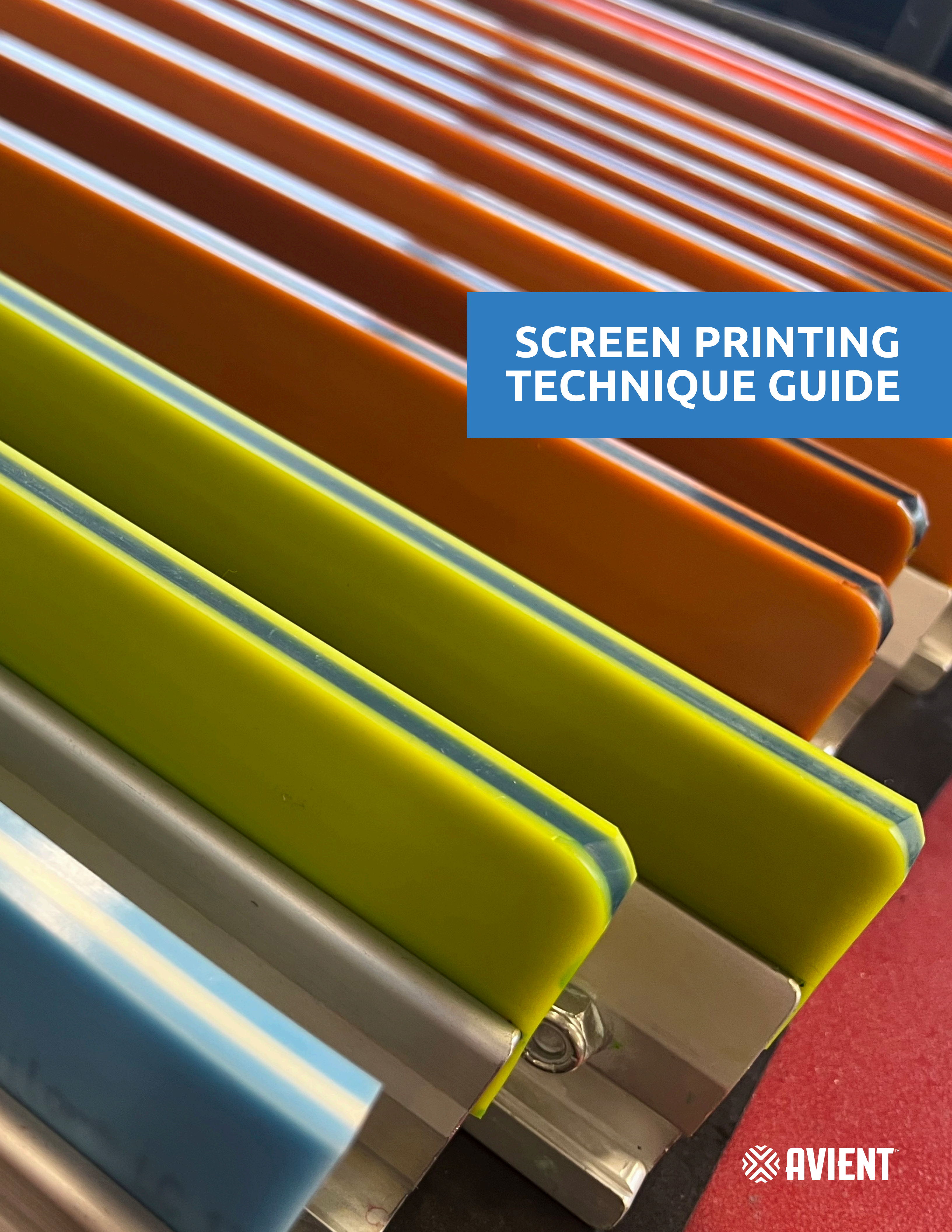
SCREEN PRINTING TECHNIQUE GUIDE



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INTRODUCTION

This guide will discuss screen printing best practices for achieving soft, detailed prints, from garment and squeegee selection to screen coating, and more.

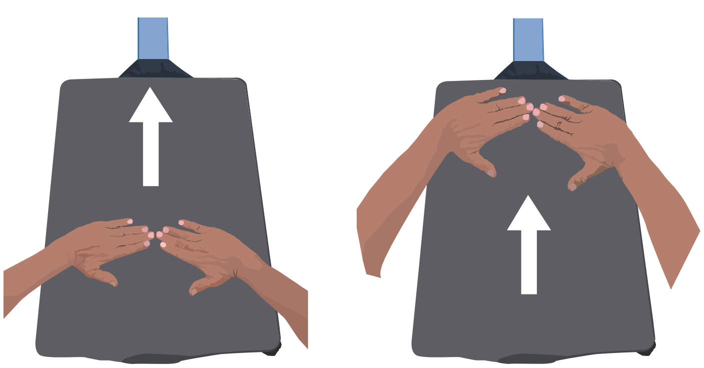
GARMENT SELECTION

Selecting the appropriate garments for your screen printing projects is critical in avoiding fibrillation, when garment fibers stick up through the ink and create an unwanted rough texture. A 100% polyester jersey-style garment is tightly woven and smooth, which decreases the opportunity for fibrillation to occur. Meanwhile, a 100% cotton garment is woven out of yarned cotton fibers that are irregular and fray easily. Additional abrasion from a sticky ink and excessive squeegee blade pressure can disturb these fibers and create more fibrillation.

Tri-blend garments consist of three different fiber types of fabrics, typically cotton, rayon, and polyester. Cotton is the softest, then rayon, and lastly polyester. The more the tri-blend fabric moves, the more the poly fibers in the blend will abrade and fray the cotton and rayon. It is important not to overhandle the garment—take special care when loading these softer, spongier garments to avoid wrinkling and fibrillation.

LOADING THE GARMENT

After selecting your garment type, place your shirt on the shirt platen in one smooth movement. After the garment is aligned on the shirt platen, rake the garment surface with both hands in the direction that the print squeegee will travel. This orients the surface fibers in the same direction to ensure smooth prints. Try to avoid pulling or repositioning the garment excessively. Use this technique for all "spongy" and soft fabrics that fibrillate easily.



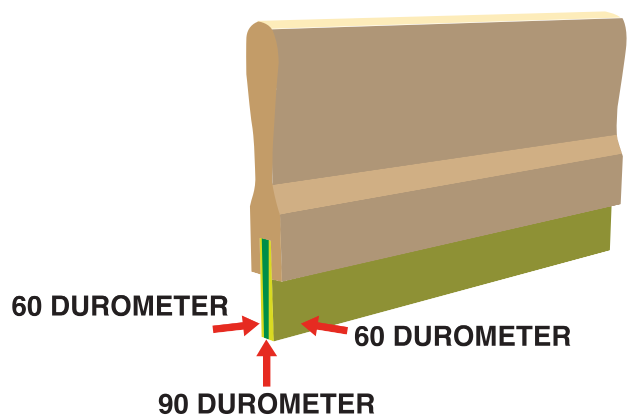
If it is difficult to load the garment onto the platen smoothly, consider the following:

- Replace the pallet tape with new tape
- Use less spray adhesive
- Clean lint build-up off the pallet

Assuming that the ink has been pre-sheered to optimize ink flow and will drizzle off your mixing knife with a honey-like consistency, add enough ink to the screen to allow the weight of the ink to continue sheering in screen and prevent the ink from climbing the squeegee.

SQUEEGEE SELECTION

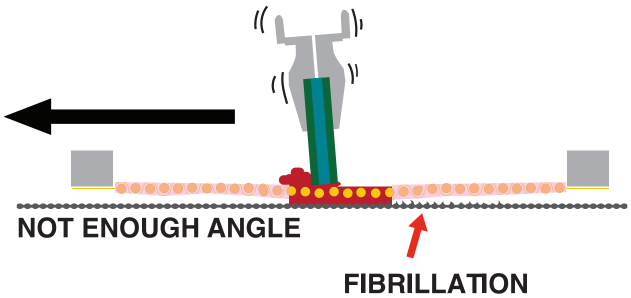
Squeegee material is graded by its hardness. This measurement is referred to as its "durometer." Logically, harder durometer squeegees will disturb the surface fibers of a garment, causing more fibrillation than softer squeegee durometers. However, very soft durometer squeegees may not clear the screen, as well as a harder durometer. For this reason, "triple durometer" squeegees were developed. A triple durometer squeegee has three layers of squeegee material adhered to each other, usually with a 90-durometer rubber in the middle to provide more structure.



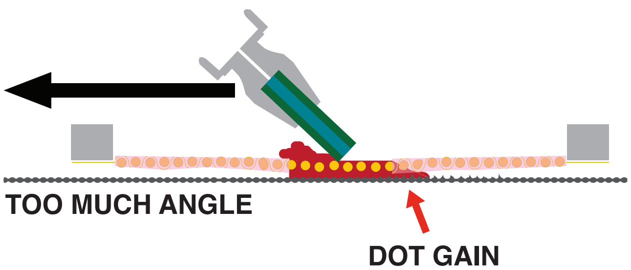
The outside durometer helps to create a softer, smoother ink deposit and is less likely to disturb surface fibers. White inks and inks with high white content, like yellows, benefit from 60/90/60 squeegees. For dark inks, 70/90/70 helps to hold finer detail.

SQUEEGEE ANGLE

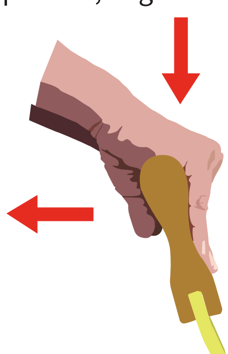
Too much angle can create dot gain and prevent proper screen peel, possibly lifting the garment off the pallet when the screen raises or drops away from the screen.



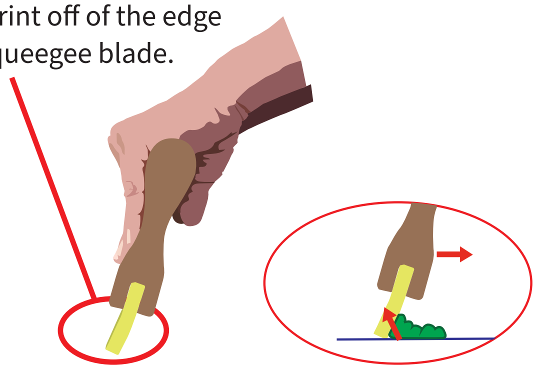
Too little angle can create what is known as “chatter,” leaving undesired lines in the print deposit. It can also cause fabric surface disturbances and fibrillation.



On automatic presses, start with a squeegee angle between 10–15 degrees. On manual presses, begin holding the squeegee behind your ink deposit while resting the blade on the screen surface. From a vertical position resting squarely on the foot of the blade, add downward pressure while beginning to lean the squeegee handle back. Begin your pull, ensuring not to lean the squeegee handle back very far.



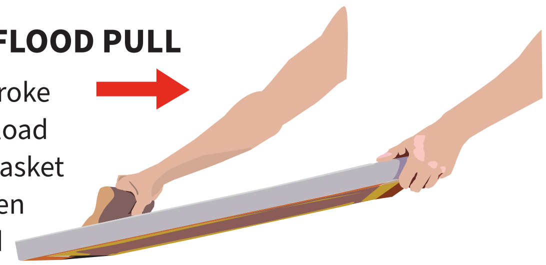
The squeegee blade should only bend enough to create downward pressure while still allowing you to print off of the edge of the squeegee blade.



Be sure to flood the screen before committing to your print stroke. Load your screen stencil with the flood stroke and then with adequate pressure, print with the print stroke.. The goal is to deposit the ink onto the substrate while simultaneously sheering the top of the ink off.

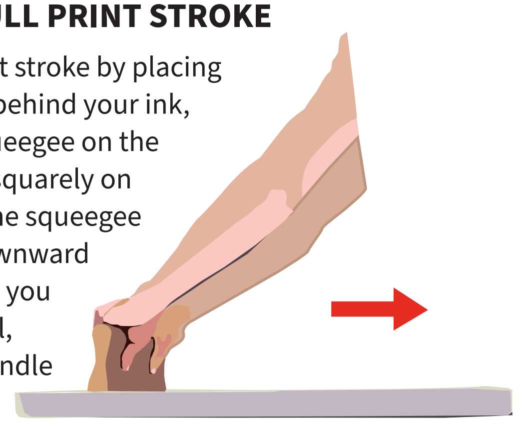
MANUAL FLOOD PULL

The flood stroke is meant to load the stencil gasket of your screen with ink and deposit enough ink along the print stroke to lubricate the squeegee blade. This allows the squeegee to move smoothly across the screen mesh.



MANUAL PULL PRINT STROKE

Start your print stroke by placing the squeegee behind your ink, resting the squeegee on the mesh surface squarely on the “foot” of the squeegee blade. Add downward pressure while you begin your pull, holding the handle between a 45- and 60-degree angle.



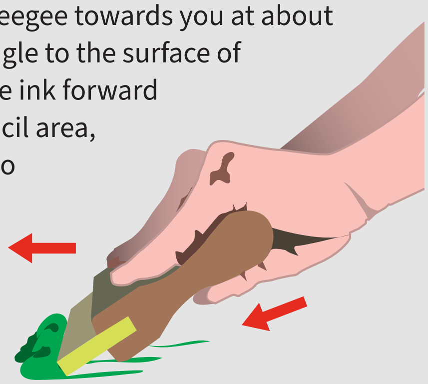
Only the sharp edge of the squeegee should contact the mesh surface. Use enough pressure to clear the ink from the screen, but not so much that you add dot gain and disturb surface fibers.

On a well-imaged screen, you should be able to feel when you are going over the image area and when you are no longer printing over the image area. Too much print pressure will create more blade-to-screen surface contact area which can create dot-gain or compromise line detail.

Be sure to print ONTO the substrate and not INTO the substrate. Too much pressure results in rough, fibrillated prints and can create dot gain or compromise line detail. On garments where dye migration is a concern, you want your low bleed or poly blocker inks to sit on top of the garment to block dye migration. If you print into the garment, the chemistry of the garment may overwhelm the chemistry of the ink.

MANUAL PUSH PRINT STROKE

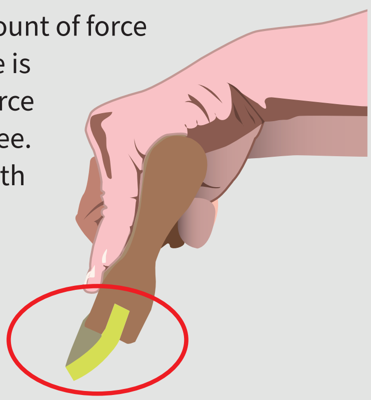
A "push-stroke" is another squeegee technique that can be utilized. After using a traditional flood technique, as described previously, lower the screen down onto the garment. Place the bottom edge of the squeegee blade in front of your ink mass to prepare for the stroke. Angle the handle of the squeegee towards you at about a 30-degree or less angle to the surface of the screen. "Drive" the ink forward across the image stencil area, as seen in the image to the right, pushing the ink like a bulldozer blade with light to medium downward pressure. You should see a rolling bead of ink in front of your blade as you move across the image.



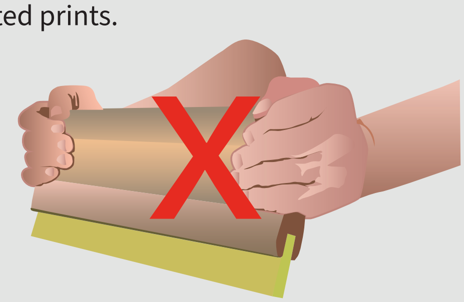
This technique is terrific for holding fine detail on CMYK and simulated process prints and can help control fibrillation.

SQUEEGEE BEST PRACTICES

Using the appropriate amount of force when handling a squeegee is important, as too much force can over-bend the squeegee. If your blade is bending with little effort, you may want to consider replacing your blade or trying a harder durometer squeegee. When you over-bend your squeegee, as seen in the figure to the right, you are no longer printing from the edge of the blade, causing dot gain and a sloppy print finish.



Do not hold the squeegee from the sides, as this technique will add a curve to your blade and create an uneven ink deposit. This technique will also usually result in excess of print pressure and produce fibrillation or distorted prints.



PRESSURE SELECTION

One of the most important aspects of achieving a soft print with clean detail is controlling your squeegee print pressure. A widespread misconception about screen printing is that more pressure equals better detail. In garment screen printing, we have to take a different approach. If you are struggling to clear a fine line and adding pressure is closing up other parts of your design, you are most likely trying to push too thick of an ink through too fine of a mesh. This means you can reduce your ink or re-burn your image on a lower mesh screen.

Before you add reducer to an ink, make sure that is the correct choice. If you are using a white ink that is designed for blends or polys (low bleed or athletic inks), then you should abstain from reducing them, as you will compromise their ability to fight dye migration. Before adding reducer to other inks, make sure that you have pre-sheered the ink thoroughly to optimize the ink's flow. Many inks are thixotropic and gain false body when they haven't been used for extended periods or have become compacted during shipping. Do this by stirring the ink thoroughly with a strong ink knife or using a "turn-about" style machine designed for pre-sheering or mixing plastisol inks. Do not use a drill to sheer heat curable inks.

Next, inspect your squeegee. Is the squeegee bending too easily? It may need to be replaced. Is the squeegee too dull to sheer off the ink as it passes through the screen mesh? Run your thumb over the sharp edges of the squeegee one at a time. Does the edge feel sharp? Consider sharpening or replacing your squeegee blade. Do not simply remove the squeegee blade and flip it over to use the previously unused edge, as this portion of the squeegee could be deformed by being held securely in the holder.

Before adding additional squeegee pressure, determine if you need to separate your halftones from your vector art. An example would be the sponsors on the back of a running, biking, or triathlon-style shirt. The backs of these shirt designs tend to divide the sponsors into three tiers: platinum, gold, and silver. The platinum-level sponsors will undoubtedly want the trademark logo and every detail of their logo to be crisp and detailed. The silver sponsors often have a logo with an excessive amount of halftones. In this scenario, you need enough pressure to clear the trademark logo on the platinum-level sponsor while not closing up all the halftones in the silver-level sponsors. Assuming that you have a head available on your press, separate the solid vector art to a 110–156 screen and image all your halftones onto a

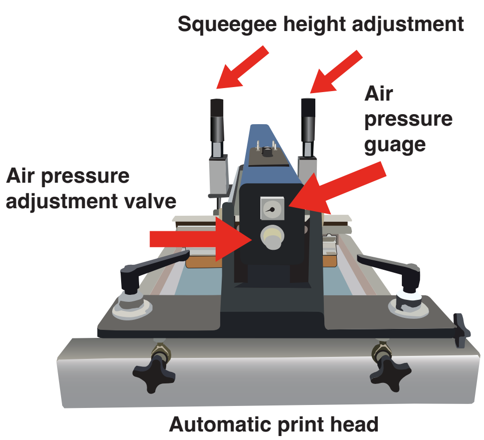
230–355 screen. Sponsors who have supported these events before will notice that you somehow know how to maintain detail that the competitor can't.

On manual presses, it can be easy to print with too much pressure, especially if you have a lot of upper body strength. If you feel like you may lean too much of your upper body weight into the print stroke, try a push stroke or verify that you have properly pre-sheered your inks before printing and then reduce your pressure. Remember that feeling the need to use more pressure on a manual press may mean that you are using the wrong mesh, squeegee, or even the wrong ink.

DIALING IN PRESSURE ON AN AUTOMATIC PRESS

Controlling pressure should be a top priority when using an automatic press. Unlike a manual press, an automatic press cannot make all the micro muscle movements that a manual press operator does during their print stroke. On the other hand, an automatic press does not vary or become tired and change pressures inconsistently.

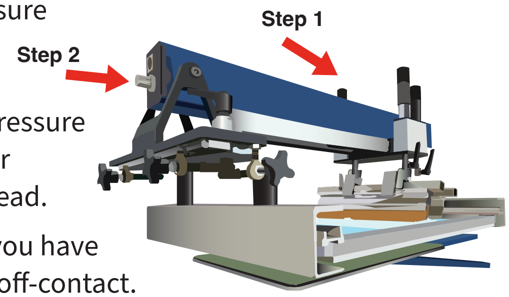
There are usually at least two ways you can adjust pressure on an automatic press' print head. Not all machines are the same, but they are usually very similar in how they control pressure. Most presses require an air compressor to provide air control for some of their mechanical movements, like squeegee pressure, while some presses only use the air source to control the squeegee pressure. The image to the right illustrates how to use these controls based on popular American-style automatic presses.



Some presses will only have a squeegee height adjustment to allow you to add more downward pressure to the squeegee. It is important to understand that this adjustment is only for controlling how far downward the squeegee will move. This adjustment will add downward force, but if your print head is equipped with an air pressure regulator, like in the image above, you should use this control instead of your height controls.

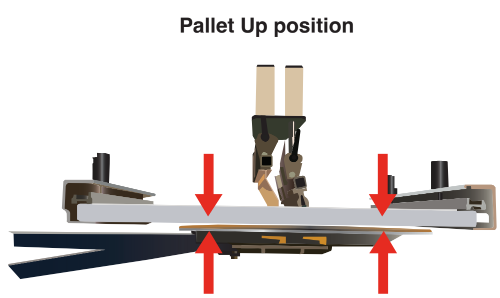
STEPS TO CONTROL SQUEEGEE PRESSURE

1. Rotate squeegee height controls completely counterclockwise so that the squeegee pistons are completely extended downward.
2. Set air pressure to between 35–40 PSI on the air pressure regulator for that print head.



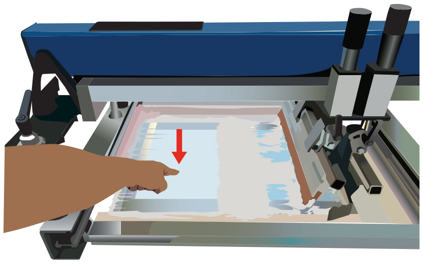
3. Verify that you have the correct off-contact. Your off-contact controls may be towards the base of the press at the center of the carousel. There may be up to four off-contact controls on your screen clamps (two each, left and right). On older presses that do not have built-in off-contact controls, you may need to place a shim made from a wooden paint stick or metal between the bottom of the screen and the bottom of the screen clamp. This will allow for proper screen peel.

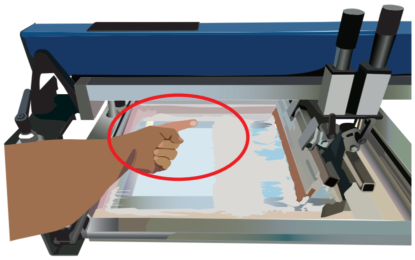
   With the shirt platen in the raised position, you should be able to squat down and see space between the surface of the garment and the screen. This space should be higher than the width of a dime, but you may need more distance for longer screens or screens with low screen tension. Properly tensioned screens (greater than 16 newtons) with a free mesh area of 2½ inches on each end of the squeegee should have an off-contact of around 1/16 inch and less than 1/8.



4. With your pre-sheered ink in your screen, a test garment or Pellon® loaded onto the press, squeegee angle set at 15 degrees, pressure set at 35–40 PSI, and a 60/90/60 or 70/90/70 squeegee installed, you are ready for your first test print. Perform your first test print. As long as everything goes as expected, do one or two more strokes to esnure the stencil gasket is loaded with ink, and replace your test material with a new Pellon or test garment.

5. Now, do another test print of just a single stroke of the white ink. After the squeegee passes over the image area, run a finger across the screen above the image area and inspect your finger.





6. If your finger looks clean after wiping it across the screen, there is too much pressure, and you should reduce pressure by a few PSI at a time. If your finger looks clean after succesfully clearing the screen image area excpet for a chalky resisdue in the valleys of your finger print, this indicates you are at or near ideal squeegee pressure.
7. Now inspect the print. A single stroke of white should produce an image with about half the opacity you are looking for while still holding down fibers. The goal here is to deposit the first layer of ink to not only build a base for the second coat of ink but also to lock down surface fibers. Too much pressure here can orient the fibers upward. Too much ink can cause a sloppy peel that will orient the fibers upward, reinforce their structure, and create an abrasive surface.

   Too little off-contact here will prevent proper screen peel as the squeegee travels across the screen, allowing the garment to stick to the screen resulting in either a rough ink deposit or lifting the garment from the platen. Too loose of a mesh will cause sticking and lifting as well. If you are achieving a successful deposit and peel, but fibrillation is occurring, consider going up in mesh count so that the fibers have less opportunity to stick up into the screen mesh as the tighter, smaller openings in the weave of the mesh are less likely to allow the fibers to be drawn upward.
8. Print your second stroke and verify that it is improving in opacity and vibrancy without causing fibrillation. If the second print had improved opacity while achieving a clean, crisp print, flash it to prepare for the top coat (either a final white or a top color). The first layer of white should go down in two strokes so that fibrillation is controlled while still achieving a soft, lightweight deposit.

   Flash the ink to a state of “gelling” but not all the way to full cure. If you fully cure your under base layer, subsequent layers of ink will not be able to “bite” or adhere to the base layer. This type of failure will be apparent after washing. The top layers of ink will appear to have flaked or washed off the shirt, leaving evidence of the under base layer.

   The goal for flashing ink should be to reach a pudding skin-like surface, just stable enough not to stick to the next screen but not cured. If you are printing a low-bleed or poly ink that has blowing agents to fight dye migration, these particles will swell and possibly burst when over-flashed. The resulting “burst bubble” will leave a ring of cured ink where the bubble was or a bump where the particle swelled in the ink surface. This will contribute to a rough, abrasive, or “wavy” surface indicating that too much heat was used.

   While using a laser temperature probe to check ink temperature is not advisable, you can use it here to ensure you do not over-flash. To do this, point the laser to the ink deposit on the garment as it shuttles out from under the flash. Ideally, you want to see a temp of 140°F or slightly below. The longer the pallet is away from a flash, the more the temperature will decrease. If the temperature is above 140°F or does not cool down as it moves further from the flashing station, you may need to adjust your temperature or power settings on your flash to maintain a lower pallet temperature. Consider adding a “cooling station” after the flash by adding an open print head with no screen. You may also want to slow down the flood speed on your slowest print head, allowing more time for pallets to cool.
9. With your base layer, also known as a base plate or under base, stabilized and gelled, print your next layer or top white. The final print should be crisp and smooth. The less ink you deposit, the less heavy your print should be. The less pressure you use, the less “boardy” your print should be.

   If you print with too much pressure, you drive ink into the weave. This fills the areas between the weave, spreading the weave, distorting the image, and giving the garment structure once the ink is cured. Our goal is to print on top of the fibers.

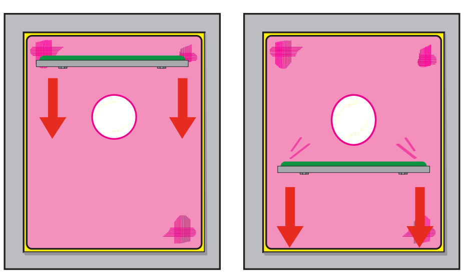
This results in a soft, vibrant print, allowing your low-bleed or poly chemistry to fight dye migration more effectively. When you drive the ink into the garment, you risk allowing the dye chemistry of the garment to overwhelm the dye-fighting chemistry of the ink. You also end up coating through and around the fibers, resulting in a stiff print with surface fibers oriented upwards as a result of thick ink peeling away from the screen when the garment and screen lift away from each other.

If your prints continue to produce unwanted results, verify that you have proper screen tension.

SCREEN TENSION

Low screen tension contributes to many types of print failures. A loose screen will cause print distortion and low tension, which can contribute to garment lifting, registration failures, and poor print finish. Below is an example of a low-tension screen attempting to print a circle. When the squeegee blade comes down to meet the ink and the screen surface, it will pull the “sag” of the screen in the direction of travel. It’s not hard to see how this screen may appear in register to the other screens in the print order until printing begins and parts of the image seem to print lower than they were registered.

Our industry has a few types of screen printing frames, including static, roller re-tensionable, and replaceable panel frames.



STATIC FRAMES

When these frames lose tension, you must cut out the mesh, re-stretch them, and glue new mesh down. Very few shops do this in-house as it is a dirty and dangerous job. Generally, a shop will save up its loose static frames and send 25 or 100 at a time back to their local supply distributor for re-stretching.

ROLLER FRAMES AND RE-TENSIONABLE FRAMES

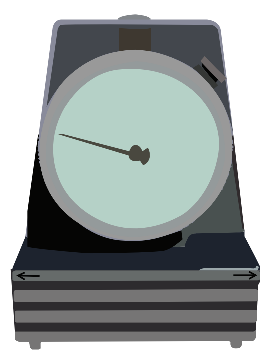
These frames allow you to not only re-stretch your mesh but also change the mesh from one mesh fabric to another to give you absolute control of your tension in both directions. These are often heavier than most other screen frames and do not always work best with modern registration equipment. But as stated before, you can adjust the frame to exactly the tension you desire.

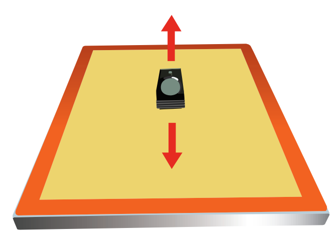
REPLACEABLE PANEL SCREENS

Replaceable panel screen frames are usually much lighter than roller frames and only a little heavier than static frames. Some will allow one or two adjustments, but their primary design function is to allow you to replace your old mesh with new mesh in-house, with almost no mess and minimal equipment.

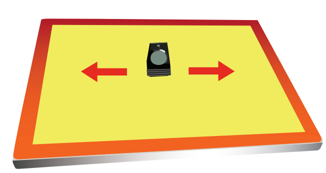
Whether you send your screens out to be re-tensioned or you re-tension in-house, you will need to understand how to tension correctly. To understand what the tension of your screen is, flick a clean screen with your finger. Do you hear a dull thud from the mesh, or a tight snap like a snare drum head? Ideally, your screens should produce a snare drum-like snap when you tap them. If the sound is more like a loose floor tom drum sound, then that screen is too loose.

Another way to understand your screen tension is using a device called a “Newton Meter.” Refer to the mesh manufacturer for its suggested tensions per mesh count. If the suggested tension is 20 Newtons, check to see if you have 20 Newtons in both the warp and weft directions.





Weft direction
(Weft is right to left direction)



Warp direction

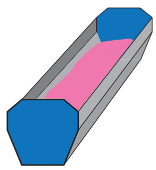
The Warp direction receives the most abuse during printing, so this direction is usually looser than the Weft direction. Whenever you receive new screens, verify the tensions are adequate before accepting them. When re-tensioning screens, go above the suggested Newton measurement by 3–5 Newtons if the mesh feels it will allow it. Set a weight on the screen overnight, or at least for a few hours to pre-stretch the mesh and re-tension to the desired Newtons, ensuring to match the tension in both directions.

SCREEN COATING

Your print quality relies on your screen quality!

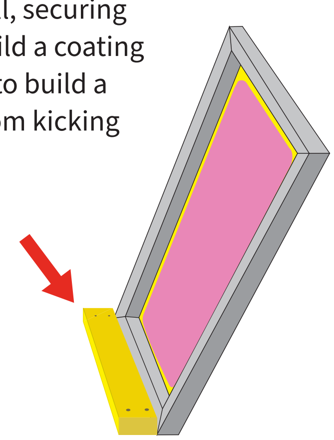
SCOOP COATER

Only fill your scoop coater halfway. Run your thumb across each coating edge to ensure no burs are on the coating edge. Use the round edge of the scoop coater for a better emulsion deposit.

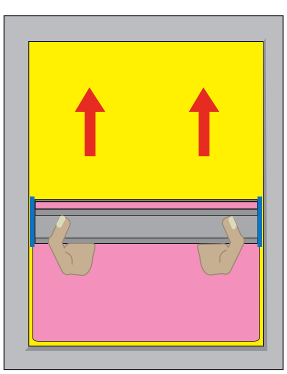


EMULSION APPLICATION

Set your screen against a wall, securing the bottom of the screen. Build a coating table if you need to. Be sure to build a block to keep your screen from kicking out, as seen in the figure to the right. Build this table so the base of the table is at waist level, allowing you to use both hands. There are two important goals here:



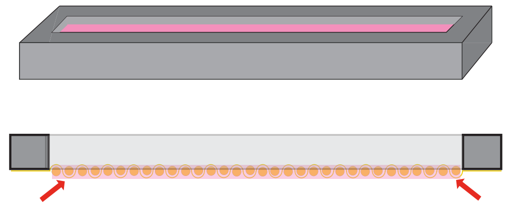
1. Improve screen coating uniformity and quality.
2. Create a process that is enjoyable for yourself or whoever is coating screens so that the steps are not rushed or skipped.



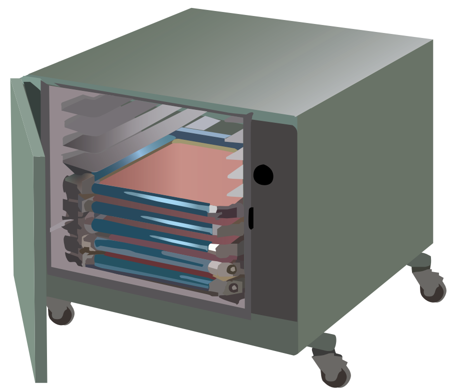
SCREEN COATING

Use both hands to control the scoop-coater moving at a speed that prevents chatter. Using a 2 and 1 or 2 and 2 coating technique is common. Make sure your last coat is on the “well” side. This will force the emulsion through the mesh, allowing the stencil gasket to occur on the print-face side.

Dry screen face down. You want gravity to pull the wet emulsion downward so you can achieve a successful stencil gasket.



Don’t allow fans to blow dust onto wet emulsion. Instead, set fans to pull air from your screens or dry with a space heater, or in a hot box, or specifically designed screen drying cabinet.



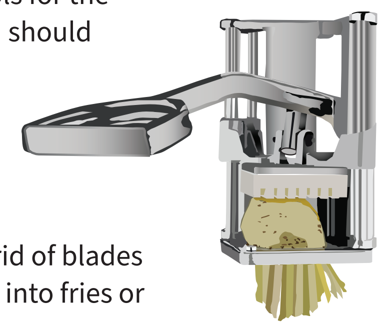
SCREEN COATING TIPS

- **Consider adding a dehumidifier to your screen room if you live in a humid climate.**
- **Do an exposure calculator for each mesh to help prevent washing away your stencil gasket.**
- **Make sure your exposure unit light source is sufficient enough to inter-adhere your layers of emulsion.**
- **Confirm that your emulsion is the correct choice for your exposure unit and its light source.**
- **Don’t coat screens one-handed or on the floor. Build an ergonomic coating station so your screen person can handle this process.**
- **When using Emulsion with diazo, allow the mixture to sit for several hours before use in order to avoid bubbles which may create pinholes in your emulsion surface.**

UNDERSTANDING YOUR SCREEN MESH

The screens you use and how you image them directly affect your print quality. If you have loose screens, you will likely have a bad finish and poor detail. If you have too high of mesh for a glitter or shimmer, you will end up filtering out the flakes and printing the dyed base. If your stencil gasket is too thin, you will not be able to print a durable layer of ink, which can cause dye migration and fibrillation.

Visualizing the mechanical actions of the screen as it relates to the screen printing process helps you predict how an ink will behave and better prepare you to choose the correct tools for the job. The first thing you should visualize is how the ink is deposited through the screen. Imagine a French fry cutter; the potato is pushed through a grid of blades that slice the potatoes into fries or columns.

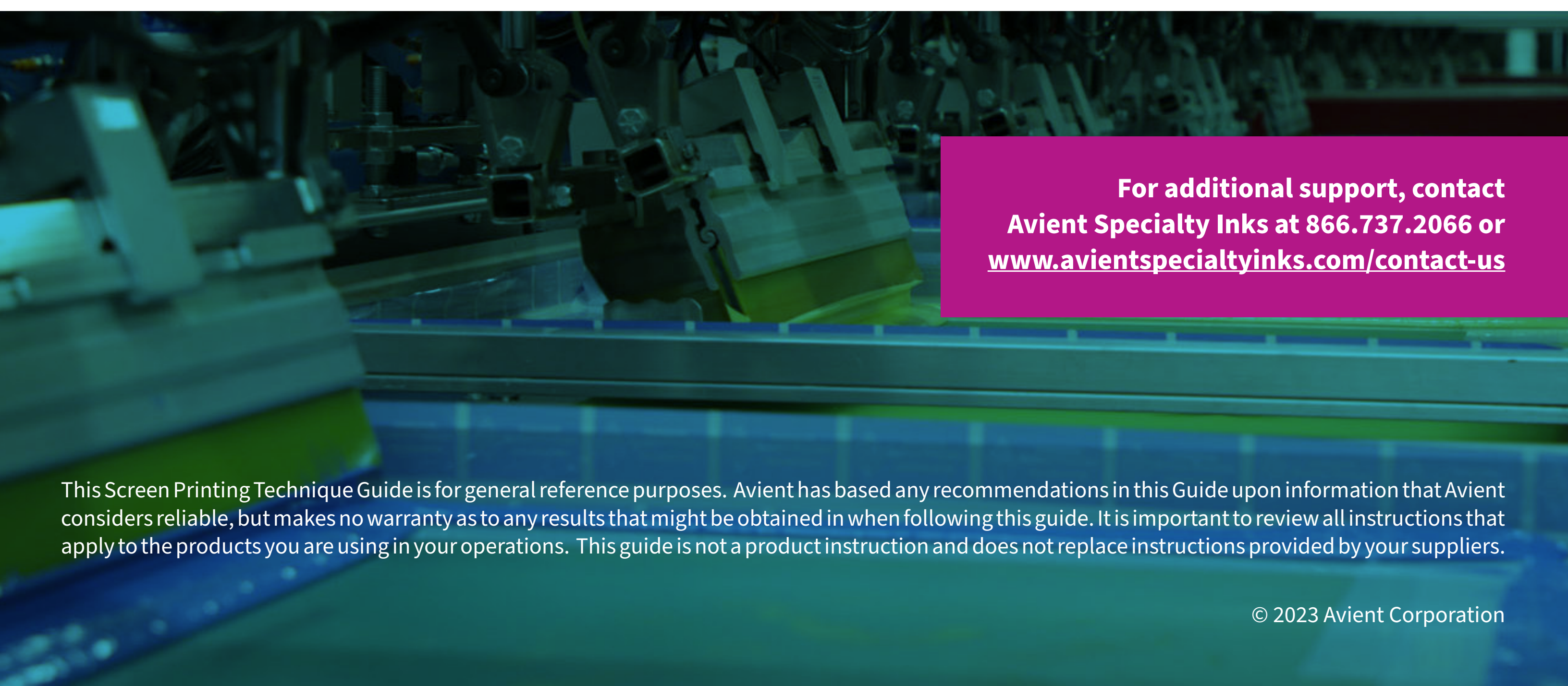


When we push the ink through our screen, a similar action occurs. The mass of ink is forced through a grid of polyester mesh, depositing very tiny "fries" or columns of ink onto the substrate. How uniformly we deposit those columns of ink and how cleanly the mesh peels away from the substrate will determine the quality of our ink deposit. If our mesh is too high for the solids in the ink to pass through the screen, like in the case of a low bleed or poly ink, we will lose our dye-blocking ability or opacity.

If we use too low of a mesh, the large openings can deposit too much thin ink, creating dot-gain and producing a rough ink film surface. When printing plastisol ink on dark or black garments, we typically use a low mesh of around 110 for an under base and higher meshes for the subsequent color layers of ink. These meshes printed over top of the under base print can range from 110 for a large vector or athletic print, to 156 for smaller ink deposits that you wish to have better detail control over, and 230 mesh for halftones and simulated spot process jobs. Going to a higher mesh generally results in a thinner ink deposit and better detail.

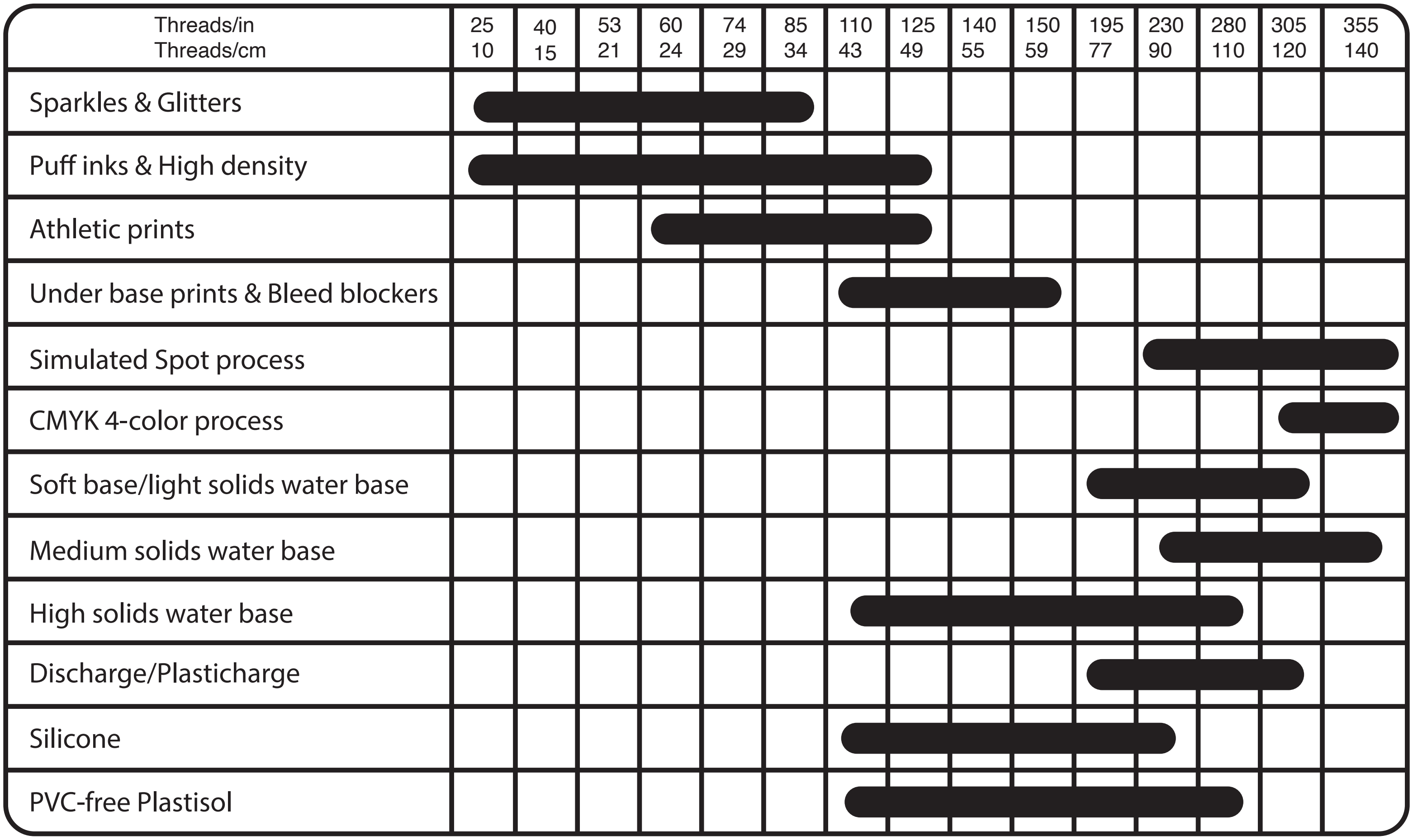
When printing water-based inks or other non-plastisol, thin-bodied inks, we typically use higher meshes to first lock down loose fibers and then build opacity with a lower mesh. There are multiple water-based chemistries with different viscosities; refer to the mesh guide on the next page for more information.

It is also important to consider thread diameter. In some instances, it is preferable to go with a higher mesh that has thinner threads to achieve less ink film surface disturbance as the mesh peels away after the print stroke. These meshes are less common, so you may need to ask specifically for the mesh count and thread diameter when ordering. The companies that produce screen mesh often have their own system of categorizing these thread diameters. Still, we commonly refer to the different thread diameters as S, T, & HD, with "T" being the most common thread diameter available from most suppliers.



For additional support, contact Avient Specialty Inks at 866.737.2066 or www.avientspecialtyinks.com/contact-us

Mesh Selection



Note: Proper screen tension and stencil emulsion are CRITICAL for achieving optimum ink permanence and quality prints.

Mesh Thread Diameter

Mesh Thread Diameter: In certain mesh counts, there is a selection of thread diameters S, T, & HD.

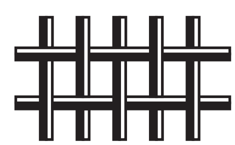
For best results consider these thread diameters:

S Thinnest diameter thread. Permits higher speed print stroke. Requires a durable stencil.
Mesh for glitters: 25–53(in) 10–21(cm)
Mesh for metallics: 60–86(in) 24–34(cm)

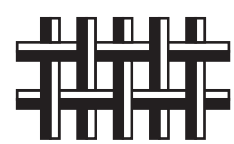
T Medium diameter thread. Softer printing, wet-on-wet printing on darks.
Mesh for soft hand: 140–305(in) 55–120(cm)
Mesh for under base: 110–160(in) 43–62(cm)
Mesh for wet-on-wet on darks: 110–200(in) 43–81(cm)
Mesh for halftones: 305–355(in) 120–140(cm)

HD Thickest diameter. Requires a slower speed, thicker stencil and a dull edged squeegee.
Mesh for athletic numbering and flocking: 51–95(in) 20–38(cm)
Mesh for opaque hot-split transfers: 51–86(in) 20–34(cm)
Mesh for high profile puff: 74–125(in) 29–49(cm)

S mesh



T mesh



HD mesh