Fixing in on Mesh-to-Frame Attachment

Decisions you make during the screenmaking stage can have a major impact on the success of the printing process. Here, learn about the choices you face in frame selection and in securing your mesh to the frame.

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Screen printers face as many options in screenmaking as there are opinions about which frame types and mesh-attachment methods are best. Here, I'll cover the most popular frame systems and procedures for affixing screen mesh to the frames, considering the benefits and drawbacks of each. I'll also explore how the specific fabric selected can influence the effectiveness of different screenmaking components and methods.

Rigid frames

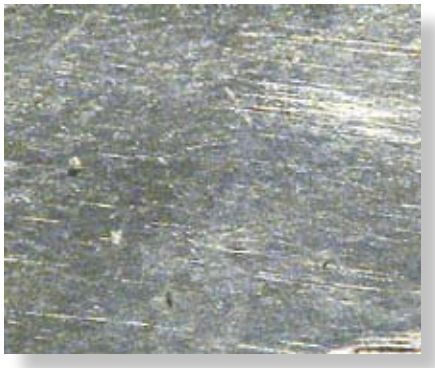
Frames come in two main varieties: static and retensionable. Within these two categories you have multiple options from an assortment of manufacturers. Of these two groups, the simplest form are the static or rigid frames, commonly known as stretch-and-glue/staple frames (yes, there are people who staple mesh to wooden frames!).

Rigid frames are available in many different materials and profiles. The configurations frequently are based on the size of the frame and the intended use. The most common materials are wood, tubular aluminum, and tubular steel. Wood frames are arguably the most popular due to their lower cost but are limited in size for strength reasons and generally not recommended for high-resolution, tight-tolerance work. Among the metal rigid-frame types, tubular aluminum is the most popular in the United States. Aluminum frames are lighter than steel frames but provide similar stability. Steel frames, epoxy coated or powder coated, are more popular overseas.

Tubular aluminum frames support a variety of gluing surfaces, including sandblasted, ground, or raw with no texture ***(Figure 1)***. Testing at Saatiprint has shown that a ground or sandblasted surface provides the strongest bond with mesh adhesive due to the greater surface area created by these surface-preparation methods. The adhesive type and viscosity play a factor in bond strength as well, but I'll address these issues later in the article.

Frames have a great surface to work with when they're brand new. But after new mesh has been applied several times, the surface can become less than ideal due to multiple layers of adhesive, fabric, and ink residue that have built up ***(Figure 2)***. You can—and most people do—re-glue mesh over old adhesive numerous times before the frames must be reconditioned. But many printers don't take the time to prep the frame properly when they attempt to recondition it.

The most common mistake people make with aluminum frames is that they sand the glue off with a palm sander or similar device. While sanding is acceptable for wood frames, it may not be the best for aluminum. Sanding aluminum usually leaves the surface too smooth for the adhesive to bite into it effectively. Sandblasting is great for small frames but may be impractical for large frames. So this leaves only a few options to remove the adhesive, including mechanical brush grinders, angle grinders with flapper discs, or chemicals. Regardless of the method used to remove old adhesive, it's important that the person performing



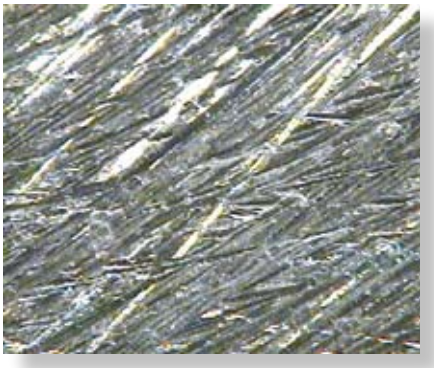


FIGURE 1 THE FRAME SURFACE
It's beneficial to have a textured frame surface on the edge to which the mesh will be glued because it improves the adhesive bond. Shown here are close-ups of a raw or untextured frame surface (left most image) and several ground and sandblasted frames.

this task has proper safety equipment (eye, ear, and breath protection).

The chemical method is most commonly used with coated steel frames, but it is also used with aluminum frames. The chemicals come in two main varieties: gels and liquids. To ensure the best performance, the exact chemical makeup of the strippers should be recommended by the manufacturer of the adhesive you use.

The task of chemically removing adhesive can be performed in a few different ways. Some people will dip their frames (if the size allows) in a stripper solution. Others will paint or spray the cleaning chemical onto the frame, wait a period of time, and then remove the residue with scrapers. To complete the process, excess stripper material and residue is cleaned off the frame with an appropriate solvent.

No matter which method of adhesive removal you use, once you've reconditioned a frame, you will need to treat it as if it were brand new. That means you'll need to check the gluing surface and edges of the frame for nicks, cuts, or any sharp protrusions that could cut or puncture the fabric during the stretching and gluing process. The use of a solvent to clean the gluing surface also is recommended for non-wood frames. The solvent should evaporate rapidly and leave little to no residue. Oily solvents, such as mineral spirits, lacquer thinners, or safety solvents, are not appropriate. Solvents such as acetone or isopropyl alcohol (99%) are very good choices and will leave the frame clean and free of any material that could compromise the adhesive bond.

Stretching and gluing with rigid frames

The frame is ready for the screen-stretching phase once it is clean and prepped. Just like frame types, you have many styles of stretching equipment from which you can choose ***(Figure 3)***. The two main categories of stretching devices are mechanical and pneumatic systems. The type of system you use will be determined by the number and sizes of the frames you plan on stretching, as well as your budget.

Within the pneumatic category are air-bar and individual-clamp stretching systems. The air-bar systems tend to be less expensive due to the fewer parts they involve, but they normally don't stretch mesh as uniformly as a system based on individual pneumatic clamps. The individual-pneumatic-clamp systems can compensate for inconsistency in mesh loading, while air-bar systems can't. However, both types of pneumatic systems allow for the fabric to stabilize since constant pressure is put on the fabric during the stretching process. Another benefit to pneumatic systems is the fact that most can pre-bow the frame, resulting in even more consistent tensioning among screens.

Mechanical stretching systems can be as simple as canvas pliers or as complex as individual clamps attached to a moving bar. Normally these systems are used for low-volume stretching or where a tight budget is involved. The more elaborate mechanical stretchers are used for wire-mesh tensioning because of their ability to stretch with little deformation of the fabric during the stretching process. Extremely large mechanical units also are offered for large-format screen-making. Mechanical systems are highly effective in getting the job done, but generally they lack the finesse of a quality pneumatic system.

After the mesh is stretched, it's time to adhere it to the frame. With wood frames you can use adhesives. Some people even use staples, but I'm too nervous about putting sharp pieces of metal through a fabric at high tension. With metal frames, adhesive is the only option (unless you have some really tough staples). On the adhesive side, you have a few options, including two-part epoxies, two-part urethanes, and cyanoacrylates. All three systems can be called two-part; two feature a base material and a catalyst and the other comes with an adhesive and an activator that is used to make the adhesive cure instantly.

Both urethane and epoxy adhesives consist of a base adhesive that requires a catalyst. The catalyst accelerates the curing and improves the hardness of the adhesive. The mixed adhesive and catalyst has a pot life, which will vary depending on the formulation and manufacturer. In general, pot life ranges from a few hours to a few days. Be careful to not go past the pot life—old adhesive may appear to work properly, but its solvent resistance will be greatly diminished.

FIGURE 2 POOR FRAME SURFACE
After the mesh has been replaced several times on a rigid frame, the glue that accumulates on the frame needs to be removed. This will help ensure that the next time a screen is attached, the adhesive will bond properly. Chemical strippers can be used to soften adhesive residue so that is can be easily scraped off.

With recent changes, urethane and epoxy adhesive systems have gained popularity. Newer laws and regulations have made these adhesives a lot milder than they were a few years ago. With these changes, the products are easier to work with both in application and removal. Unfortunately, the solvents used in most of these systems are very similar to the solvents used to remove ink from screens, so care is needed when choosing screen washes. It is highly recommended to test the adhesive with the solvents in your shop to determine whether they are compatible. Typically, you will find urethanes to have better solvent resistance and more flexibility than epoxy-type adhesive.

A variety of catalyzed adhesives are available, including formulations for just about any application, mesh count, frame type, and environment. Most manufacturers have multiple viscosities from which you can choose to accommodate coarse mesh (24-196 threads/in.) or fine mesh (230-460 threads/in.). The viscosity is important because it influences how well the adhesive penetrates the fabric

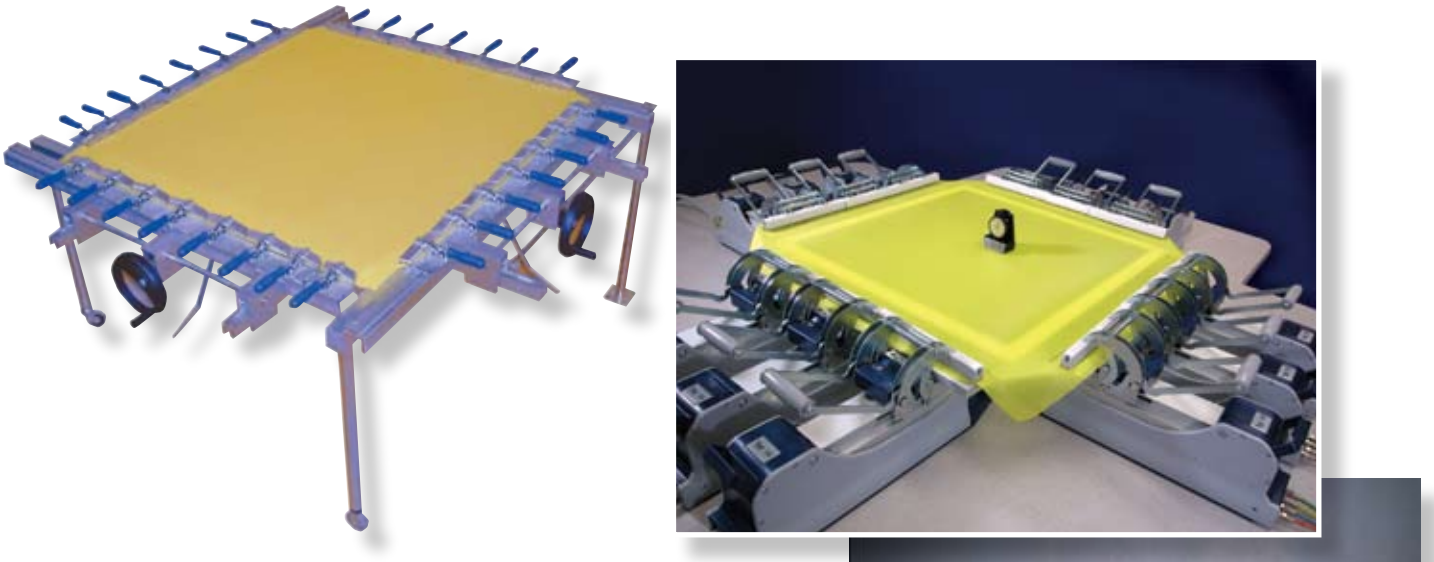


FIGURE 3 STRETCHING SYSTEMS
Mesh-stretching systems come in a variety of formats. Shown here are a mechanical drawbar stretching system, a pneumatic system featuring numerous independent clamps, and a system for automatically stretching mesh on roller-style retensionable frames.

to reach the frame. The viscosity also relates to the solids content of the adhesive, which determines how well the adhesive bridges the gaps between the fabric and the frame. If you use a thin-viscosity adhesive on a coarse mesh, as the solvent evaporates and the adhesive shrinks it could leave air pockets between the mesh and the frame, which can cause bonding problems. Most catalyzed adhesives are not surface sensitive and are approved for use on wood and metal frames alike.

When mixing catalyzed systems, most users fall into the catalyst trap. Mixing the product properly is key. The old adage, "if a little is good, a lot is better" does not apply when adding catalyst. In most cases, adding more catalyst will help with the chemical resistance but it will slow down the reaction time of the adhesive. Normally the two-part epoxy systems are tack dry in 5-20 min but are not fully cured for 24 hr.

As far as applying the adhesive, I have seen this done in every conceivable way, from manual to automatic application. Personal preference dominates here since there is no right or wrong way of applying adhesive. In other words, you can achieve the same good results from applying a bead of adhesive, pushing it through the mesh, and smoothing it out with a plastic card as you can by dipping a stiff brush into a cup of adhesive and brushing it through the fabric. Additionally, some manufacturers will tell you to prime the frame with adhesive before stretching the mesh and bringing into contact with the frame surface. This is not always necessary if the frame has been prepared properly, but it usually won't hurt to do this for added insurance.

The other type of adhesive system, which was extremely popular a few years ago but is slowly losing its hold on the market, is the cyanoacrylate (CA) or superglue adhesive. The CA adhesives mainly consist of ethyl cyanoacrylates, which have a good strength characteristic, fair solvent resistance, and compatibility with most materials. Some manufacturers offer specific formulas for wood, aluminum, and painted surfaces. Just like the catalyzed systems, the CA adhesives come in many viscosities for just about any application.

The allure of CA adhesive is its speed. The curing speed comes from the second component in the system, the activator. Activators are normally either acetone- or heptane-based products. Activators come as sprayable aerosols and in liquid forms that can be wiped on. Can the adhesive be used without the activator? Yes it can, but it will take a few minutes to cure depending on the viscosity of the product and the thickness in which it was applied on the mesh and frame. The CA system tends to be very brittle compared to most catalyzed systems and can leave sharp edges when cured if not properly trimmed. There are flexible versions of CA, but when the manufacturer adds material to make it flexible, the trade off is adhesion strength. The solvent resistance of CA adhesives to some chemicals is good (not as good as catalyzed systems), but again, to ensure compatibility, you should test the adhesive with the chemicals you use.

CA glues have short shelf lives—as short as a few months. They must be stored in a cool, dry place. Storing them in a refrigerator will greatly improve their shelf life. CA can be used directly from the refrigerator but its viscosity will be slightly thicker while cool. The adhesive also can be stored in a freezer, but it must be allowed to warm to nearly room temperature before use.

Just as for catalyzed systems, automated glue-dispensing machinery is available for CA adhesives, too. But in most cases the material is applied by hand allowing the material to flow through the mesh onto the surface of the frame. Then it is spread out with the help of a plastic scraper and the activator is applied. Note that when using any of these adhesive systems, adding weight onto the fabric inside of the frame helps keep intimate

contact between the of the frame and the fabric and promotes a stronger bond.

Retensionable frames

The alternative to the stretch-and-glue process for attaching mesh to rigid frames is to use retensionable frames. These frames became extremely popular because standard polyester mesh fabrics were unstable in terms of maintaining consistent tension levels. With the advent of newer low-elongation (LE) fabrics, the benefit of retightening mesh is no longer as important, but these frames are still very useful. Retensionable frames area available in drawbar and roller configurations.

As their name implies, retensionable frames allow mesh to be retensioned. They use no glue, and they can be fitted with new mesh relatively quickly without the use of chemicals. It takes some skill to get consistent tensions with these frames, and the process usually takes a little more labor to stabilize the fabric, but the results are usually worth it.

Drawbar frames have several configurations for locking the fabric into the frame. One is a stretch-and-glue version, but most consist of either one to two plastic rods or a metal bar that slide into grooves or channels on the frame sides and lock the mesh in place ***(Figure 4)***. Which configuration to use depends mainly personal preference, but also on the mesh type and thread count you use. For instance, printers working with stainless-steel mesh tend to use the single plastic rod or metal bar locking mechanisms as opposed to the two-rod systems since these meshes are stiffer and the single-component locking systems are easier to work with. Locking the fabric in the frame uniformly is fairly critical to ensure a consistent stretch with drawbar systems.

The act of stretching screens on a drawbar frame usually consists of either turning a series of bolts along the side of the frame or using a special tool on the corners to draw the bar back mechanically. In the first scenario, depending on how much you turn each individual bolt along the frame, you can influence the fabric in that general area to compensate for any inconsistencies in the way the mesh was loaded. In the second situation, the construction of the frame may cause issues because as you tension the mesh, the dimensions of the frame will increase. This is not a problem in some applications, but it's something to keep in mind if you're considering this frame type.

Roller frames are clearly the most popular of the retensionable frames. Once again, some skill is required to use these frames, but once they are mastered, roller frames provide a quick and easy method of making a screen. The principle behind the roller frame is that the fabric is locked in the frame with either a plastic strip or two round plastic rods. Then the rollers are turned away from each other to increase the tension. Just like the drawbar frame, the fabric can be retensioned to a degree to compensate for tension lost during printing. Also, pneumatic tensioning systems are offered for roller frames to simplify tensioning even more.

With all retensionable frames, you have to take care when reclaiming and handling due to the fact that there are many pockets in which cleaning chemicals can collect, only to drip out at the worst possible time. The other common issue with these frames is that oily reclaimers and ink washes tend to get trapped in the locking channels and can sometimes lead to the fabric slipping out of the channels. Liquids also can leak into the hollow tubes. This problem is quite common when using a dip tank in the screen-cleaning area. Everything works fine until the frame is placed under vacuum in the exposure unit, which causes chemicals trapped inside the tubes to be pulled out and across the screen, ruining the emulsion.

Strive for superior screenmaking

Whether you use static or retensionable frames, it's imperative that you strive for consistency and repeatability in your screenmaking procedures. Begin by making sure your frames are structurally sound, clean, and free from defects that could lead to lead to damaged mesh. Take care in stretching the screen fabric and measure the tension level to ensure that it's high and consistent from screen to screen. If you are attaching the mesh with an adhesive, make certain the glue is compatible with the inks and cleaning chemicals you employ. And on retensionable frames, focus on loading and locking the mesh in place as evenly as possible to ensure that the tension will be consistent across the entire screen surface. By following these steps, you'll be rewarded with long-lasting screens that deliver top-notch prints. ■

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FIGURE 4 MESH-LOCKING OPTIONS
On retensionable frames, rods are typically used to lock the fabric into channels on the frame sides.