SCREENPRINT 101

What is Screen Printing?

Screen printing is a process though which ink is mechanically applied to a substrate via the use of a screen and squeegee. In it's basic form, screen printing is a very simple process. First we start with the artwork. Each color of the design requires an individual screen so we must separate the design into its component colors. This is done on the computer and each color separation is printed to a transparent sheet.

Next we must prepare the screens. The screen is a rigid frame of wood or aluminum that has a fine mono filament nylon mesh stretched over it. This mesh is then coated with a light sensitive emulsion that will become the stencil through which the ink will pass when printed. The screen is then mounted, with the separation, in an exposure unit. This machine exposes the screen to high intensity UV light.

Exposing the Screen

When the UV light hits the emulsion a chemical reaction hardens the emulsion making it water and solvent resistant. The separation acts as a shield to block the light in certain areas of the screen. These soft areas are then rinsed away with water to create the open area of the stencil.

The screens are then mounted in the press and registered, or aligned, so that each color prints in the proper location relative to the other colors. Ink is loaded into the screens and squeegees are installed. The actual printing is accomplished by pushing ink through the screen and onto the shirt with the squeegees. As the squeegee scrapes across the screen it fills the stencil with ink while simultaneously bending the mesh down to transfer the ink to the shirt.

To create the composite image on the shirt, individual colors are printed then the shirt is moved to the next color. After test prints are run to check alignment, shirts are loaded one by one and printed. Once all the colors have been applied to the shirt it is removed from the press. The ink on the shirts is still "wet" at this point and needs to be "dried".

The ink we use for t-shirts is the variety called "Plastisol" and is not actually "dried" but cured with heat. Plastisol is made up of polyvinyl chloride resins (PVC), plasticizer and pigments. When plastisol ink is heated the PVC resin particles swell and absorb the liquid plasticizer and these swelled particles merge with each other and form a solid film. Curing of plastisol ink is accomplished by rapidly bringing the ink up to curing temperature (~330° F) with electric or gas infrared heaters.

To cure the shirts we run them through a "drier" that utilizes a conveyor belt to pass the shirts under infrared heating panels. The shirts spend between 30 seconds to 1 minute in the dryer, and when they come off the belt they are done and ready to be folded and packed.

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What is Spot-Color?

Spot-Color is the term used to describe separation and printing with one ink color for every color in the design. Each color that makes up the composite image will be printed using a separate screen. A slightly more advanced type of spot-color uses halftones to create the appearance of a gradient using small dots of the solid ink colors. This technique can be taken a step farther to combine two gradient screens and produce the appearance of more colors then are actually being printed. The small dots being printed so close together trick the eye into seeing the color they make when mixed.

What is 4-Color Process?

4-color process is a more advanced separation and printing technique that uses 4 colors of transparent ink to produce the colors from the original design. The four colors, Cyan, Magenta, Yellow, and black (CMYK), are printed as halftones that interact with each other and the white background of the shirt to create color and tonal values. A wide spectrum of colors can be represented but some colors are impossible to produce.

4-color process is used mostly for photographic or digitally created designs because many shades and colors can be created with only four screens. High screen counts and screen frequencies are required to create the tiny halftone dots. One drawback to 4-color process is that the garment must be white.

What is Simulated Process?

Simulated Process is another advanced technique that uses halftones of a few ink colors to represent the colors in the original design. This process differs from 4-color process in that the inks are solid opaque colors usually printed on dark colored shirts. Because the shirts colors are normally dark, simulated process requires the use of an under base. When working with simulated process, we start with a digital design or one that is scanned into the computer.

We make adjustments in color and contrast so that it looks proper on the shirt color. Then we process the design through a special program that automates the difficult separation calculations. Once finished, the separations are printed out as usual. Simulated process also requires relatively high mesh counts and screen frequencies. Depending on the design, 3 to 11 ink colors may be needed to accurately reproduce all subtle color variations.

Simulated Process Separations

When printing simulated process, the under base (usually white ink) is printed first and then flash cured to gel the ink. Then the rest of the colors are printed wet on wet on top of the under base. Sometimes 11 colors are used, most designs can be printed with only 5 or 6.

What is Index Color?

Index color is another separation and printing technique that uses a few ink colors to produce a full color print. Unlike 4-color and simulated process, index color does not use halftones. Rather, the design is broken up into tiny square areas of solid color. These squares are very small (200 per inch) and when printed they blend together to trick the eye into seeing color shades and variations.

Index color works well on both white and colored garments but generally takes more ink colors to represent a design with lots of color variation. Index color has the added advantage that you can pick the exact ink colors to use. This way you can more accurately represent colors that are difficult to produce using a "process" method. It also requires high mesh counts to print the tiny squares properly.

What are Halftones?

Halftones are a pattern of tiny dots that can simulate different shades of color using varying percentages of a single ink. Visually, halftones create the illusion of a continuous tone image by using spots of varying size and density to represent darker or lighter color values.

Halftones work by fooling the eye into seeing the combination of the ink color and the color of the shirt they are printed on. When seen from a distance, the colors blend together and the dots merge with the background color of the shirt. If you look closely at or magnify the print, the separate dots are quite clear. You can see good examples of halftones if you magnify a picture in a magazine or a print from a color printer or even if you look closely at your TV screen. All these are made up of tiny dots.

In screen printing we use halftones for three main purposes:

1. To create a tint or lighter shade of a color. This will allow more "colors" in the design without adding more screens.

2. To create a gradient or the appearance of a continuous tone of color:

3. To create overlapping screens of different ink colors that combine to simulate more colors.

What is Line Count, Screen Frequency, and LPI?

These terms all refer to the number of vertical lines of halftone spots per inch or lines per inch (lpi). Halftones are created using a grid of cells. Each cell contains one halftone spot. These spots vary in size depending on the shade of color being represented but only one fits in a cell. The size of these cells determines the lpi.

Various lpi numbers are used for different types of printing. Magazine pictures may have 100-130 lpi, newsprint is typically 85 lpi, a 300 dpi laser printer is around 55 lpi, and billboards might be 3-6 lpi. When we are using halftones for screen printing we use 45 lpi for basic designs and 65 lpi for detailed and process type designs.

The correct lpi to use is a function of the detail you want to produce and the distance from which a print will be viewed. When reading a magazine, the 100 lpi halftones will be invisible at 12 ". Likewise, if you view a 45 lpi t-shirt print from 3-4 feet you won't notice the halftone dots.

What is Screen Count or Mesh Count?

The mesh count is the number of threads per inch (tpi) used to weave the mesh. Typical mesh counts for screen printing Tshirts range from 85 tpi to 355 tpi. The mesh count defines basically two things: The thickness of the ink deposit and the size (or lpi) of halftones that can be printed.

The lower mesh counts, 85-110 tpi, have a relatively large thread diameter and more space between the threads (called "open area"). This allows for a thicker deposit and more ink to pass through the screen. Typically, lower mesh counts are used for specialty inks (like glitter) and when a thick deposit is needed on dark garments.

The high mesh counts, 305-355 tpi, have a very small thread diameter and less open area. These are used when fine detail and high halftone lpi are needed.

In the middle, 200-255 tpi, are general purpose screens for spot color, good detail and acceptable halftones.

What is an Under Base?

An under base is a layer of ink, usually white, that is printed under the other ink colors when printing dark garments. When printing most colors on dark garments the color of the shirt will show through the ink slightly. For instance, yellow ink printed directly on a royal blue shirt will look very green. To prevent this, a thin layer of white ink is printed, then "flash" dried, and the yellow is printed on top. This gives the top colors a good neutral base and reduces or eliminates the shirt color showing through.

What is Flashing or Flash Drying/Curing?

Flash curing is the process of "gelling" a layer of ink with a spot heating unit while still on the press. To "gel" the ink layer the temperature is raised to the point where the ink begins to dry but is not completely cured. The ink will be dry to the touch and will form a solid surface to print additional colors on. When the garment is run through the drier the flashed layer will cure completely and bond to the ink layers on top to form a solid film.

What is Discharging?

Discharging is a chemical reaction that destroys the ability of selected dyes to reflect color. This reaction takes place at temperatures above 180 degrees Fahrenheit while water is present. No other process produces such soft, breathable, absorbent, bright prints on dark colored garments.

What Shirts Are Dischargeable?

Only selected dyes used on natural fibers are dischargeable. Fruit of the Loom and Lee are the only major garment manufacturers stating some colors of their 100% cotton T shirts will discharge well. Fruit of the Loom rates their black, navy, denim, burgundy and brick as being the most dischargeable and their wedgewood, cadet blue, royal, purple and yellowjacket as the poorest. Other colors fall somewhere between. Lee rates their shirts on a 1-10 scale with ten being the most dischargeable. Lee colors rated as tens are: black, gold, navy, purple, english rose, primrose and powder blue. Colors rated at 7 and discharging ok are peacock, kelly, wine and true red. Colors rated as poorest dischargeable colors are royal, hunter and ash.

Printers are advised to test the dye lot of each new case of shirts by checking the dischargeability of the top and bottom garments in a shipment, using the area to be printed or on an inner seam and put aside garments which do not discharge well for other uses.

What Are The Advantages Of Using A Discharge Underbase Over a Normal Plastisol Underbase?

The discharge underbase will produce a softer feeling and the print will not have the rubbery, bullet proof feel associated with a dark garment printed with a regular white plastisol underbase. The printer will also increase his production output because since the discharge underbase is absorbent and does not seal the shirt, it allows the printer to easily print each subsequent color on top of the discharge underbase wet on wet. To eliminate pick-up on screens overprinted onto the discharge underbase printers may elect to flash cure the underbase print for about 1 second. However, if printers decide to flash cure it negates part of the increased production advantages of this process.

Why Use A Plastisol Discharge Mixture Over A Waterbase Discharge?

Most textile printers are comfortable with plastisols and are familiar with the techniques of how to use them. Although a 100% waterbase discharge print yields the ultimate in softness, breathability and absorbency, prints produced by overprinting Union plastisols wet on wet through fine meshes over a plastisol discharge underbase come very close without the problems of drying in the screen and the pot life associated with straight waterbase discharge inks.