SCREEN PRINTING FUNDAMENTALS

SCREEN PRINTING: START TO FINISH

STEP 1: PREPARE YOUR SCREEN

Screen printing relies on a completely clean and well cared for screen. You must first remove all previous photo-emulsion, ink, and unwanted build-up, referred to as *haze*, from the screen. *Emulsion remover* and the *pressure washer*, followed with a *degreaser,* will usually do the job. If your screen is not completely clean after this, you can repeat the steps, or use a *de-hazer*, which is a stronger cleaning solution that requires approximately 20 minutes to work on the screen.

Warning: Use of the pressure washer requires ear and face protection. Emulsion remover and de-hazer requires the use of gloves.

STEP 2: COAT SCREEN WITH PHOTO EMULSION

A thin, even coating of *photo emulsion*, that is worked well into the mesh, is essential to the screen printing process. It is best to first coat the back side of the screen, and then the squeegee side of the screen, so that the emulsion has completely coated the screen.

Start by checking that you have the correct width of scoop coater for the screen you are using, and that its sharp edge is clean and dent free. It should be 2 inches narrower than the screen frame. Take out the small container of emulsion, and a paper towel for clean up. Fill the scoop coater with emulsion and let sit for a minute so any bubbles have a chance to float to the surface to be popped. Set the emulsion container on the paper towel to avoid drips on the counter. Carefully coat both sides of the screen, and place it in the drying cabinet to dry for at least 45 minutes. Scrape the excess emulsion from the scoop coater back into the container and return it to the fridge. Put on your gloves, and clean the scoop coater thoroughly with warm water, and a sponge. Be sure to clean up any spills or drips.

Warning: Wear protective gloves when cleaning emulsion.

STEP 3: EXPOSE AND DEVELOP

Check your films for opacity, accuracy, and dust before exposing to your screen. If you are exposing multiple images to your screen, carefully plan where you will place them so they are at least 3 inches from the frame, and are at least 2 inches apart from each other. Also consider how you are setting up your screen for printing, the direction your squeegee will travel across the screen, to avoid any difficulties while printing.

To expose images to your screen, place your film, rubylith, or drawing, face up on the glass of the exposure unit, and arrange as needed. Place your screen, back side down, over the films and centered on the glass. Select the correct exposure time and press start on the exposure unit. The vacuum will turn on first, and a minute later, the light, and both will turn off when the exposure is complete.

Warning: Wear protective gloves when developing emulsion.

Develop your screen by first rinsing the front and back with water. Once the emulsion has begun to soften, gently rub the image with a clean developing sponge, while wearing gloves to avoid skin contact. Rinse the front and back again, and turn on the back-light to inspect your image. Check fine details and light areas to be sure they have opened up, using the hose as needed. Be sure to give the entire screen a thorough rinsing to remove all unexposed emulsion, and to assure your screen stays clean through repeated use. When you are finished, collect your films, turn off the exposure unit, shut off the water, and dry your screen in front of a fan.

STEP 4: PREPARE PAPER

While your screen is drying after developing, cut your paper to the size determined for your artwork and margins, and punch your paper for punch registration if needed. You will also want to collect some newsprint with your paper for proofing and dealing with printing problems.

STEP 5: PREPARE INK

You can mix all of your inks at once if you have sealable containers to store them in. Otherwise, mix as you go.

There are three important aspects to color that will help you determine how to mix your ink. *Hue* defines which color you will use, such as red, blue, orange, ocher, etc. *Saturation* determines how intense the color is – whether it is a retina burning yellow, or the pale yellow glow of sunlight on the snow. Finally, the *value*, or relative lightness or darkness, helps identify where the color exists along the spectrum from white, through the grays, to black. Another aspect that is important to consider for screen printing, is whether your ink needs to be *transparent*, allowing other previously printed colors to show through and combine with the new ink, or if the ink should be *opaque*, covering over other colors to not be affected by them.

Cole Rogers, Artistic Director & Master Printer at Highpoint Center for Printmaking in Minneapolis, and Senior Printer Zac Adams-Bliss, using a large one-arm screen printing vacuum table.

Identifying each of these characteristics for the ink you wish to mix, will help you determine how to go about mixing your ink. Is your color to be a pale, transparent turquoise that will layer over an orange to produce a third darker and richer color? Then start with extender base, and add in small amounts of color to gradually achieve the saturation you are looking for. Or, is it meant to be a dark opaque gray that will cover that orange? Start with white, and mix in black to reach the value you are seeking.

The last factor to consider is the volume of ink you need to mix, and any additional additives you will need to add.

STEP 6: PRINT

Proper organization and setup are necessary to trouble-free printing. Start by gathering your screen, paper, newsprint, ink, blue tape, registration tabs or pins, appropriate sized squeegee, spatula, and a spray bottle filled with water. Be sure your screen is tightly locked into the hinges when it is laying flat and lifted up. Tape foam board squares to the table under the corners of the screen opposite the hinges to assure proper off-contact printing. Using your blue tape, block off the

open areas between the frame and where the emulsion begins on your screen, as well as any images that are close to the area you will be printing.

To register your print to the screen, first accurately align your film on your print and tape it in place with small pieces of tape. Slide them under the screen and align the film to the screen, pressing the screen down in a number of spots to assure that it accurately aligned. Turn on the vacuum to hold the paper down, and then securely tape your registration tabs or pins in place. You can now remove your film from your printing paper.

Lift your screen and pour your ink along the edge of the image that is closest to you. Pushing your squeegee away from you at a 45 degree angle, flood your screen. Lay your screen down, bear down on your squeegee, and swiftly print the image while holding the squeegee at a slight angle. Immediately lift and flood your screen. Check your print for accurate registration, making any adjustments needed, and marking the print to note that the registration is off. You only have a very short window of time before the ink will begin to dry on the screen, so you must make adjustments and decisions quickly. Printing to a sheet of newsprint, and flooding the screen again, will help prevent the ink from drying, if you need more time. Otherwise, continue printing and flooding, quickly checking the prints for consistency as you go.

STEP 7: CLEAN-UP

Once you have finished printing, gently scrape up the excess ink from your screen, and squeegee, and return it to its container. Spritz your screen with water, and loosen the hinge clamps. Take your screen to the ink rinsing booth and remove any tape from the screen. Wash your screen with water, soap, and a scrub pad until it is completely free of ink, and then place it in the drying rack. Wash off the squeegee, and spatula, and return the squeegee to the rack. Remove all tape and ink from the printing table and put away all of your materials, leaving the area ready for the next person.
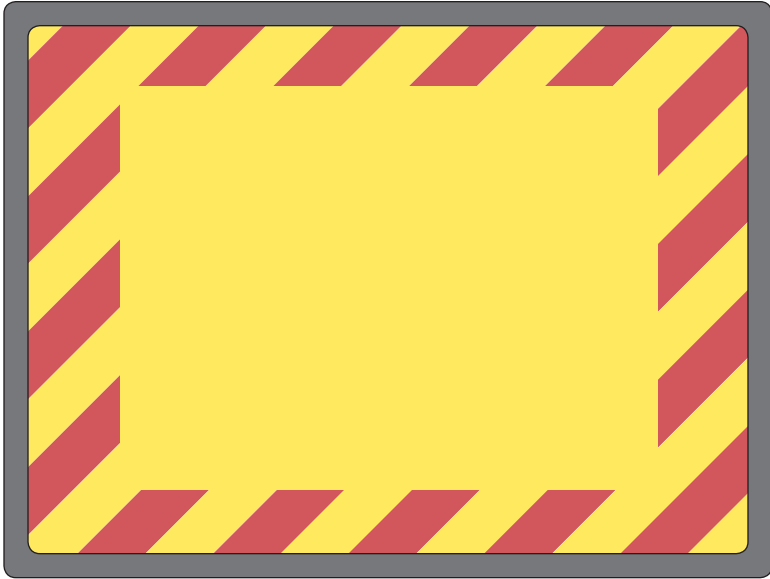
*Keep your image(s) at least 3 inches away from the frame.*

SCREEN ANATOMY

The two sides of the screen are the *squeegee side*, that has the frame, and the *back side* or *paper side,* where the mesh is laminated to the frame. The frames are made of either aluminum or wood, and both are reusable should the fabric mesh become damaged or unusable. You can reapply mesh to wood screens by hand, but it won't be nearly as taut if it were done professionally. The aluminum frames are far more durable, and can be professionally re-meshed, and will last many years if they are taken care of, and handled carefully.

The polyester mesh fabric is measured in *threads per inch*, and comes in either white or yellow, with the yellow being used when working with *photo emulsion*. The mesh you will use is determined by what you are printing onto. For paper, like we are using, #230 is standard, but it can go a high as #305. For T-shirts and similar fabrics, #110-#156 is used since the larger openings between the fewer threads allows for more ink to pass through the screen, and fill the fabric of the T-shirt. Paper needs much less ink in comparison, and the higher mesh counts will also translate into more image detail.

Although a screen may seem fairly large, the amount of space you have to use is deceptive. It is not possible to print images close to the screen frame because the mesh cannot flex enough to contact the *printing substrate* – in our case, paper.

**Always leave 3 inches between the frame and the images.**
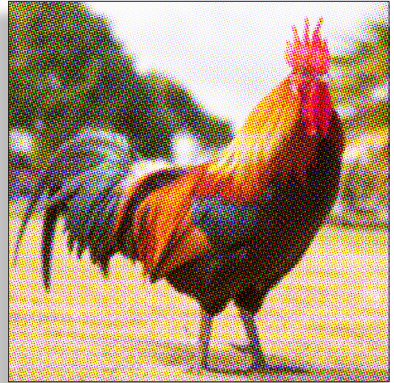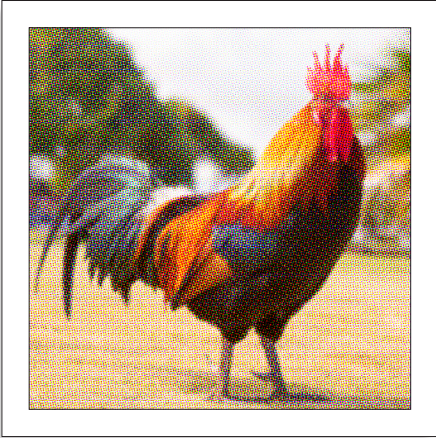
A window print, and a bleed print.

PRINT FORMATS

There are two standard formats for prints. A print with margins, also referred to as a *window print*, is most the common for screen printing because it is extremely difficult to print all the way to the edge of the paper. A 1/2 - 1 inch margin is standard, but larger margins can be used for more dramatic effect. Typically, the bottom margin will be slightly larger than other 3 edges.

If you want to produce a *bleed print*, with the image running off the edge of the paper, you will still need to print with margins, and then trim your edges off when all printing is finished. Screen prints often have cut edges, but you may prefer a deckled edge typical of fine art papers. To do this you will need to have 1 inch margins on all sides, and tear your paper while it is face down. This will prevent paper fibers from tearing up around the image and leaving a white edge – the opposite of what you are trying to do. To know where to tear your paper from the back, pierce a thumbtack through the paper in each corner of the image. Flip your paper face down and tear off your margins.

70° printing stroke

90°

45°

foamboard
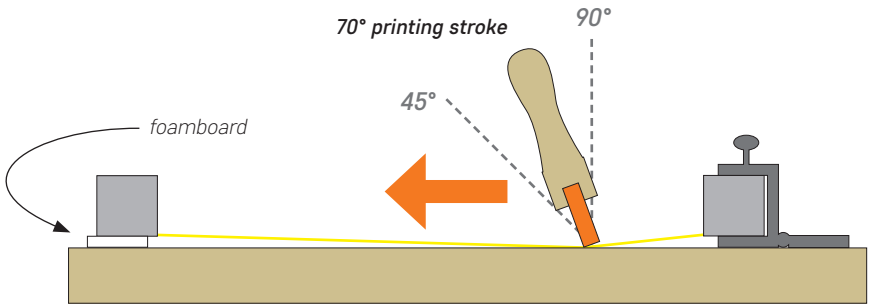
**PRINTING STROKE**
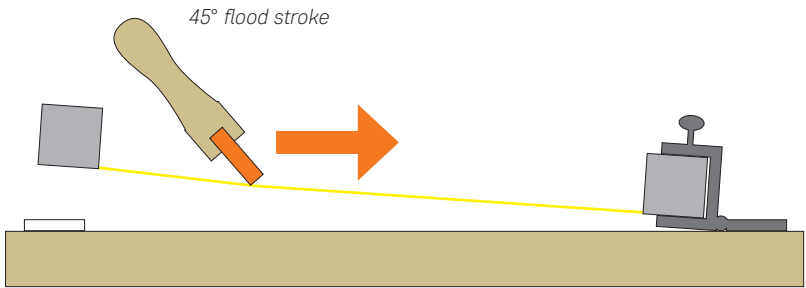
45° flood stroke

FLOOD STROKE

SQUEEGEE HANDLING

There are two different ways you will use the squeegee. The *printing stroke* is pulled towards you, and requires a steady and swift motion, while bearing down on the squeegee to assure full contact with the substrate. For the *flood stroke*, you will push the squeegee away from you. This will fill the stencil with ink to prepare it again for printing, and to prevent ink from drying in the stencil. The flood stroke must be done with the screen lifted off the printing table.
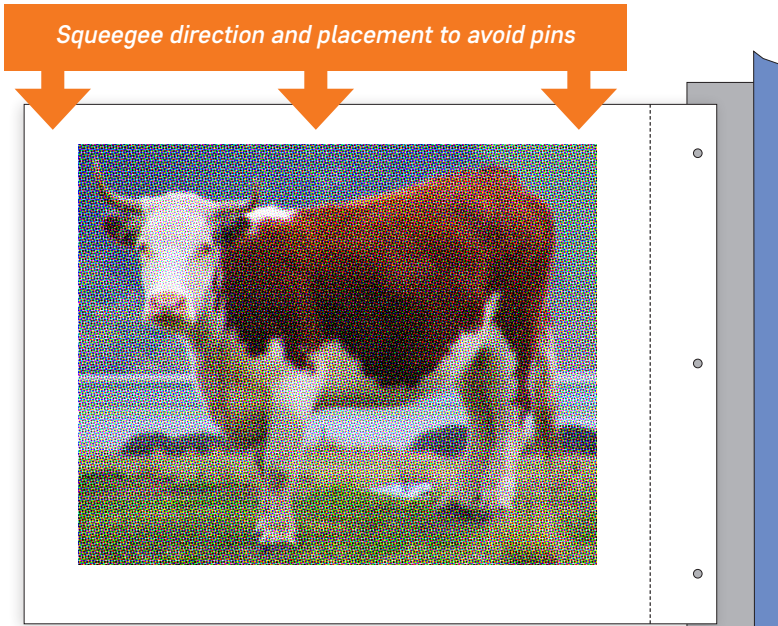
REGISTRATION

Registration is a critical aspect of screen printing, and although it can present some challenges, it can easily be perfected with patience. There are two forms of registration and which you use is often a matter of preference. Tab registration uses paper, or cut up plastic strips (such as used credit/gift cards) taped to the printing table as guides to butt the paper against. Two guides are taped down at

TAB REGISTRATION
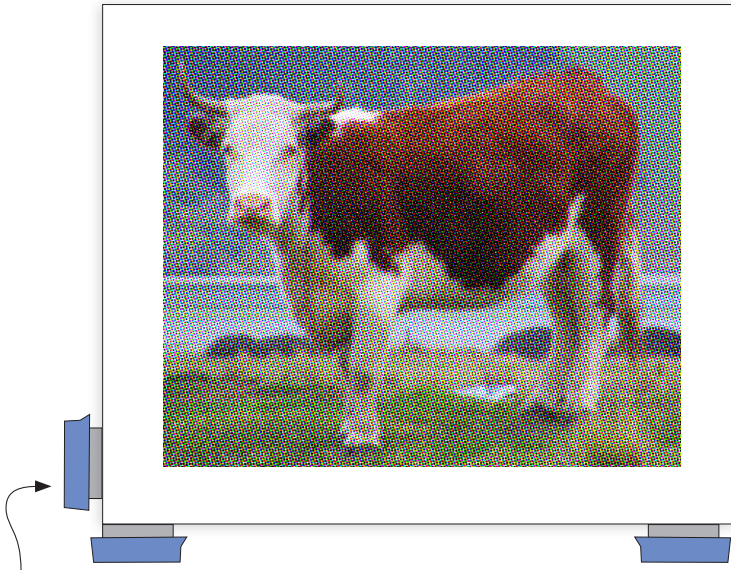
Double stick tape works best!

PUNCH REGISTRATION

Squeegee direction and placement to avoid pins

Cut off the punch registration when you have finished printing.

Methane Studios: Sketching, creating and checking films, determining inks for the color separations, and the final print (opposite): "Banjo Man". 4 Color screen print. 18x24 inches.

opposite corners along the edge closest to you, and a third goes along one of the adjoining edges. Your paper and tabs must be cut straight for this to work, and the tabs must be taped down securely so your printing paper doesn't slip under them.

Punch registration is a very reliable form of registration that requires just a little more preparation. You must first punch holes into your printing paper that will then attach onto registration pins that are taped to the printing table in a strip. We have a special hole-punch for doing this, but you must center your paper to the hole punch by putting a small pencil line on the back of your paper, opposite the edge you will be punching. This mark will line up on the hole-punch, and assure that your paper and image will be correctly positioned on each sheet.

CURATING AND SIGNING YOUR PRINTS

1/10   Title   Signature or Initials, Year

Sign your prints in pencil.

An edition of prints is usually two or more prints or multiples that are *essentially alike* in appearance and the materials used. Although slight variations occur from print to print, the goal is that, throughout an edition, the prints are consistently similar with no noticeable differences. Before signing your prints, carefully examine them for consistency and correct any minor flaws if possible. A white eraser and a clean x-acto knife are the best tools for corrections. Prints are signed in pencil to note the size of the edition, the title of the print, the year it was created, and authorship through initials or signature. You can put this information where you like on the print, but usually artists follow the order seen in the diagram

above. If you do not want all of this distracting information on the front, just put it on the back. Prints should be stored between acid-free glassine or interleaving. In museums or galleries you may notice some prints that have small embossed symbols in one of the lower corners. These 'chop-marks' note the studio where the print was produced and sometimes the person who printed the edition.

There are quite a few different designations you might find on prints. These are ones you might use depending upon what you print:

Edition Number: 1/10, 2/10, 3/10, 4/10, etc.

Artist's Proof: AP x/x
A maximum of 5-10% of the edition size, retained by the artist for personal use.

Printer's Proof: PP x/x
Prints reserved for the printer and assistants who helped produce the prints at a professional print publishing studio.

Variable Edition: x/x VE
A designation reserved for prints that use the same matrices but the inking, color or other aspect (such as using watercolor), varies from print to print.

**Bon a Tirer or Approval to Print:** ATP, BAT, RTP
A print signed by the artist authorizing the printer to produce an edition of prints. This print serves as a guide for the printer to maintain the quality the artist intended for the edition.

Trial Proof: TP
If your image is unique or there is only one of them, you can label it as a trial proof. This designation is also used for various tests prints created that are different from the final edition.

BITMAP FILES FOR SCREEN PRINTING

Screen printing requires high contrast images that will create either printing or non-printing areas on the screen when exposed to ultraviolet light. Digital images that have been converted to black and white using the bitmap mode in Photoshop are ideal for screen printing. There are three different methods you can choose from for converting your images to black and white, and which one you choose depends on the type of image you have and the qualities you are seeking in your final print.
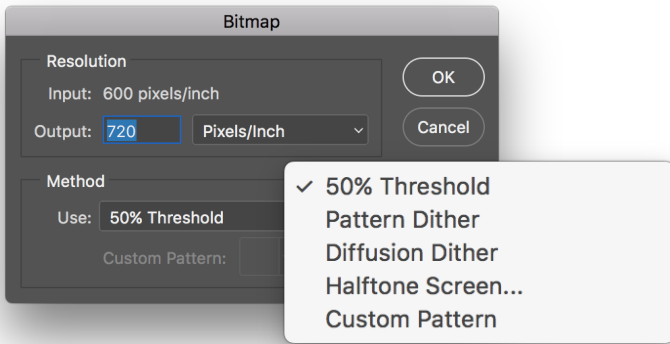
The Bitmap dialogue box: Image > Mode > Bltmap...

50% Threshold: For line art, images created with technical pens and India ink, or high-contrast graphic images, Most commonly used for screen printing. Set the output resolution to 720 Pixels/Inch.

Diffusion Dither: For tonal drawings, or photographic images where a less mechanical dot pattern is desirable. Also used for 'index color separations'. The output resolution will effect the size of the square dithered dots. If the resolution is too high, the dots will be too fine to print. To determine an appropriate resolution, divide the mesh by 1.6, 2.3, or 2.6 , to find a dot size you are happy with, that will not create a moire pattern with the screen. For example: A 225 mesh screen ÷ 1.6 equals an output resolution of 135.

Halftone Screen: Best for photographic images. Set the output resolution to 720 Pixels/Inch, and then set the lines per inch, the angle and the shape. The frequency, or how many lines of dots there are in a given inch, should be the screen mesh ÷ 5. The default angle used for screen printing is 22.5°, but if you are printing color separations, each bitmap will need a specific angle. Finally, the shape of dots preferred for screen printing, is ellipse.

GRAYSCALE FILE

Although the smooth gray tones look good, they will not work with screen printing.

50% THRESHOLD

Pixels are converted to either black or white. For line art, and other black and white images, it is best to have a resolution of 600 dpi or higher, to assure sharp images and smooth curves.
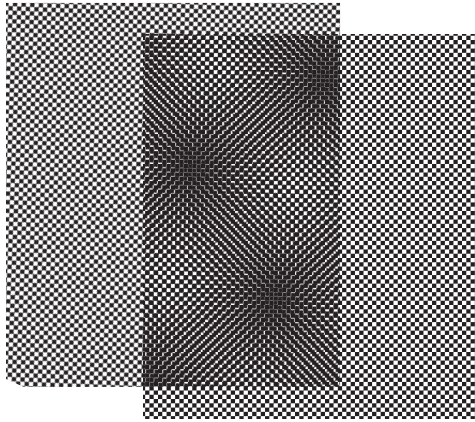

DIFFUSION DITHER

Square dots describe values through their frequency, or how the are grouped together.

HALFTONE SCREEN

Varying sized dots in a grid describe value. The overall size, shape, and angle of the dots are important to avoid moire patterns with screen printing.

Moiré patterns occur when two regular patterns overlap and create a third wavy, or rippling pattern. They occur with halftone and dither images that conflict with the screen mesh, and are typically very undesirable.

GENERAL FORMULAS, NUMBERS AND DEFINITIONS

Remember that these are not fixed rules.

ppi = pixels per inch (the resolution of your file)

300 ppi = typical file resolution for photographs

600-1200 ppi = file resolution for line art, black & white logos, etc.

dpi = dots per inch (pertains to printers)

lpi = lines per inch (lines of halftone dots)

Halftone lpi = screen mesh ÷ 5

Halftone lpi × 16 = ppi of bitmap file

Dither ppi = screen mesh ÷ 1.6, 2.3, or 2.6

Halftone Screen Angles:
Black = 22.5°, Cyan = 112.5°, Magenta = 52.5°, Yellow = 82.5°

GETTING MORE FROM THRESHOLD

The Threshold setting in Photoshop is an easy way to create a high contrast black and white image to use for screenprinting. But you will often loose more information than you would like with this option. To pull more out of images with Threshold, create a Threshold adjustment layer, and then use the dodge and burn tools on the image layer to bring back more information. The dodge tool will help bring back details in the black areas, and the burn tool will help add details in the blasted out white areas.

CMYK			32 bits 4 Channels
RGB			24 bits 3 Channels
Grayscale			8 bits 256 Grays
Bitmap			1 bit / 0 or 1 Black or White

Although RGB is the default digital color space, printing relies on several other color spaces and image modes.
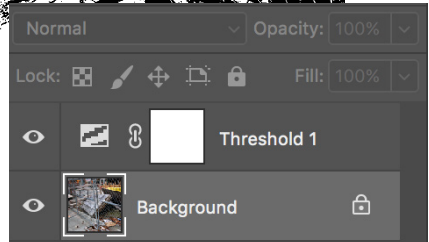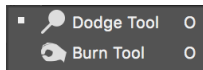
The image on the left was converted from Grayscale to a 50% Threshold Bitmap. The image on the right had a Threshold Adjustment Layer applied, and then the image was adjusted using the Dodge and Burn tools before converting to a bitmap, to bring out more information and detail by dodging dark areas and burning some light areas.