# PINHOLE AND SAWTOOTHING PROBLEMS

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Impressions Magazine
July1993

**In the February column I wrote about some techniques that maximize the life of your stencil. While there is some duplication in this month's discussion, I would like to add a few topics that I didn't have a chance to cover. Among these are pinholes and sawtoothing.**

**Although closely related to stencil life, pinholes and the emergence of pinholes throughout a run are constant sources of frustration and lost productivity. They seem to appear from nowhere, and always when you don't have time to deal with them. Overcoming the causes of pinholes requires steady effort. With reasonable care, the vast majority can be brought under control.**

**Proper degreasing will help greatly. All fabrics have oils and silicones on them from the weaving process that must be removed. Normal handling imparts oils and dirt from our hands. The mesh is also contaminated from the printing inks we use and the reclaiming process.**

**Contributing to surface contamination is the fact that polyester is highly prone to developing and holding a static charge. This electrical charge attracts dirt and dust from the air to the mesh surface where it is trapped. This is compounded if you or any of your workers smoke in the are of the screens. Secondhand smoke deposits tars and other compounds on the mesh that can affect the coating and adhesion of an emulsion.**

**The screen must be degreased to cleanse it before every coating cycle. Proper degreasing results in a "sheeting" of the rinse water off the mesh. If there are any areas of dirt or oil, you will see the water repelled in those areas. I have also seen situations where the rinse water was so hard that it would not sheet properly. A simple water softener test will determine if this is a problem. Water hardness in excess of 10 grains is suspect. If your water is above this, you may need to add a water softener to the line. Soft water is also a great aid in proper capillary film adhesion. This is your first check to verify that your screens are clean and ready to accept a stencil.**

**After degreasing, the mesh should be dried vertically in a dust-free area and coated as soon as all moisture has evaporated. If fans are used to speed the evaporation process, they should have a furnace filter taped to the intake side. This one-dollar investment will collect and trap the vast majority of airborne dust and dirt.**

Screens that are stored for a long period after degreasing are more likely to develop a static charge on the mesh surface. Screens waiting more than 12 hours to be coated may require degeasing again to insure a properly prepared surface.

Contaminates, oils, and silicones cause emulsion to pull away from mesh filaments. This weakens the bond and can result in an immediate pinhole–or a weak spot that develops into a pinhole on the press. The frustrating part of this is that a screen can look perfect, yet fail later in the process. Severely contaminated areas will result in "fisheyes" and other obvious defects in the coated screen. These defects represent thin and weakened areas in the stencil that are likely to fail.

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

Coating speed also has a great deal to do with this. The faster you coat, the more bubble formation will take place. I have seen screens where virtually every cell is filled with a bubble. The ability of the emulsion to wet and flow is affected by the temperature and speed with which the screen is dried. The faster the screen is dried, the greater the likelihood that bubbles will be trapped and preserved in cell openings. Keeping your temperature below 85° F and good air circulation help to minimize this. The lower the viscosity and the lower the solids content of an emulsion, the more likely is bubble formation.

There is also another very negative effect that happens to emulsion when you coat too quickly. If you are coating many screens at one time, it is common to "foam" the emulsion. Rapid coating results in the formation of billions of microbubbles in the emulsion itself. The mesh opening acts as a tiny bubble blower, trapping air in the emulsion as it is passed through the mesh opening. When the coater scrapes excess emulsion off the opposite side, bubbles are returned to the emulsion reservoir in the coater. When this emulsion is coated on a screen, the result is millions of pinholes. Often they will not be apparent until you are on the press. At that time, the abrasion from the squeegee breaks the extremely thin bubble skin, and a pinhole results.

When mixing emulsion, you must also be careful not to stir air into it. This has the same effect as "foaming." 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. If you have "foamy" emulsion, be sure to keep the container covered. If you don't, there is a tendency for the surface to skin. This partial hardening–or skinning–of the emulsion will effectively trap the air bubbles. If this happens, you may need to strain the emulsion after you have skimmed the surface.

Dust and dirt are the third major cause of pinholes. The number of pinholes depends on how accurate your exposure is, and how large the dust particles are. The shorter the exposure and the bigger the particle, the bigger the hole. Often printers will overexpose their screens in an attempt to burn out the dust, tape edges, and dirt. This may work with relatively coarse images, but as soon as you start

working with fine lines and halftones, either your image will suffer, or your screens will be full of pinholes. Increased exposure on halftone screens also has the effect of enhancing moiré, particularly in highlight regions. More about moiré formation next month.

The screen-making department gets the least amount of attention in the shop. It is usually a dirty, dark, wet corner–the last place anyone wants to work. I contend that it is probably one of the most important places in the business. When you start treating it that way, the quality of your prints and your productivity will improve dramatically.

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 safelight 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 light level increased, you will be able to see all of the loose lint and dirt. Besides the 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. Concentrate on eliminating the majority of dirt, to the point that you get acceptable results for your level of satisfaction. Once clean, it is not difficult to maintain.

There is a new product marketed by a company called Modern Solutions (6370 Copps Ave, Madison, WI 53716;1-800 321-2328) that is excellent for elimination of dust on contact frames and vacuum tables. It is an anti-static friction-reducing coating that is wiped onto the glass. It actually repels dust. You apply it once a day to once a week, depending on your production level. You then dry wipe the glass between exposure to lift off any loose particles. It is a very effective product for reducing pinholes.

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 second major area for discussion this month is sawtoothing of an image. All screen printers have experienced this at some time or another. It is usually apparent on coarser meshes and on curved shapes. Sawtoothing results from the inability of an emulsion to bridge the square mesh opening. When this bridge fails, the curve that is reproduced is approximated a series of stair steps. When printed and viewed from a distance, these serrations appear as sawtooths.

Some of the causes and solutions to sawtoothing are obvious, while some are not. One of the easiest-to-fix causes is inadequate coating thickness. With economy emulsions (total solids content 20%-33%), there is so much shrinkage of the emulsion coating as it dries as to virtually require multiple coats. The shrinkage of emulsion results in the total emulsion becoming thinnest at the center

of the mesh cell. Upon exposure, this thin center breaks apart, resulting in a serration of the image curve as the emulsion bridge fails. Multiple coatings on the print side of the screen is the solution. The coarser your mesh count, the more important this is.

Another extremely common cause of sawtoothing is improper washout and post processing of the exposed image. The wet stencil that remains is very fragile after an image is washed out. It still absorbs some water and is soft. After it dries, the resistance and toughness to abrasion increase dramatically. However, while it is still wet, it is very susceptible to damage from high water pressure or high air pressure.

To minimize damage to your image, wet the exposed screen with warm water on the front and back. Allow one minute for the water to soften the unexposed emulsion. Wash the softened emulsion with a warm spray of water. The strength of the water would be about the same as you would use if you were to water or mist a delicate houseplant. This will keep from damaging the emulsion.

After you have washed out the image, blot it with clean unprinted newsprint. You can buy this in 24' x 36' sheets, 1000 per carton from your local paper supplier. This will cause water in the mesh to be harmlessly absorbed. It is very common to see screenmakers using compressed air to blow out the water from the mesh. Unfortunately, the soft emulsion bridging the mesh cell also gets blown out. If you are printing halftones, this can cause a printed image to look very grainy and coarse. It also leads to color shifts and tonal imbalance in an image.

A third cause of sawtoothing is overexposure of the stencil. Serration results from light scatter (halation) at the knuckles of the mesh. Overexposure results twice as quickly at the knuckles as in the center of a cell. The reason is that you are halating in both the x and y directions at the knuckles. This stray light then exposes the emulsion, rendering the bridged image useless. Reduce your exposure to the point where the edge of your film is visible just as a nonprinting line on the screen. You can then add 10% to this exposure to obtain the best possible exposure.

Closely related to overexposure is poor vacuum. Do not confuse a high reading on a vacuum gauge (25"-27") with a good screen-to-glass vacuum. The reading that you see on the gauge reflects the seal vacuum at the point where the vacuum inlet meets the glass of the frame. Make sure that your bleed cords are properly placed and that the vacuum seal around the outside of the frame is sealing properly. A good vacuum is evidenced by "Newton's Rings." These appear over the surface of the image and look very much like the "oil on water" rainbow film you see in the street after a rain. It takes a little practice to see this for the first time, but once you see it you will never forget it. Make sure it is present when you expose your frames.

Lastly, make sure that your positives are emulsion up. We all take it for granted that our film is emulsion up. If you are having your film made outside your shop, or supplied by a customer, check it by scratching the right reading image in a nonprintable area. The emulsion should scratch. If it does not, the image is on the base and the film will have to be duped.

With some attention to basic details it is easy to control both pinholes and sawtoothing. While these are not all of the causes of these two common defects, they are some of the more common ones frequently overlooked. Hopefully they will help you in producing better screens that improve the quality of you work.