TECHNICAL GUIDE

TEXTILES

MEASURING COLOUR ON TEXTILES

Second Edition

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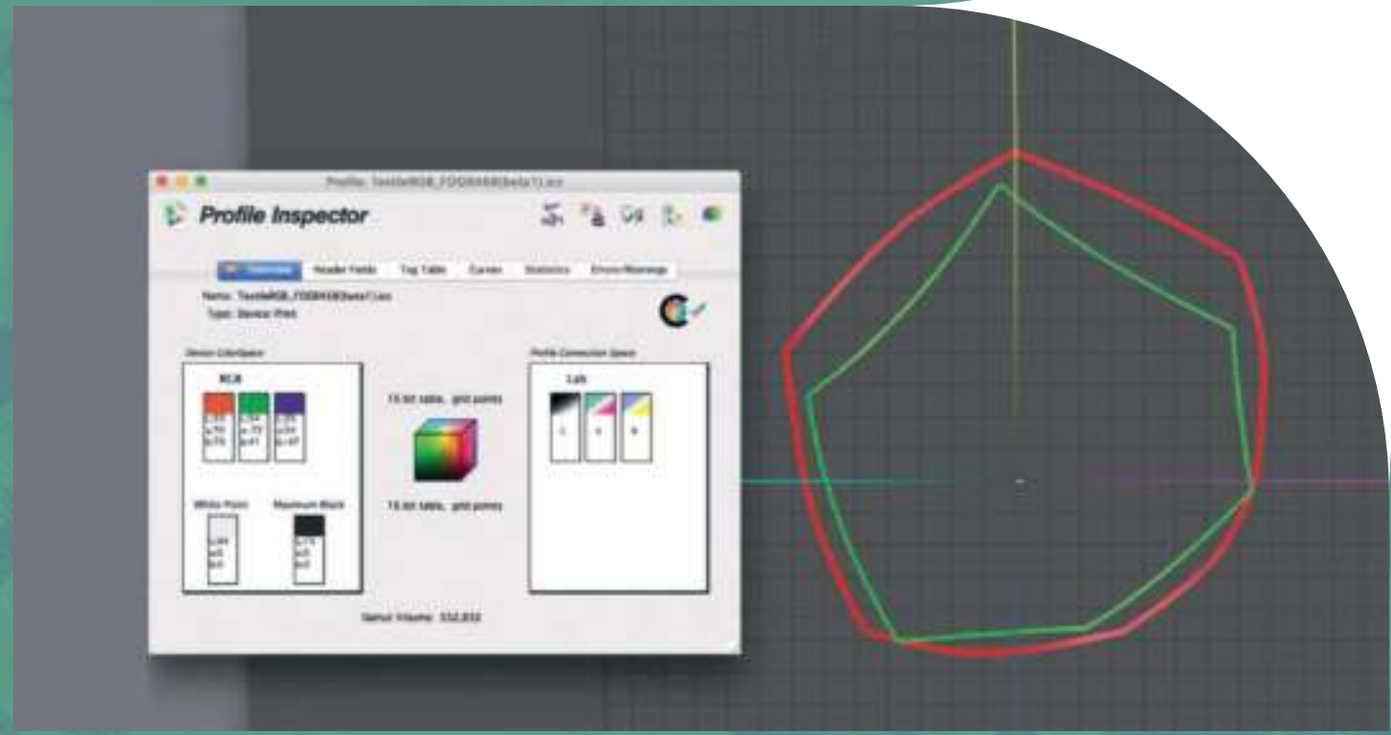
Measuring Colour on Textiles

Some may say that colour is subjective, however, in truth colour is a deep science, and with the correct workflow can be controlled. In simplistic terms colour is light, and as such it is affected by the light source in which it is viewed. To control colour a sequence of measurements must be taken, and the output colour adjusted to reach the customers colour standard.

Successful colour must be defined and controlled at the point of sale, and throughout the production cycle. Poor colour management creates waste, generates poor print quality and without doubt, customer complaints. All of which reduce profits and may damage your businesses reputation.

Colour must be understood, and standardised wherever possible within both the supply chain and the print workflow. Colour management, by its very nature is a historic

element of conventional print, what was once a manual process, where colour was adjusted by production colourists, has now largely been digitised. Now measured electronically, colour can be defined as data, and as such its digitisation has streamlined the production process, but with some limitations. Not all desired colours can be achieved in digital ink-jet printing as colour gamuts vary across all the various ink sets; Reactive, Dye sublimation, or Pigment. For example each print process gives a variance to the output that can be achieved; ink limits, gamut and final substrate affect final print colour, and must be quantified. In textile it is perhaps even more important than other print segments to spend time logging the incoming fabric white point, noting presence of OBA's and the variables of processing through to finished products. Variance in dye sublimation transfer temperature or steam fixing can all have their impact to achieving consistent colour reproduction.



This screen capture shows an indication of the FOGRA58(beta1) RGB ICC profile in red compared to the well known FOGRA39 CMYK profile much used as a target in commercial print. FOGRA are developing this as a suitable RGB colour exchange space for Textile designers to use as a better alternative to Adobe RGB (1998) or sRGB which have gamut volumes that far exceed the printable colour range of any technology. This represents a useful approach to ensure better colour management especially when combined with the ICC Max with its support for spectral data and measurement using CxF data.

When characterising and profiling any given fabric it will pay dividends to be thorough in recording all the parameters. This will ensure that those settings become the de facto standard for future production in screen or digital printing.

The Datacolor 800 Spectrophotometer is an example of a Sphere device that measures colour by sampling light from multiple angles to account for gloss and surface reflection. They offer many useful features for process control within larger production environments and require greater financial investment.

Spectrophotometers are used in conventional printing to manage colour using electronic colour mixing kitchens. They measure the entire spectrum and offer very accurate and reliable results. This colour science has been utilised as digital ink-jet has evolved to form the bedrock of the software we use today to control colour in digital textile production, and has over the years developed into an exacting science that gives the manufacturer complete control.

Spectrophotometers are an essential tool, and when used in tandem with colour management and calibration software, provide a vital control function to professional printers.

Designers and manufacturers must collaborate to work within accurate colour tolerances within the specified production workflow. When this is achieved, colour is controlled and standardised.

Where your requirements are less demanding or you're looking for a way to measure colour at low cost then a colorimeter can be used. These devices which include Pantone Capsure and the Datacolor ColorReader can sample a colour and search databases of colour recipes. Whilst it doesn't offer comparable accuracy for use against spectrophotometers it can be really useful and improve efficiency and process control over visual comparison in colour matching.

Lower cost colorimeters such as the Datacolor ColoReader Pro have with it's D65/10° specification, the ability to search colour books or ink databases via Bluetooth.

The CRD-1 lightbox from GTI demonstrates the colour variation between TL84 Store Light, D65 Daylight and Incandescent (Illuminant A) home lighting. This type of comparison can be helpful when checking metamerism of the same printed design on multiple fabrics.

Light plays a huge part in the approval of colour, and the only way to assure clarity is to use an industrial lightbox where the final lighting in which the product will be viewed can be selected.

The Just Normlicht Garment Viewing Booth illustrates that viewing cabinets are made for every application. This one for made up garments features five light sources. D65, Incandescent (Illuminant A), TL84, D50, UV-A can be programmed to switch in sequence. The inclusion of UV-A is useful for spotting Optical brightening agents.

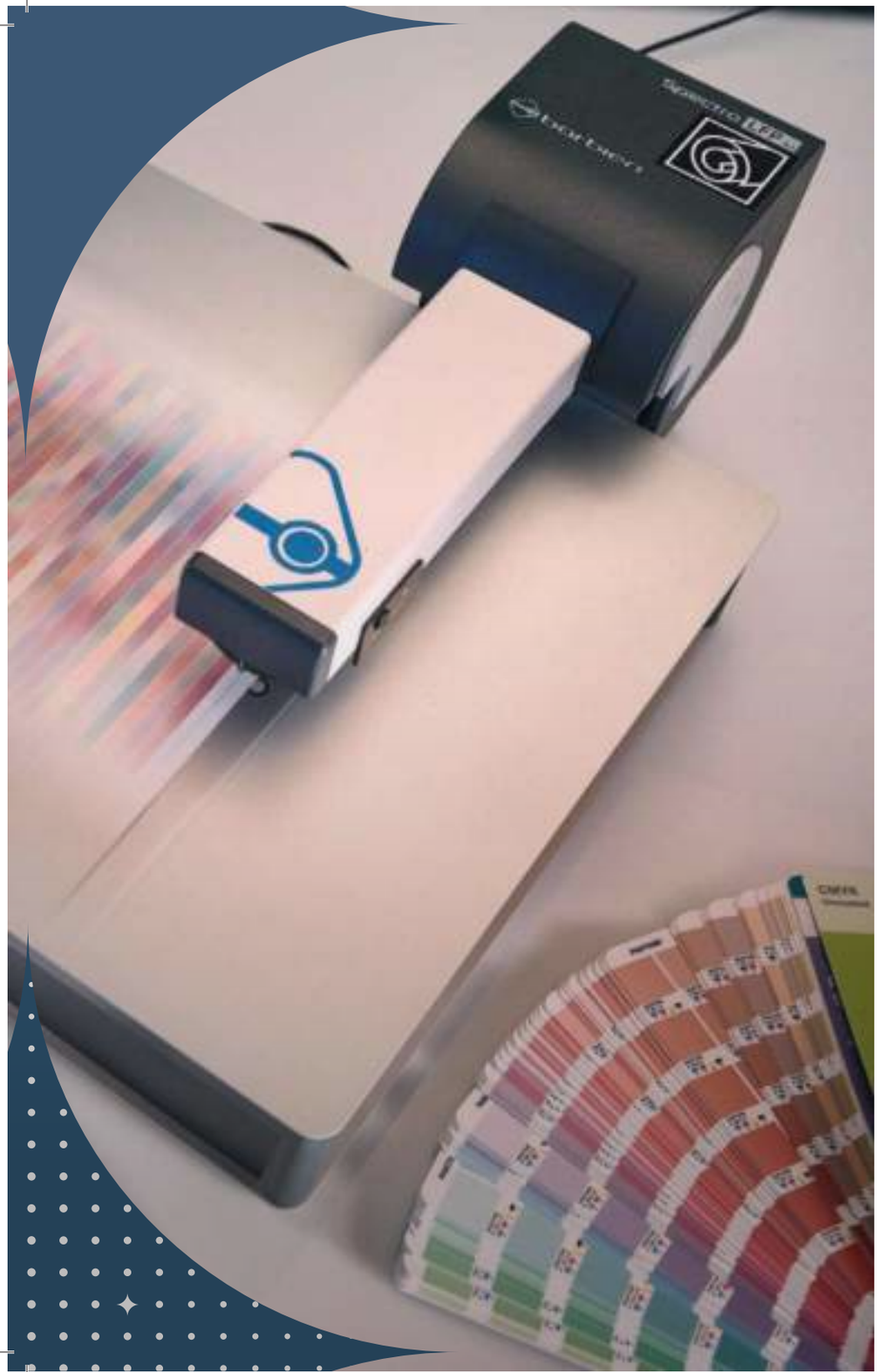
Where no output light is specified, TL84 has been the staple choice for the textile industry for many years as it represents typical office or store lighting in Europe and the Pacific Rim. This offers a consistent standard for designers and printers to compare in. The use of D65 is also commonplace in industries where paint finishes and automotive interior finishes are assessed. The most important thing to reinforce is that printers and customers agree which light source will be chosen for their production to avoid misunderstandings and the potential for orders being rejected, it should be written into the sales contract.

Choosing the correct type of spectrophotometer

Once we have assured ourselves that we have a correctly set up our lightbox, and selected the correct type of light, we can start to measure colour before and during print. Spectrophotometers measure the actual spectral output produced by the reflected light bouncing off of the printed fabric. You can also use a spectrophotometer to measure the light from a monitor, and so also then use it to calibrate your proofing monitor to your output target.

X-Rite offer their 8mm aperture spectrophotometer that supports textile and backlit profiling and can be connected to a range of colour management software packages or run with X-Rite's i1Profiler to create profiles and process control routines.

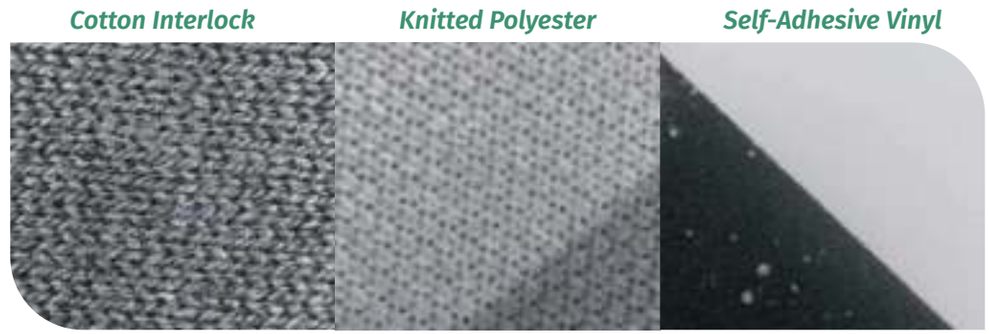
When measuring printed fabric, it's important to use a suitable spectrophotometer with a large aperture. Shown here is the Barbieri Spectro LFP, popular within large format digital print production.



The spectral data can be expresses as raw spectral data or converted into a device independent colour space, depending on the needs of the colour management software. The file format used for spectral data is CxF, published as ISO 17972 (Graphic technology — Colour data exchange format: CxF/X).

Spot colours especially are often expressed using CxF, since this file format uses rich metadata to describe both the printing conditions and the setup of the spectrophotometer when the measurements were taken.

One challenge with taking measurements on printed fabrics is that the surface is uneven and the resolution relatively low. To counter this technically we need to make sure that the spectrophotometer's



These microscopic images at equal magnification demonstrate why a large aperture spectrophotometer is required to overcome the rough surface texture variations when compared to a smooth material like self-adhesive vinyl.

aperture is quite big and that the measured samples are large enough to give stable and representative values.

For Textiles it is common practice to use the spectrophotometer in scan mode and average several sets of measurements. In this way you avoid getting the wrong colour through having read a too small area of the fabric. This technique is also helpful when reading metameric fabrics and fabrics that contain OBA's (optical brightening agents) and can be specified and then adjusted automatically within the colour management software.

What to do with the measurements?

It's all well and good to have a decent spectrophotometer, but to make full use of this equipment you will need good software. The first use of a spectrophotometer is to check the colour of a specific sample. For the wide format sector, there are several

printed colour guides for spot colours, but the Pantone system is perhaps the most commonly used. Pantone also offer a Textile version for cellulose and polyester fabrics. Be aware that the sample may be old or worn, so a better option is to measure the sample. Take note of the CIE Lab values and then try to match those values as closely as possible.

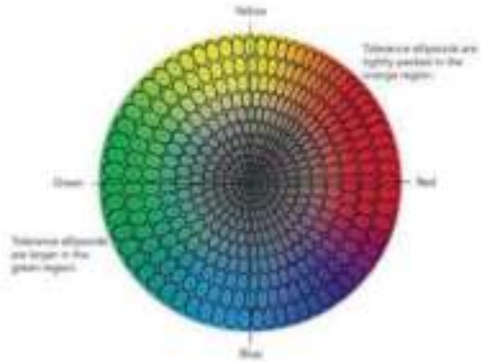
This might not be possible when only using the CMYK process colours, which can only reproduce about 60% of spot colours. When printing using conventional process's, you are used to loading a specific spot colour in the press, but this is not always possible when using digital presses. You might be able to load a few very popular spot colours as a special ink in the digital press, for wide format, but you are not likely to be able to order all the 1000+ colours in the Pantone colour library.

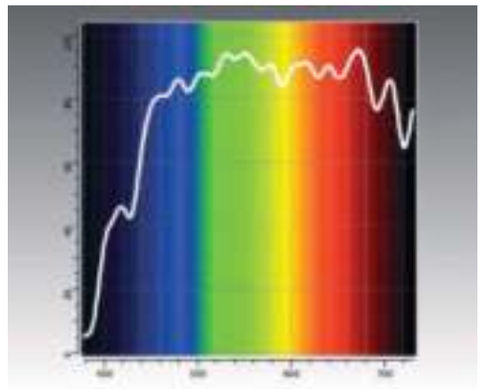
Digital Textile manufacturers make use of use of an extended colour gamut to create an extended colour space, and graduated tones, especially is certain sections of the space. This is possible if you combine the traditional ink set of CMYK plus additional inks such as Orange, Green and Violet.

When using an extended gamut ink set you should be able to reach about 90% of the spot colours in the Pantone library, but this depends a great deal on what fabric you are printing and on and the ink set.

To express the perceived colour difference a couple of formulas have been developed over the years. The oldest is from 1976, and if nothing else a colour difference, expressed as Delta E (written ΔE), is calculated using the formula from 1976. Of late the year 2000 formula is becoming more and more widely used. However, it must be stated if the colour difference measured, or tolerances defined, have been done using the year 2000 formula.

The tricky thing is that while it's generally said that humans can detect a colour difference smaller than ΔE 1, this is only true according to the old formula from 1976. The year 2000 formula typically gives you values for colour difference that are about half compared that of the formula from 1976. But checking that you





When evaluating prints and proofs it's important to use the correct light. An ISO-compliant viewing booth typically uses a specific standard daylight called D50. This means that the spectral distribution for the artificial light is even, and the whitepoint is at 5000 Kelvin, or K. (The Kelvin scale is used to measure the colour temperature of visible light).

reproduce colours within the specified tolerance for colour deviation is one important use of a spectrophotometer.

The other important use of the spectrophotometer is to calibrate a printing device, and after that to characterise it, meaning building an ICC profile.

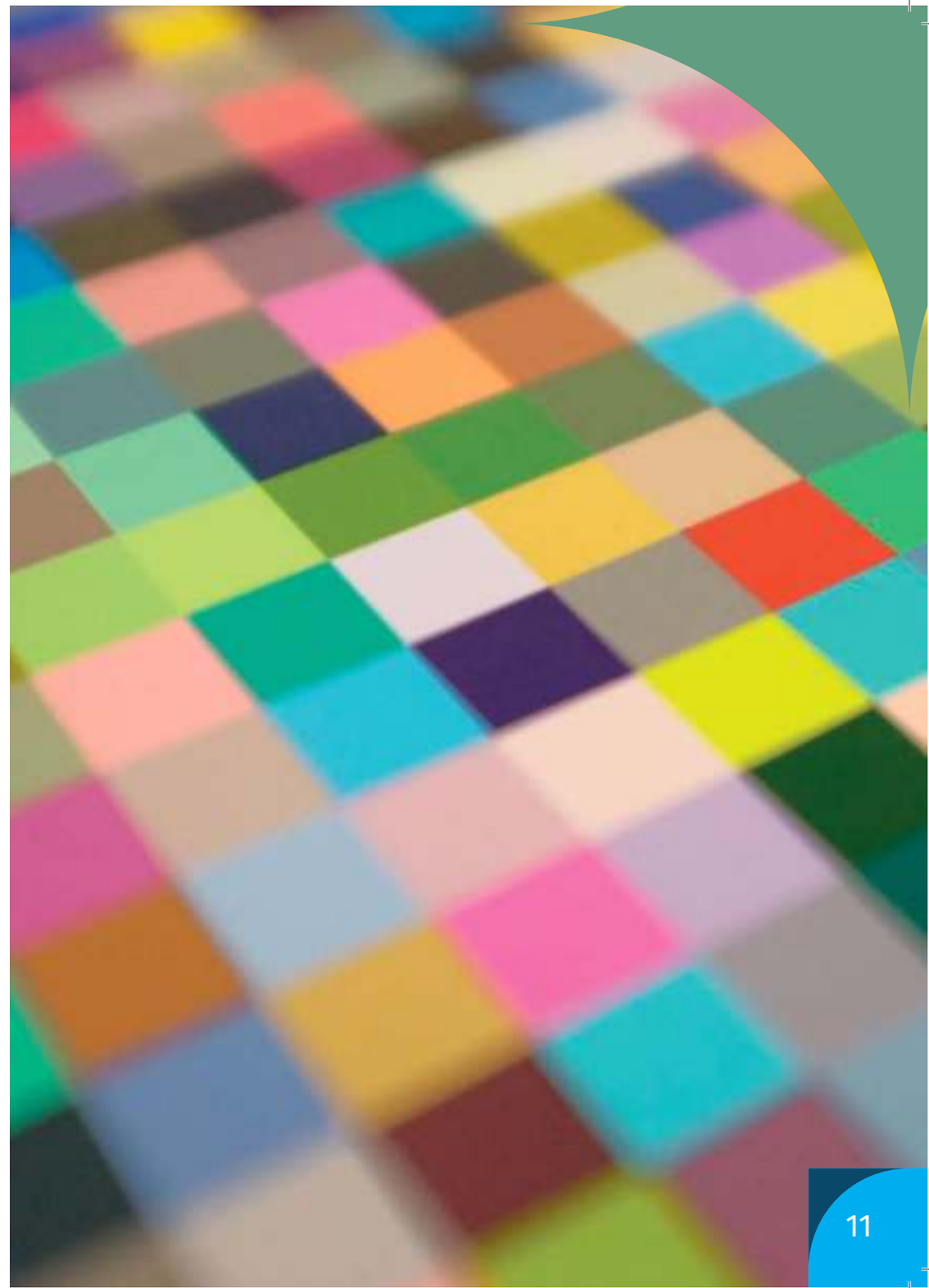
The ICC profile describes the colour gamut the printer can produce and is used both for colour conversion from RGB and to simulate the printed result. If you activate this ICC profile in the software used for design and the creation of artwork, you can simulate the printed colours in what is often called a softproof, an image presented on a high end and carefully calibrated monitor.

Moving from conventional and mainly rotary printing technologies to digital printing on fabrics is a timely move. The technology is developing fast and opens up a huge array of opportunities. But it's also a move into a fully digital world, where the colour management is expected to be computer controlled, and the resulting colours properly

Profile building using X-Rite's i1Pro3.

validated. There isn't any specific ISO standard for digital print in general, and definitely not for digital printing on fabrics, but there are well defined standards for viewing (including soft proofing), measurements, file formats and hardcopy digital proofing, or virtual proofing in a fully calibrated supply chain.

There are still limitations to digital printing on fabrics, especially in terms of the ink sets that can be used on specific target fabrics, but progress is swift, as is the speed of print. The digitisation of the Textile sector offers sustainable benefits that cannot be ignored. The opportunities are wide and varied and colour management critical in order to manufacture sustainably and profitably.



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Holmbury
The Dorking Business Park
Station Road
Dorking
RH4 1HJ

t +44 1737 240788
f +44 1737 233734
e info@fespa.com
www.fespa.com

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