MAXIMIZING STENCIL LIFE

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Impressions Magazine
February 1993

A key ingredient in print productivity is the life of the stencil. With automatic presses now configured to 14 colors, the chances of a press going down because of screen failure are quite high. The life of a screen is a relative point. For some printers, stencil failure at 1000 dozen is acceptable. For others, 10,000 dozen may be the requirement. If your screens are failing before 500 dozen, there is something seriously wrong. To minimize this, extra care needs to be taken to insure long life of the stencil.

Breakdown of the stencil can be characterized by the increasing incidence of pinholes, image loss, and ghosting of the print area. Each failure type has its own set of causes. All causes can be traced to the screen preparation phase or press conditions.

Careful preparation of the screen will go a long way toward increasing stencil life. Inattention to proper processing can result in direct failure as well as delayed failure of the screen. Some of the steps are obvious, others more subtle. Attention to the proper sequence and techniques of stencil preparation will eliminate the vast majority of failures. In addition, properly prepared stencils will resist abrasion and fatigue on the press.

Pinholes, and the emergence of pinholes throughout the run, are a constant source of frustration and lost productivity. It is not easy to overcome all of the causes of pinholing, but with steady effort the vast majority can be brought under control. Pinholing will be the sole subject of a column later this year.

Starting with screen preparation, proper degreasing will help greatly. The screen must be degreased to cleanse it before every coating cycle. Proper degreasing results in a "sheeting" of rinse water off the mesh. If there are any areas of dirt or oil, you will see water repelled in those areas. This is your first check to verify that your screens are clean and ready to accept a stencil.

The coating method used can also lead to pinholes, in a big way. If the edge of the coater is very sharp, there is a very good chance that you will form micro-bubbles in the mesh opening. The coarser the mesh, the greater the chances of developing them. The larger the mesh opening, the greater the chance of bubbles forming.

When mixing emulsion, you must also be careful not to stir air into it. It is always better to sensitize your emulsion and let it sit for several hours, if not overnight. The more resting time that you allow, the more bubbles will rise to the surface. They will either burst by themselves, or they can be skimmed off carefully. Most emulsions today

contain surfactants that will increase flow and wetting properties as well as aid in breaking bubbles.

While we are on the subject of coating, let's consider how emulsion coating looks on the mesh. A typical stencil breakdown can result from too thin of a coating on the squeegee side of the mesh. This can result from an underexposed stencil, but the coating thickness can also have an effect. The coating method that you use should be consistent for each mesh count that you use. Notice that I said *consistent* and not *identical*. The coarser the mesh count, the more emulsion will be needed to provide the proper coating thickness. Where a 355 mesh may require only one pass on each side, a 110 may require three over two to achieve the same quality results. Your emulsion, coater, and mesh all come into play in determining the optimum combination.

The important consideration here is that thread on the squeegee side has enough emulsion to completely encapsulate it. Because there can be a great deal of abrasion during the print run, a thin coating will rapidly break down. Fortunately for us, today's high solids emulsions do an excellent job of providing a thin coating that has little shrinkage and provides adequate protection against premature breakdown. A high solids emulsion would be any emulsion with a solids content above 40%. Your supplier will be happy to provide you with technical details for the emulsion of your choice.

Light-sensitive screens do not have to be handled in the dark. This seems like a contradiction, but it is not. Photo emulsions are sensitive to ultraviolet and purple. They have little or no sensitivity to yellow, orange, or red. Most screen rooms are poorly illuminated with weak yellow safelight. This is unnecessary and contributes to poor productivity and poor quality. There are a number of manufacturers of safelight sleeves that fit over standard four-foot fluorescent lights. These will raise the light level dramatically. You can purchase them in yellow, or UV absorbing clear for use with white tubes. This means that now you can see what you are doing without exposing your screens.

With the light level up, you will be amazed at how dirty your work area can get. All this loose dust is one of the major causes of early screen failure. Besides dust, there is the surface of your exposure table to deal with. Ink, emulsion, tape, rubylith, and scratches can all affect the quality of your screen.

I am not suggesting that your screen department be an operating room. Far from it. My contention is that it should be clean enough to keep your screens from failing. It's nice to have a perfect area, but the reality of day-to-day business is that very few of us have enough time to maintain this type of area. Concentrate on eliminating the majority of dirt, to the point that you are getting acceptable results for your level of satisfaction. This is the realist in me speaking, not the theorist.

Check the glass on your vacuum frame. If it is heavily pitted and scratched, you have two choices. The first is to replace it. This is the best option, but the most expensive. The second is to flip it so that you have a new surface to expose on. Because light is refracted, it will bend around the nicks and scratches, thereby allowing extended life. The proof of how effective this is for you will be in how the stencil looks. If you cannot detect any scratches or defects after the screen has been exposed, you may be able to get some more life out of that tired old glass before you have to invest in a new one. Halftone printing with very fine meshes is the most susceptible to nicks and scratches. Line work on coarse meshes is the least sensitive.

The next major source of screen failure is related to humidity in the processing area and in the stencil itself. This is particularly important with diazo and dual cure emulsions. Too high a humidity blocks the chaining of the diazo and PVA during exposure. The resulting short molecular chains mean that the full strength and chemical resistance of the stencil are not attained. When the screen reaches the press, the added stress of squeegee pressure and off contact cause the stencil to rapidly break down.

In itself, lack of humidity control is probably the single largest factor in premature stencil failure. The requirements are not too stringent. A humidity range of 30%–50% RH in the coating room is safe if the temperature is kept between 65° F and 85° F. If your temperature is too hot, it will cause the emulsion to "skin" before all of the moisture has evaporated from the center of the coating. The result is again, trapped water that interferes. If the humidity is too low, the emulsion can become brittle, resulting in the formation of millions of micro-cracks or fissures. These break down on the press almost immediately, and the stencil will print a definite ghost image over the entire squeegee stroke. This happens when the RH falls below 20%.

You must also maintain good air circulation in the coating area. The object is to create an environment where the water vapor can reach an equilibrium of 40% RH. The moving air helps to distribute the evaporating water molecules so that the air space above the screen does not get saturated with moisture vapor. If the moisture is distributed, the water in the emulsion will work its way out of the stencil and into the air. If saturation occurs, there will be no place for the evaporating water to go. The result is water trapped in the stencil until exposure, where it interferes with the cross linking.

Try to determine what the optimum time for screen drying is for your shop. There is always the tendency to rush screens into production. If you do, you run the risk of shooting a screen with too high a moisture content. A screen can feel dry to the touch and still have too much water trapped in the stencil. Water is one of the major enemies of a durable screen. Make a rule that no screen will be exposed for one hour after coating. You may be able to shorten this time if you have a good dehumidifier, but be conservative.

Exposure is the next major area of consideration. This is the step where ultraviolet light crosslinks the emulsion and converts the exposed stencil to an insoluble resist. The amount and quality of UV that strike the emulsion is the determiner of how good the stencil will be. If your light source is weak and of low energy, you will require very long exposures to achieve the proper conversion. The key factor here is that the UV output of your light source must match the sensitivity of the emulsion that you are using. If your light emits UV that your coating is not sensitive to, you will have a weak stencil. Most emulsions in use in our industry today are sensitive to the 365 – 420 nanometer range of the spectrum. Your supplier should be able to tell you what the UV frequency is for the light that you use.

Completeness of the exposure is very important for the durability of the stencil. The first reason relates to length of the molecular chain that results from exposure. The second is that the exposure penetrate the emulsion and expose all available sensitizer. This is very important because the last area to be converted is the emulsion that coats the inside of the screen. This is the area that the squeegee runs over and is most subject to abrasion. If the exposure does not convert the emulsion that covers the top of the

threads, you will experience rapid breakdown on the press.

When you wash out the exposed stencil, you will know if your exposure is sufficient. After the screen has been wetted and washed on the inside, there should be no "sliminess" of the emulsion. If it feels sticky or slimy, it is underexposed and will break down. Increase your exposure. Another way to tell if the screen has been exposed properly is to blot the inside of the screen with blank newsprint after washout. Any color on the newsprint indicates underexposure.

During the washout phase it is important to properly process the exposed stencil. It is very vulnerable at this point, and considerable damage can be done to the emulsion structure if you are not careful. Always wet both sides of the exposed screen with warm water and allow it to rest for at least one minute before you attempt to wash out the stencil. This will allow the unexposed areas to rehydrate or absorb water so that they will dissolve easily. It is very common to see screen makers "blasting" the stencil with a steady stream of high-pressure water in an attempt to clear the image area. This can result in serious sawtoothing and damage to the emulsion adhesion to the mesh. This is especially true if the screen is washed from the inside. Let the water do the work. The pressure of the washout should only be high enough to carry the unexposed emulsion away from the image area.

After washout the screen is dried and prepared for touch-up. This requires that the image be carefully examined with a strong backlight to identify any pinholes and other defects that may be present. They are filled with blockout and allowed to dry. At this point I usually apply another coating of blockout to the print side of the screen with a plastic squeegee. This reinforces the stencil and applies a reinforcing coating to the nonimage portion of the screen. If any pinholes should develop during the run, the blockout will help to keep them from breaking through.

If you are using a waterbased ink, some special precautions should be taken at this point. Instead of using conventional blockout to reinforce the screen, use water-resistant emulsion. Block out the screen in the manner described above, but dry the screen in the coating room under safelight. After the blockout is dry, re-expose the screen to your light source or set it out in the sun to harden. The coating will expose in the same way as the emulsion and a much harder stencil will result. It is very important to dry the screen under safelight because if you coat and expose it, water in the emulsion will block the chaining that we described earlier, and the blocked out areas will breakdown. You will notice this the first time that you wipe the screen on the print side. It will immediately become tacky, a sure sign of stencil attack.

The next major area affecting screen life is press set-up. Abrasion and physical stress must be minimized. Squeegee and flood bar pressure can cause serious problems. Likewise, too much off contact can result in rapid breakdown. There are also failures related to the type and color of ink being used and with the heat from flashing.

The easiest way to eliminate pressure and reduce off contact is to increase mesh tension. The higher the tension, the lower the squeegee pressure and off contact. Screen life will be greatly extended. Keep squeegee pressure to a bare minimum. It is always best to back the pressure out until there is no print, then bring it in a half turn at a time until the image is sharp and clear. Printers in our industry have a basic rule: if a little pressure is good, a lot is

better! This excessive use of squeegee force will cause any screen to fail. Increase your mesh tension and back off the squeegee.

The off contact is also responsible for early failure. Think of the flexing of mesh as a cycle, down and back. For each cycle the threads are stretched the distance of the off contact. If it is 1/8", the cycle is twice that. Now think of bending a paper clip back and forth several hundred (or thousand) times. We all know what happens. The same is true for your mesh and stencil. Reduce the off contact by increasing mesh tension on the screen, and your screen life will increase accordingly.

The last area that affects stencil life is flashing. Unfortunately, this is a practice that we are mostly stuck with. I have never liked it and avoid it whenever I can. Residual heat from the surface of a garment and from the build-up of heat in the platens can rapidly destroy a screen. This is particularly true of some pure photopolymer emulsions that are on the market. Heat softens the emulsion and makes it particularly vulnerable to abrasion (the squeegee) and chemical attack. Some citrus-based cleaners can eat a softened screen in one application.

If you must flash, do everything you can to cool the garment and the pallet before it hits the next screen. There is new technology hitting the market that controls the flash unit based on the temperature of the garment surface, not the flash element. This should help in greatly increasing production speed, and stencil life as it relates to flash drying.

By paying careful attention to basic concepts of dust and dirt control, coating and drying, exposure, and press conditions, you can produce screens that are capable of 100,000+ impressions without failure. Good stencil life is within the grasp of any professional screen maker. There are always shortcuts but invariably we pay for them on the press in the forms of spoilage and press downtime.