



A Beginning Primer For Four-Color Process Printing



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- *Overview*

Four-color process printing is where you start with finished full-color artwork and separate out the three subtractive primary colors of yellow, cyan, magenta, plus black. The program creates the separate films that are then printed with special process inks and the print looks like the original artwork—or at least it should look like the original artwork. Process color is not the same as basic 4-color printing where you cut overlays for the colors and use halftone dots from sheets of dots to create other colors and patterns. Some people think they are printing process color when they are just printing 4 individuals colors. Four-color process printing is not for everyone but if you follow the guidelines in this paper you should be able to print 80% of the process jobs you encounter.

- *Why Use Process Color?*

Because the prints look great if done correctly! Where else can you print with just 4 colors (process colors) and get hundreds and hundreds of colors and also come very close to matching the original artwork? Also, with computer graphics and process inks getting better, process printing will become as commonplace as puff printing, jacket printing, caps or any other commodity item.

- *What Kind Of Artwork Is Needed?*

For process printing you must start off with a great piece of artwork because the design is only going to look worse when printed. You just can't take a small photo, enlarge it and hope it will be better on the shirt. Most printers use oversize artwork even as large as 2' x 3'. Since this size is too big for most separators the standard practice is to have the art shot as a "transparency." This is like a large slide and can be done by most professional photography studios. Since a transparency cannot be viewed without a light table, the photography studio should also make a print at the same time for use as a reference. The artwork should have good contrast and avoid fine subtleties that can get lost in this process. Artists should also avoid fluorescent colors as they do not reproduce as accurately.

In addition, a high quality computer generated image may be used. Since most art today is transferred from customer to printer via the internet, it is essential that any file destined for process separations be in a high resolution format. To paraphrase the previous paragraph, if you start with garbage, it is hard to produce a great process print

- *Screen Angles*

Computer graphic programs default to screen angles that are designed for lithography. They are useless for screen printing. If you are creating your own films, make sure that these angles have been adjusted before the film is produced.

The screen angles, line counts, dot shape and tonal compression are critical for screen printing. Most separators are accustomed to separating for lithography. They are not usually prepared for the different factors that must be taken into consideration for screen printing.

The angles are important because of interference from the mesh. Mesh creates axes that are situated at 90° angles. If you use these angles you are almost certain to introduce moiré into your design. Moiré is the condition where an unplanned wave or line pattern appears in your print. Often, it cannot be seen until ink is actually printed onto the substrate. Using a typical angles (except for yellow, which will not show the moiré) is one of the factors in avoiding moiré.

A suggested starting point for your screen angles is as follows:

yellow = 5° cyan = 55° magenta = 22° black = 80°

The line count most commonly used in textile process printing today is 26.6 lines per cm (65 lines per inch). This level of definition creates a fairly high level of detail combined with a heavy enough ink deposit to stand up on the fabric. Experiments have been done at finer line counts but at present, they do not have the durability of the present standard.

Screen printing has a major disadvantage as compared to lithography when it comes to process printing. Since process printing requires the use of dot patterns of some type, we are using a printing system that can compound the error possibilities. We print dots through a mesh that may not match the pattern of the dots. Textile printers have the additional disadvantage that graphic screen printers do not face in that they are printing onto a substrate that also has a pattern that can cause interference.

Lithography is capable of printing and holding the halftone dots from about 3 to 97% density. Screen printing cannot achieve such range. The rule of thumb for textiles is that 15 to 85% is achievable. There are printers who are printing a wider range but this level is a good starting point for anyone. The main reason for the restriction is dot gain/loss. When you print a 80% dot, it usually gains to somewhere above 90%. When you print a 15% dot, you usually lose down to under 10%. The modern separation programs adjust the entire tonal range using a mathematical algorithm to match the ability of the screen process.

The accepted dot shape for screen printing is elliptical. Of the myriad dot shapes available in modern separation programs, elliptical dots work best with the screen printing process. The main reason is that the dots avoid interference problems with the square holes of the mesh. The result is a minimization of dot gain, especially in the mid-tones.

Union Ink has made available a small computer plug-in file that contains the color values and initial dot gain curves for Adobe Photoshop®. This file is available in the software section of the Union Ink website or on disk from any authorized Union Ink dealer.

- *Mesh Selection*

The most common mesh count for 65 line per inch halftones is 355 to 390 threads per inch. If you are printing 55 line per inch halftones, you can use 305 threads per inch fabric. White printers are most commonly printed with 305 threads per inch and spot prints can use 230 to 305 threads per inch, depending on the ink laydown desired.

In addition ink deposit, moiré control, and image density can be greatly affected by the thread diameter of your mesh. A finer thread gives a larger open area. For example, a 305/30 has approximately the same open area as a 280/34. If a job is printed the first time to everyone's satisfaction using a 355/34 and the next time the fabric is a 355/31 there can be enough difference to make it impossible to achieve the same print.

- *Mesh Tension*

High-tension mesh is a must for four-color process printing. The use of retensionable frames has been a great boon, especially for textile printers. The high viscosity of textile inks makes high tension a great method of maximizing the benefits of off-contact printing. High tension helps to minimize dot gain and minimize the additional gain caused by wet-on-wet printing.

Whatever type of screens you use, all of the screens for a given job should be exactly the same tension. Even if the mesh counts are different for the spot prints or white printer, having all the screens at the same tension will help you to maintain registration and proper ink laydown.

The mesh should never be brand new. The first time screens are used, they tend to change tension more than "work hardened" screens. Previously used screens are more stable and likely to remain at the same tension throughout the job.

- *Stencil Quality*

In the past, it was common for printers to use direct emulsion for all jobs except when they were printing halftones. Capillary film was the preferred stencil for fine detail. With the advent of improved dual-cure and photopolymer emulsions, it is now common for printers to use the new improved direct emulsions for all types of printing. The stencil thickness is critical however. The goal is to achieve a thin smooth screen

coating. I highly recommend the use of face coats on all screens used for any fine detail work. (Face coats are thin coats of emulsion applied to the print side of a previously coated and dried screen. These extra coats help to smooth the surface of the stencil and fill any voids.)

Proper screen exposure is crucial. The most common mistake in screen exposure is underexposure. The second most common mistake is overexposure. Both mistakes make good process printing impossible. If you are not sure if you are exposing correctly for your mesh, emulsion, and exposure system, make sure that you test with an exposure calculator. These simple but accurate devices are available from your emulsion supplier. Their use should be a regular part of your screen room procedures.

- *The Press*

A high quality press is imperative for good four-color process printing. The ability of the press to hold precise registration is imperative. While good manual presses can be used, it is very difficult to print with enough consistency to produce process prints that are all identical on a manual machine.

A good semi-automatic press is the best way to assure good results. The ability of the press to hold proper off-contact, consistent squeegee angle and squeegee pressure makes repeatability possible.

It is possible to print four-color process with a manual press but it does take a great deal of skill and patience. A good manual press with side screen clamps works best because of their ability to hold registration and off-contact.

On either type of press, off-contact should be set as low as practical. Forty-thousandths (0.040") is ideal. The concept is to keep the screen off of the substrate but also to minimize the amount of deflection necessary to print. By doing so, you will be able to print with a minimal amount of squeegee pressure. The result is minimal dot gain, maximum registration quality and increase screen life.

- *Squeegees*

Squeegee and floodbar angles should be about 15° or less. This minimal angle will also help shear the ink without excessive ink laydown. The optimal squeegee hardness should be 70 to 75 durometer in single layer type squeegee or 70/90/70 durometer in the laminated type squeegee. I have had good results with both types. A too soft squeegee (60 to 65 durometer) tends to result in excessive dot gain and incomplete ink shear.

- *Ink*

The process inks today are excellent at reproducing accurate prints. Union Ink's Tru-Tone process inks are recognized as the ultimate inks in achieving accurate true-to-life color reproduction. The colors available in the Tru-Tone pallet include the normal Cyan, Magenta, Yellow, and Black, but also include a Fine White Printer for printing white highlights and a cool and hot Magenta for use in manipulation of artwork that does not quite meet your standards for accurate reproduction.

If spot colors are needed, they should be prepared so that they have a viscosity as close to the same as your process colors so that no excessive squeegee pressure is necessary to print them. Since spots are printed last, it is important to avoid pressing too hard on the print which will increase the dot gain in your halftones.

- *Garments*

The quality of process printing is definitely affected by the quality of the substrate. Since you are printing dots, if there is nothing for them to land on, then they do not transfer to the substrate. A tight weave high quality garment is best. In practice, 100% heavyweight jersey will yield the best quality.

Beware of using some of the "super" heavyweight T-shirts. The thread diameter used in some of these shirts to obtain the high weight creates a wale affect that can cause a loss of dots.

- *Summary*

The best policy is ... test everything. Test your press, test mesh, test screens, test ink, test squeegees, and test garments. When you test, document what you did and what the results are. The documentation

will help create a historical record of what works and what does not. Try to limit your changes to one variable at a time. If you are trying different screen angles, do not mess with your mesh count. If you are trying different tonal compression ranges, leave your angles alone. If you change too many things at one time, you will not know the exact reason for the changes you observe.

Process printing is very challenging. It is also the true test of the quality your shop is able to produce. By improving your process printing, you will also improve the quality of all the other work your shop produces.

- *Disclaimer*

Customer testing is required and should be mandatory with this product or any new product or process before running production. Our technical advice and recommendations given verbally, in writing, or by trials are believed to be correct. They are not binding also with regard to the possible rights of third parties and do not exempt you from your task of examining the suitability of our products for the intended use. We cannot accept any responsibility for application and processing methods which are beyond our control, nor can we accept responsibility for misuse by you of the products or use by you of the products outside the specified written instructions given with the products. User must protect sensitive skin, exposed wounds and eyes from contact with products.

- **For More Information**

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