FROM DESIGN FILE TO FABRIC

By **Steve Smith**, DPInnovations

Getting your design file printed onto fabric has never been easier. Online suppliers now offer a plethora of fabric options, each one matched to a compatible ink chemistry, with the necessary fabric treatment and post processing. The majority of online suppliers offer a service designed for the consumer. As such, there are no guarantees when it comes to colour matching or accuracy. Most online suppliers recommend the client orders test prints on their desired fabric to ensure the printed fabric meets their colour expectations.

Fabrics and ink chemistry

Digitally printed fabric suppliers offer products printed with pigment, reactive, disperse and acid inks. Pigment can be used on a relatively large range of fibre types, whereas reactive, disperse and acid are used on a narrower, targeted range of fibre types. Each combination of ink chemistry, fibre, fabric treatment, post-processing and printer, result in a potential colour gamut being available. A colour gamut is the theoretical range of colours that can be printed, from the darkest black, to the brightest hues of red, orange, yellow, green, blue, indigo and violet.

Simplified ink chemistry & compatible fabric chart	
Disperse	Polyester
Acid	Silk, Nylon, Wool
Reactive	Cotton, Linen, Rayon
Pigment	Cotton++++

RGB colours

Anyone who has created a digital design is familiar with specifying colours using RGB values. The RGB colour model is an additive colour model where red, green and blue light are added together, just as a cathode ray tube does in older televisions and monitors. Adding the maximum red to the maximum green to the maximum blue results in white and removing all red, green and blue results in black. For a colorist, visualising what a red 185, plus green 26, plus blue 67 would look like is very difficult, if not impossible when considering the nuances of colour adjustment and variation.

RGB values are device-dependent, meaning each device displaying an RGB colour may do so differently, since the colour elements (tv/monitor phosphors) and their response to the individual red, green and blue levels vary from manufacturer to manufacturer, or even in the same device over time. Reproducing a RGB colour on a printer is more challenging, as the majority of printers use a base of cyan, magenta, yellow and black, plus optional lighter shades of each and/or extra hues such as orange, blue, violet, green and red. Producing an acceptable printed version of an RGB colour is both mathematically complex and subject to the viewers perception of the printed colour.

Perceptual or absolute?

The majority of online, on-demand digital fabric printing services setup their workflow based on what is referred to as a perceptual printing intent. This is typically an option within the colour management software that results in the complete range of RGB (256 x 256 x 256 = 16.7 million) values being mapped to the range of colours that can be achieved. As this range

Colour Matrix ©My Fabric Designs 2017

will differ either nominally or significantly according to every variation in a printer, ink, fabric, in fact any part of the workflow, the exact same RGB based colour will almost certainly print differently for every unique print environment. Sometimes this difference will only be measurable, other times it will be dramatically visible. This endorses the recommendation when printing an image using RGB colour values, to obtain a test print on each fabric, before committing to larger volumes.

A perceptual workflow is the ideal solution when printing a photograph, image or illustration that contains thousands of colour variations. In this case the print just needs to be something that can be perceived as being a good representation of the original image.

If a user wants to print specific colours matching physical samples that they already have, they can still use the RGB/Perceptual method described above by printing a colour book on each fabric. Each colour is printed with its RGB or HEX# underneath.

Using these values for image colours will result in the same colour as when the colour book was printed, on the same fabric. There are two significant disadvantages with this approach. The first is that the colour book will print differently on each fabric, resulting in the colorist needing to change the colour value in the image depending upon the fabric that is being printed on. Secondly, a colour book typically contains a few hundred or thousand colour blocks to choose from, whereas the RGB colour model has millions of colour variations.

Instead of using the colour book/RGB/perceptual method to obtain the colours desired we could use an absolute

Colour Picker Tool, Photoshop CC, Adobe 2017, My Fabric Designs 2017

workflow combined with the HCL colour model. The HCL colour model is more compatible with how the human eye sees colour and how a colorist manipulates colour. This model may also be referred to as LCH or L*c*h*. It allows us to specify a single set of colour values that should result in the same colour matched across all print environments, when combined with accurate colour profiles and repeatability throughout all aspects of the print environment.

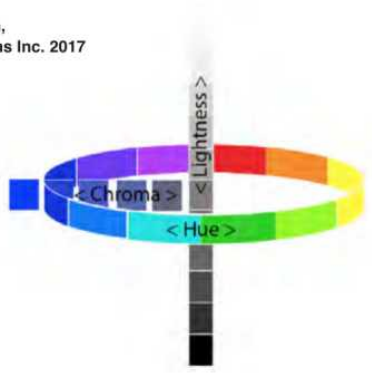
Instead of mapping all RGB variations to the achievable printable colour gamut, ensuring that all colours in the image will relate to the printable colour range and each other, the absolute intent attempts to match each individual HCL value in the image file to an ink recipe that results in the same HCL value colour being printed on the fabric. The accuracy of the match can be determined by measuring the printed colour with a spectrophotometer.

HCL refers to the values for hue, chroma and lightness. It is one of multiple tristimulus models defined by the CIE. CIE is an abbreviation of Commission Internationale de l'Eclairage, which translates to International Commission of Lighting. Hue is specified using a number of degrees from 0-359 representing the colours red, orange, yellow, green, blue, indigo and violet. Chroma is the brightness or intensity of the colour specified from 0-100, as is lightness. The HCL system is much easier to visualise than RGB.

Using this type of workflow, the exact colour being printed for each unique image colour can be controlled and will be consistent across multiple print environments. The caveat is that the colour needs to be within the colour gamut possible for that printer/fabric/ink combination. This is a major benefit for colorists wanting to match colour.

The image colour being printed should only vary significantly as a result of the colour specified being outside of the colour gamut achievable for a particular printer/ink/fabric combination.

HCL Diagram,
DPInnovations Inc. 2017



A simple example of this could be a black colour. A dark black could be specified as hue 0, chroma 0, lightness 17. Different ink chemistry and fabric combinations may have different black points, typically referencing the darkest neutral colour that can be printed. If the combination of printer/fabric/ink can only create a black with a lightness value of 22, the printed image will look very different. With an absolute workflow the other colours are not adjusted because one or more image colours are outside of the printable gamut and can't be reproduced accurately.

With an absolute workflow the image colours that are within the printable colour gamut are not adjusted due to out of gamut colours not being reproduced accurately.

RIP, colour management & profiles

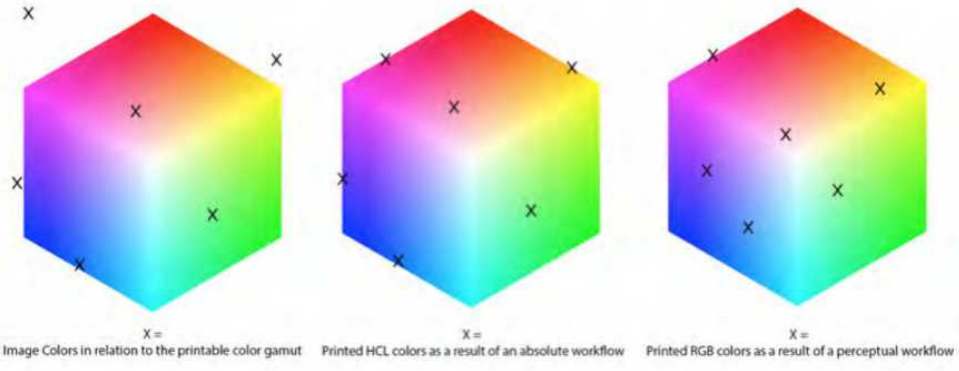
Achieving the optimum results for any given workflow is also dependent on the RIP software, colour management engine and the associated profile being used. RIP (Raster Image Processor) refers to the task of converting the coloured pixel or vector data in an image file to the necessary codes, which control the drop size of ink and where it is printed, to produce the correct colour and image reproduction.

There are multiple RIP's capable of being used as part of a digital textile printing workflow. Some RIPs have been specifically built for textile applications, some are modified versions of RIPs created for the sign and banner industry and some are multipurpose RIPs that can be used across multiple industries.

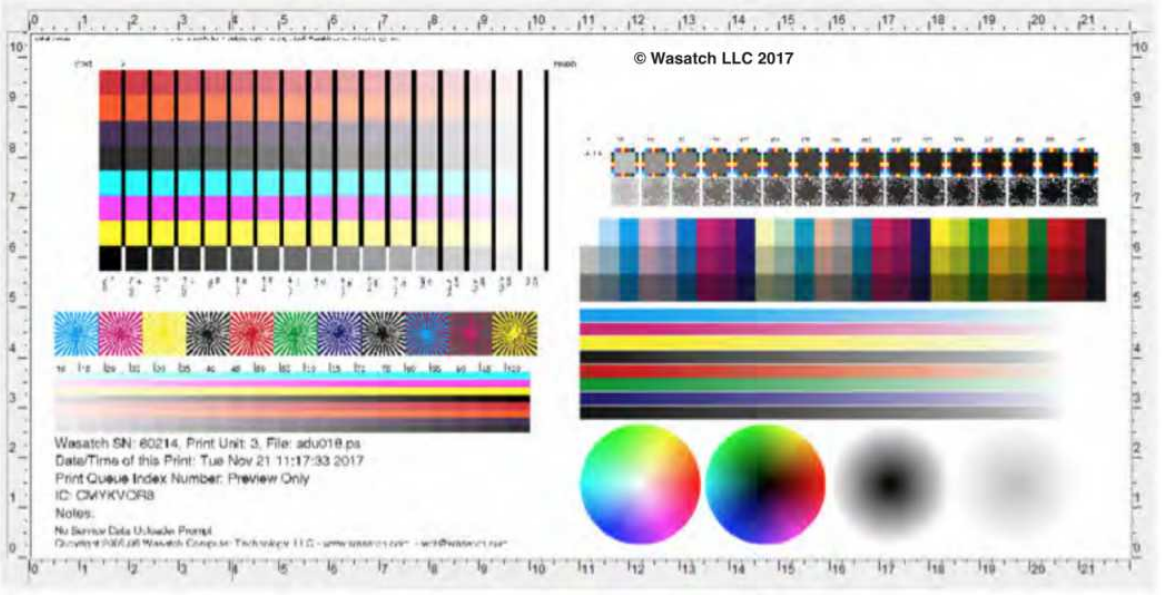
All RIP's require some element of colour management software, in conjunction with a colour profile to print an image that can be perceived as being an acceptable representation of the original image file. For most of us our eye is the ultimate judge of how good the match is between the digitally printed fabric and the original image file viewed on our phone, tablet, laptop or desktop. However, for those working in the textile industry, colour matching of individual colours is essential and can make or break the marketability of the fabric design. Those RIP's which have been specifically developed for the textile industry tend to have a more advanced set of features that address the issue of colour matching.

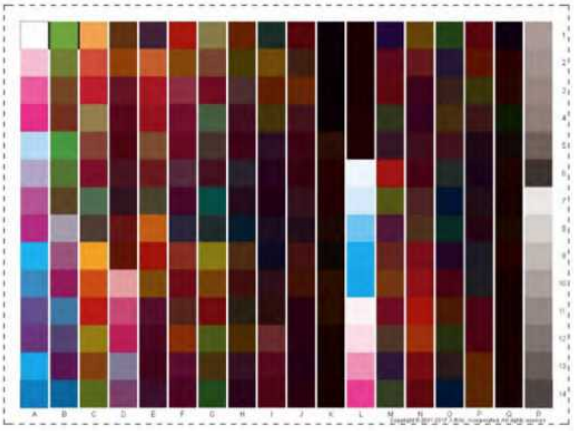
Each manufacturer's RIP approaches colour management and profile creation differently. Some manufacturers develop and integrate their own proprietary technology, others integrate and enhance off the shelf SDKs (Software Development Kit) and others rely completely on third party solutions.

Black levels diagram, DPInnovations Inc. 2017



Perceptual v absolute colour mapping, DPInnovations Inc. 2017





i1Profiler Chart, X-Rite 2017

Irrespective of the approach taken by the RIP developer, the colour management technology relies on colour measurement data found within the profile. A profile is a collection of data obtained by measuring hundreds or thousands of colour swatches, where each swatch is a different combination and amount of ink.

Once the optimum print settings have been identified to ensure the largest possible colour gamut with the sharpest image quality containing no artifacts such as bleeding, the profile creation process can be commenced.

The first step in profile creation is often referred to as linearisation. The profile creation software measures each individual ink to ascertain the resulting print density for different requested percentages. As a result of this process the profile creation software will know exactly what percentage of ink is required to obtain a desired density on the fabric. This information is then used to create hundreds or thousands of colour ink recipes, which are printed as blocks of colour on a series of pages.

These pages are then measured so that the reflectance curve of each printed colour is known. As reflectance curve data can be converted to many formats including HCL, this data along with the associated ink recipe is saved as a colour profile.

The printed result obtained as part of the profiling process will vary as a result of each print environment: RIP settings; printer/nozzle type; ink colours; ink chemistry; fabric; pretreatment; post processing, etc. Profiles should be acknowledged as being specific to the configuration and settings used for a particular printing environment. However, in today's high pressured, shorter lead-time textile industry, many digital textile printing companies use the same profile for different print environments. For perceptual printing workflows a 'good enough' result can often be achieved, but for absolute workflows where colour accuracy is paramount, use of a profile created for another print environment is not recommended.

It's important to note that profiles are a result of the print environment at the time the profile was created. If any aspect of the print environment is not consistent, the printed results will vary, often affecting client approval.

To conclude, identifying the workflow required and using accurate colour profiles created for your consistent print environment, printed output can be obtained that will result in a high degree of approval, with little or no adjustment.