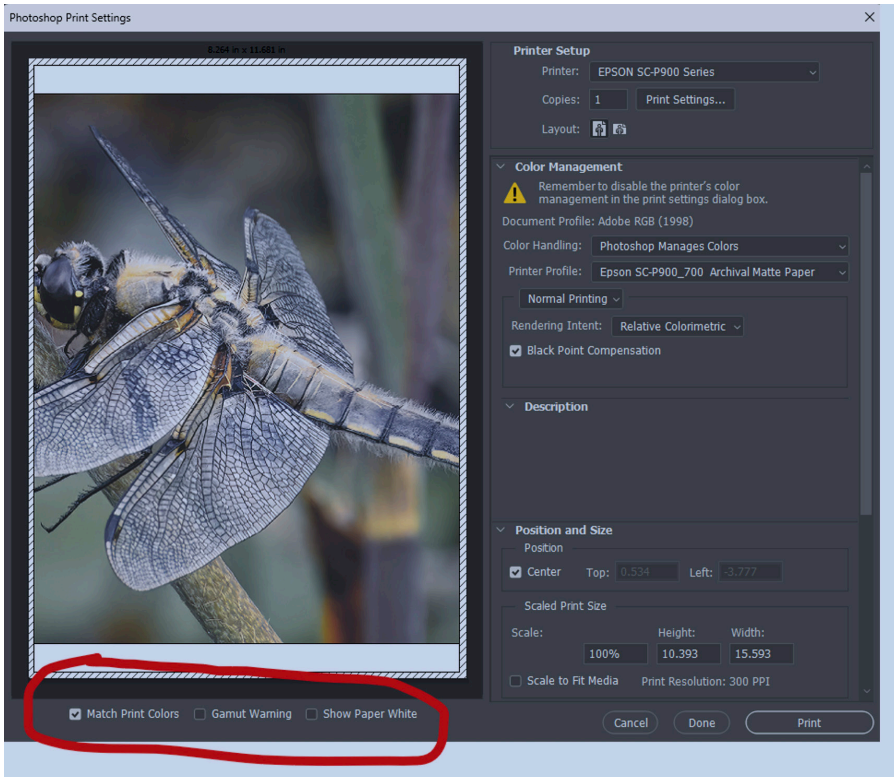


You can see that AdobeRGB not only has more colours, especially in the green spectrum portion but, as with the other spaces, there are subtle differences in other colours too. It's also clear why changing from an RGB profile to a 'true' CMYK profile would be a bad idea, as all those colours outside the CMYK gamut would be shifted to the nearest printable colour. That's why a leaflet printed by a commercial printer on a press always looks flatter and weaker than it did on your inkjet print. Happily, as I've said, your photo printer isn't really trying to print a 'true' CMYK colour space print.

Soft Proofing

When using commercial printing presses, a physical proof is normally produced for the printer and the client to check. This is done using a separate printer with a RIP (Raster Image Processor) that emulates the finished press product. Whilst we can't produce hard proofs at home, we can do 'soft proofing' i.e. a screen-based emulation of our final print. This still carries the warning about

additive and subtractive colour rendering, but it gets us closer to our final print and, in many editing and printing tools, we can make adjustments to the soft proof before we print (most often to saturation and brightness).
Apps like Lightroom and PhotoShop offer reasonable soft proofing in the print dialogue where you can tick boxes for print colour and generic paper types (if you've never done this, you might be surprised at the difference paper makes). This is the dialogue from Photoshop with the relevant section in the red circle:



Similar facilities exist in the separate print apps, such as Canon's Print Studio Pro, that printer manufacturers provide typically for photo printers of A3 and above. Some editing apps, such as DxO PhotoLab, have more extensive soft proofing capabilities that have soft proofing built into the main app window and allow the saving of virtual soft proofs for future printing purposes.

Finally, What About a Good Generic Set-Up for Printing Your Images

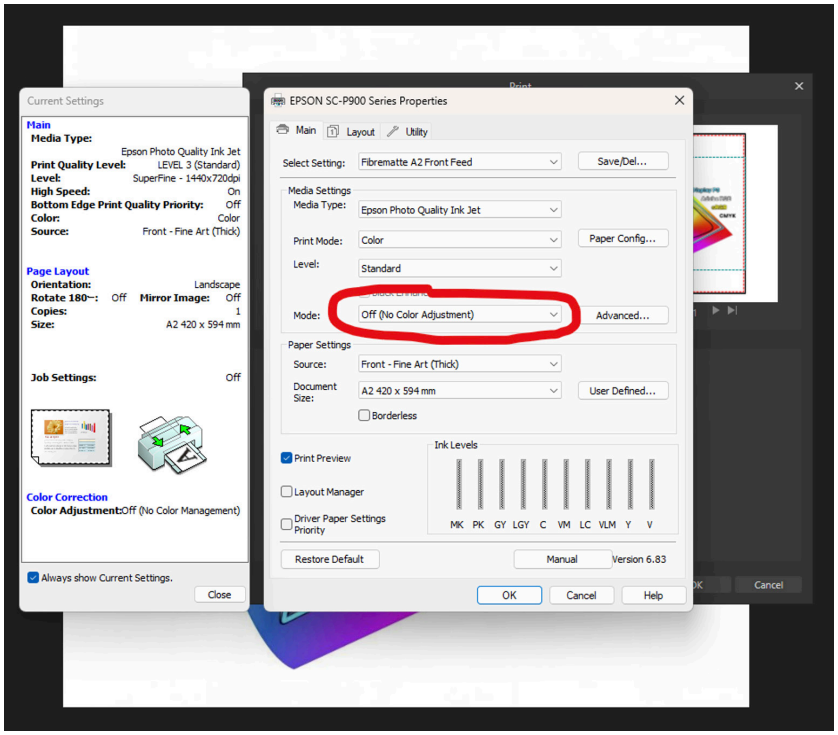
1. Make sure your camera(s), editing software and print module (probably within your editing app) are set to the same colour space. It's worth remembering that you can save separate files of the same image with different colour spaces (I save smaller files for web use as sRGB and keep all my large RAWs, TIFFs and JPEGS as AdobeRGB).

2 Calibrate your screen to whatever level you have available to you (ideally get a calibrator) and repeat at least once a month.

3. Use good quality papers and think about what paper works for which image – gloss, matte, velvet, lustre and metallic all have their strengths. Remember that good papers are expensive - calibration and profiling to avoid wasted prints are a good investment of money and effort over time.

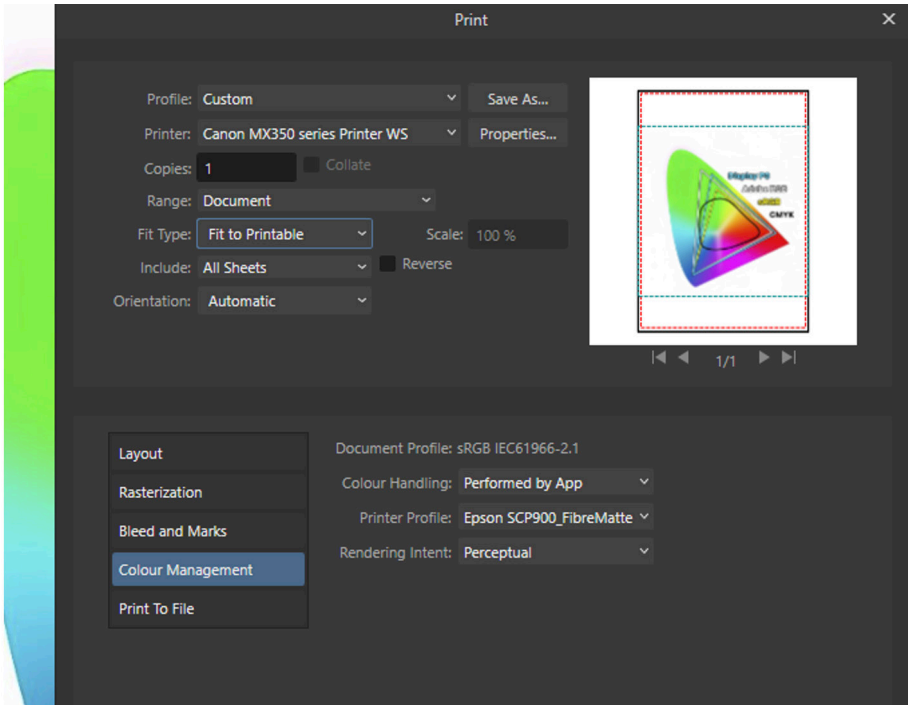
4. If you have a ‘proper’ photo printer, check what ICC profiles are available (most paper distributors have specific profiles for their papers across the most popular printers). Alternatively they will probably have a test file that you can print and send back to them on their paper and they’ll email you an ICC profile specifically for your actual printer (people like Fotospeed are great for this). Or, if you’re a geek like me with no sense, have your own print calibrator.

5. If you’re using any of the main photo editing apps, turn off the printer’s control of the colour management and let the app manage it using the paper type and ICC profile you’ve selected. Here’s a screenshot from Affinity:



I’ve circled the dialogue that turns off the printer’s colour management in the printer properties (for my Epson SC-900, this screen is identical in any editing app). You might also notice that I have a custom paper setting for Fibrematt A2 and a paper type of Epson Photo Quality Inkjet. The latter setting is one of the generic paper settings for Epson and the paper supplier will usually specify which setting to use for a particular paper. but the former setting tells the printer exactly what it’s dealing with in terms of generic paper type, size and feed (and you can set up numerous custom profiles like this).

The screenshot, on the next page, is specific to Affinity, but similar ones appear in all editing software and the important dialogue box is the one called colour management (note also that’s it’s an srgb embedded image because it’s a web download). Here, I’ve set the magic profile that is specific to the paper I’m using and my printer. With all this in place, an inaccurate print is probably down to me, or a poorly-calibrated screen (me again), or a misbehaving printer (not me, but a bigger headache!).



6. Do use any soft proofing facility you might have in your apps, as it's very likely that you'll end up tweaking a few things once you see the usual drop in vibrancy that occurs on the screen and the effect of differing paper 'whiteness'.

Last thought...

High-quality photo printing isn't an easy subject to make entertaining! The best, and most readable, book I have on the subject, Rocky Nook's superb Fine Art Printing for Photographers, is as dry as old bones and, happily for you, now superseded by the technology changes in apps and printers - it's now more automated and much easier, honestly. I've tried to cover the key concepts and workflow without getting bogged down in specific printers and apps (there's plenty of that available on the web). If it helps you to improve the quality of your prints, that's a great result. There's nothing quite like the physical presence of a stunning image, as our print evening illustrated.

Anyway, if you've read this far, well done and thank you.

Andrew Atkins (September 2025)