Stencil Washout Techniques



Stencil development or washout is given little weight in the bigger scheme of the screen printing process. It seems simple and easy, and not a variable worthy of concern or extra time. But when images carry halftones and fine detail, washout becomes an important sub-process that will impact print results. Just like any other variable, it must be controlled and repeated to attain consistent tonal-range reproduction and print quality.

It is important we understand how stencil development methods impact our image and explore the best methods for washing out today's emulsions. We'll examine some common industry screen ailments, washout variables, the Screen Printing Technical Foundation's washout testing results and, finally, recommendations for best practice. We are primarily discussing direct emulsions and, to some degree, capillary films.

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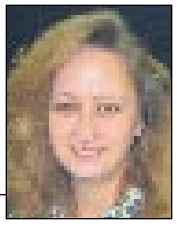
Common Industry Ailments

There are several "screen sins" commonly practiced when screen makers see halftone images. One of the biggest is intentionally underexposing the stencil in an attempt to open up more of the highlight tonal areas. Certainly, underexposing the stencil will accomplish this goal to a degree. But it can come at a high cost. Underexposed stencils cause a host of problems both on and off press. The list includes premature stencil breakdown, pinholes, sawtoothing, stencil scum that is deposited in the image area and reclaiming difficulties. If a screen problem shuts down a press run, any company would lose profits. Idle presses do not make money — they cost money.

The application of a tonal curve generally is necessary to screen print halftones and four-color process accurately. No amount of underexposure will remove the need for a curve in screen printing, except perhaps on extremely low-line counts. The simple truth is: You cannot open up the small highlight to mid-tone dots enough to eliminate the need for a tonal-curve application. So if a curve is needed, why not expose the stencil to a fuller resistance level and help eliminate stencil-related issues in production? As you will see later, it is possible to achieve similar tonal curves from longer exposure and harder development compared with underexposing the stencil.

A related practice is post-exposing the stencil in an effort to recover some of the resistance underexposure has caused. While this can be useful when working with SBQ emulsions, it is not effective at all on diazo stencils and provides little benefit with dual-cure emulsions. For diazo and dual-cure emulsions, the unused diazo literally washes away during development, so there is no longer any sensitizer for post-exposed light to activate.

KIWO states in its dual-cure emulsion literature: "To improve the resistance by 15 percent, the post-exposure time needs to be six to 10 times the original exposure time." For SBQ type emulsions, a post-exposure of one to two times the original exposure time on the squeegee side can be used. Therefore, post-exposure adds an extra processing step and costs valuable time in screen making. However, keep in mind that while post-exposure may improve the resistance of the remaining stencil



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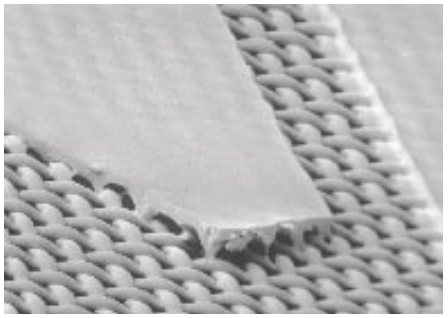


Figure 1: Underexposing the stencil leaves the emulsion on the squeegee side of the mesh soft where it washes away during development. When enough of this emulsion is washed off, the direct emulsion can actually peel away from the mesh.



Figure 2: Specialized nozzle designed for stencil washout.



Figure 3: A simple water filtration system can help remove particulate debris from the water.

layer (in the specific emulsions mentioned), the unexposed stencil material, particularly on the squeegee side, has been rinsed away during development. Obviously, this missing emulsion can't be post-exposed, and compromises to some degree the stencil adhesion. Overall, post exposure is not worth the effort in most cases. It is much wiser to expose the stencil properly in the first place.

The primary exposure is your main tool for creating a durable stencil. It is estimated that 80 percent or more of printers regularly underexpose their stencils, many unknowingly. So even if you are not intentionally underexposing screens, an exposure calculator should be used to determine and check proper exposure on a regular basis. Many articles are available on the Internet on how to use and read a stencil exposure calculator. Emulsion manufacturers also can take you through the process.

If you have the following problems during washout, your stencils are probably underexposed:

1. Stencil delamination from mesh, particularly with capillary film. Stencil exposure occurs progressively from the substrate side into the squeegee side. Underexposing the stencil leaves the emulsion on the squeegee side of the mesh soft where it's literally washed away during development. If enough of this emulsion is washed away, the direct emulsion can actually peel away from the mesh (see Figure 1). With capillary film, the fragile interface of stencil to thread can be quickly compromised when the stencil is not fully hardened.
2. Shadow dots easily rinse off the mesh. This is a symptom of the aforementioned problem. Except for the extremely small shadow dots, most should remain firmly attached to the mesh during washout, when the correct mesh count is matched to line count.
3. Squeegee side of screen feels slimy. This is a sure sign the screen is underexposed. The "slimy" material is actually unexposed emulsion. If it is not completely rinsed off, it can dry in the image areas and block the ink.
4. Excessive stencil pinholes. While there are a number of causes for pinholes, if you see a lot of them during washout, underexposure is high on the list.
5. Stencil-edge sawtoothing. The stencil will lose its ability to bridge the mesh openings sufficiently the more it is underexposed. As with pinholes, there are other causes for sawtooth edges, but you should first check for correct exposure.



Figure 4: A Stouffer 21-step transmission-step wedge can be used as an exposure-control scale.

Washout Variables

There are quite a few washout variables that come into play, whether they are controlled or not. Water temperature, water-pressure, spray pattern and distance, washout duration on each side of the screen and water quality all can impact screen development. Let's discuss each in more detail.

Water Temperature

Normal water tap temperature is usually recommended for washing out stencils. The range would be somewhere between cool to lukewarm, 15°C to 32°C (60°F to 90°F). Although hot water will shorten washout time, high temperatures should be avoided as they will quickly swell the exposed stencil. The softened stencil can be easily damaged and take longer to dry.

Water Pressure, Spray Pattern and Distance

While opinions vary on this issue, higher water pressures (up to a certain point) are actually more effective at removing the unexposed emulsion than low pressures. Many people will caution against the use of a pressure washer to develop stencils. When considering stencils containing small dots it makes sense to treat it with care so these dots are not blasted off the screen entirely.

I would agree with both of these statements if the stencil is underexposed, and most of them are. But with a properly exposed stencil, the increased pressure and water droplet dispersion do a better job clearing out the emulsion in unexposed



Figure 5: KIWO's Quick Check exposure-control scale was used in SPTF testing.

areas. High-quality emulsions can easily withstand pressure if exposed properly. You'll see results later to prove this.

The tougher and more water-resistant stencils available today actually require higher pressure to clean out of all the unexposed emulsion. Here is a demonstration test to prove the idea: Coat a screen with a dual-cure emulsion and allow it to dry, but don't expose it. Now wash out half of the unexposed emulsion with a pressure washer and half with a garden-hose nozzle under regular tap pressure. A haze of emulsion left in the mesh is sometimes noticeable on the side washed out with the garden hose, but not on the pressure-washed side.

Other advantages can be realized from using a pressure washer for stencil development including better edge definition, halftone sharpness and cleaner mesh bridging. Moiré also can be reduced as the dots become more accurately formed and opened. Other benefits possible are improved screen-to-screen consistency, less operator variation and simplified training.

Actual water pressure is related to spray pattern and nozzle distance from the screen. High water pressure can be quite detrimental if the spray pattern and distance are not appropriate, so some conditions need to be observed:

- Stick with pressure washers of 2000 psi or less for screen development.
- Maintain a distance of 30 cm to 45 cm (12 inches to18 inches) from the tip of the wand to the stencil surface. The higher the pressure used the more you should back up in distance. Moving too close will be detrimental to the stencil during development.
- Use a fan spray nozzle, not a narrow nozzle. The narrow nozzle with concentrate the pressure much like moving too close to the screen would produce.
- Never start the flow of the pressure washer directly on the stencil or screen. The initial blast comes out at a higher psi than the normal unit operation. Start the pressure washer off to the side, and then move onto the screen surface.

When using garden hose pressure, select a nozzle that has a strong fan spray pattern and don't be afraid to get close to the screen. There also is a special spray nozzle designed for washout (see Figure 2).

Duration on Each Screen Side

Common industry recommendations say to first wet both sides to soften the unexposed emulsion, and concentrate most of the washout on the substrate side. Often, a final rinse is recommended on the squeegee side until no foam or bubbles remain.

But testing indicates that equal time spent on both sides of the screen during washout can effectively clear out the image areas better on direct emulsion. The length of time spent on each side also is an important variable. That being said, for capillary film, it is wise to perform most of the washout on the substrate side as the squeegee side is more venerable.

Soaking a screen will help to rehydrate and soften the unexposed emulsion making washout faster and easier. Finer definition images can benefit with improved resolution, but soaking is not recommended for softer type emulsions such as some SBQs. Of course, soaking is simply not practical for large screens, and extra attention should be given to the washout duration in this circumstance. Any development procedure should begin by wetting both sides of the stencil as a type of soaking stage. If the screen is totally immersed, the time in the water should be controlled.

Another related issue is how uniformly the whole area of the stencil is developed. The entire stencil should be washed evenly, a difficult task when washing out by hand. There can be a tendency to focus on fine image areas (color bars, etc.), but it's best to train screen makers to treat the entire stencil the same. Uneven treatment of the non-image areas will raise the risk of leaving unexposed emulsion on the screen, which can cause scumming. A good washout procedure should specify even and consistent motion across the entire stencil surface.

Exposed emulsion is not waterproof and will absorb water, swell and become soft. So you can wash out or soak too long. Developing stencils with a pressure washer can reduce overall washout time, which is particularly important for SBQs that get soft after long washout times. Super-long washout efforts will not fix image areas that won't open up. Several other issues may be responsible for difficult washouts and should be identified and corrected. Refer to SPTF's troubleshooting guidelines at SGIA.org for more help.

Water Quality

Water quality is not as critical as the other variables, and not as easily controlled. Just keep it in mind should issues arise from water deposits or similar problems. Excessive water line debris can lodge in the image areas or damage the stencil during washout. A high incident of pinholes is likely if the same water is used for degreasing. A simple water filtration



Figure 6: A magnetic mask was used to block half of the screen from receiving water during the first washout procedure in SPTF's testing.

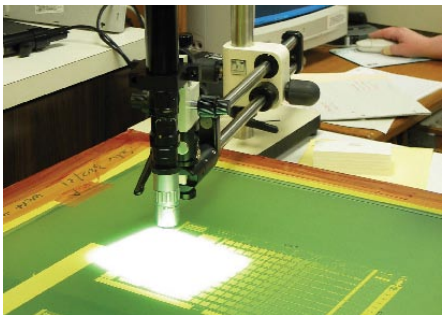


Figure 7: Print results were magnified to compare the washout conditions tested.

Automated washout systems control all of the washout variables to deliver consistent results. This is not to say manual washout cannot be fairly consistent with good practices and procedures, but taking the human variation out of the equation can certainly make this process more fail-safe and efficient.

Chart 1 SPTF Washout Test Matrix and Descriptions

		Screen Half A		Screen Half B	
Screen (set:#)	Exposure	Washout Pressure	Side to Side Method	Washout Pressure	Side to Side Method
1:1	Normal	Pressure Washer	Conventional	Pressure Washer	Half and Half
1:2	Normal	Garden Nozzle	Conventional	Garden Nozzle	Half and Half
2:1	Underexposed 60% of Normal	Pressure Washer	Half and Half	Garden Nozzle	Conventional
2:2	Normal	Pressure Washer	Half and Half	Garden Nozzle	Conventional
3:1	Normal	Pressure Washer	Half and Half Short washout	Pressure Washer	Half and Half Long washout
3:2	Normal	Garden Nozzle	Conventional Short washout	Garden Nozzle	Conventional Long washout

Descriptions

High Pressure Washer

Used a 1200 psi unit with fan Spray nozzle held 12-18 inches from stencil, evenly moved back and forth on surface.

- **Side to Side Method : Conventional**
  Spray side/duration: Wet both sides of screen, perform washout on substrate side for 2 minutes, with final a rinse (with high pressure) on the squeegee side.
- **Side to Side Method : Half and Half**
  Spray side/duration: Wet both sides of screen, spray squeegee side for 1 minute, then 1 minute washout on substrate side, with a final rinse (with high pressure) on the squeegee side.
- **Short Washout Duration : Half and Half**
  Spray side/duration: Wet both sides of screen, spray squeegee side for 15 seconds, then 15 seconds washout on substrate side, with a final rinse (with high pressure) on the squeegee side.
- **Long Washout Duration : Half and Half**
  Spray side/duration: Wet both sides of screen, spray squeegee side for 1 minute, then 1 minute washout on substrate side, with a final rinse (with high pressure) on the squeegee side.

Garden Nozzle

Used street pressure through garden hose fitted with flat fan spray nozzle held 6-12 inches from stencil, evenly moved back and forth on surface.

- **Side to Side Method : Conventional**
  Spray side/duration: Wet both sides of screen, perform washout on substrate side for 3 minutes, with final a rinse on the squeegee side.
- **Side to Side Method : Half and Half**
  Spray side/duration: Wet both sides of screen, spray squeegee side for 1.5 minute, then washout on substrate side for 1.5 minute, with a final rinse on the squeegee side.
- **Short Washout Duration : Conventional**
  Spray side/duration: Wet both sides of screen, perform washout on substrate side for 45 seconds, with final a rinse on the squeegee side
- **Long Washout Duration : Conventional**
  Spray side/duration: Wet both sides of screen, perform washout on substrate side for 3 minutes, with final a rinse on the squeegee side

system can help remove particulate debris from the water to eliminate these problems (see Figure 3, page 12).

Automatic Washout Systems

With halftones and fine-detail images, stencil quality is critical, and the screen maker responsible for manually developing stencils must be diligent. Time and skill are needed to achieve consistent washout, especially over the entire image area of a larger screen. Employees may perform this task in their own way, and therefore produce different results, especially if their procedures are inconsistent.

Automated washout systems control all of the washout variables to deliver consistent results. This is not to say manual washout cannot be fairly consistent with good practices and procedures, but taking the human variation out of the equation can certainly make this process more fail-safe and efficient.

Of course, like any automatic equipment, do your research and be clear how the machine deals with the washout variables we have already discussed. These variables also must be set consistently and with deliberation to get the best results.

Be aware, switching to an automatic washout system will most likely require an adjustment of the halftone curves. Determining tonal curves is highly dependent on screen repeatability, and the washout technique can make a significant difference in the detail present in the stencil. Automatic washout systems will generate their own unique tonal profile in the stencil, so a new tonal profile should be determined through testing.

Additional benefits of automated systems include water recycling, labor savings, sound reduction, elimination of repetitive-motion injuries and lower humidity. They can be a great investment and provide greater productivity and consistency. Companies offering automatic stencil washout systems include Image Technology, Chemical Consultants Inc., RhinoTech Inc., SaatiPrint, Interchange Corporation, Zentner Systems, DLP Imaging and ESC GmbH & Co.

Soak Tanks

While not automatic, soak tanks can speed the processing of large quantities of screens and thicker stencils. They basically consist of a water dip tank with an agitator and, in some cases, water recirculation and filtration. The water soak helps soften the unexposed emulsion and allows it to be rinsed off quickly once removed from the tank. (Note: some special thick film

stencils advise against soaking, so consult the manufacturer.)

Soaking stencils should be carefully controlled to avoid problems from overly swelled stencils. Soaking for too long can cause over-washing, blistering and emulsion delamination, especially if the stencil is underexposed. Chemical Consultants Inc. currently offers a soaking tank specifically for stencil development.

Exposure Control Films/Scales

Exposure control films/scales are an outstanding tool to check the consistency of the exposure and stencil developing or washout. These scales are a small film-positive strip containing a range of graduated-neutral film densities, sometimes referred to as an emulsion hardness scale. One of the most common is the Stouffer 21 step transmission and step wedge, with densities from 0.05 to 3.07, which runs about $7 from www.stouffer.net, (see Figure 4, page 12). The testing done by SPTF used the "Quick Check" from KIWO, but this scale is no longer available (see Figure 5, page 12).

Once the ideal exposure time is determined with a regular exposure calculator, the control film is a quick visual check to ensure the exposure and washout occurred correctly on each screen. The small control film is placed on the vacuum frame, or screen, just outside the image area on each exposed screen. It's a good idea to leave the scale in the same place or vicinity on the glass for each subsequent exposure to avoid differences from light distribution. The first screen is washed out using normal production washout procedures, and the scale is read to determine the last "solid step" or hardness.

During development, some of the 21 steps will rinse off and some will remain attached. The last step that shows no sign of delaminating or ragged edges is the solid-step target for that emulsion and mesh coating combination. Exposing to a solid-step seven means seven steps have remained completely attached to the screen, while 14 steps fully or partially fell off (see Figures 8, 9 and 10).

The step's corresponding number can now be used as a reference for each subsequent screen with the same emulsion and mesh coating variables. The solid step-target number may be different with other conditions, so each unique mesh/emulsion and coating combination must be determined separately.

With this reference step in hand, each screen developed can be evaluated for a consistent solid step. If a different solid step emerges, it is an

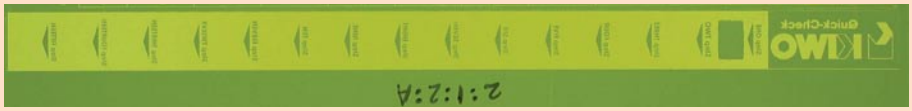


1.2 A - Garden Nozzle: Conventional Side to Side



1.1 A - Pressure Washer: Conventional Side to Side

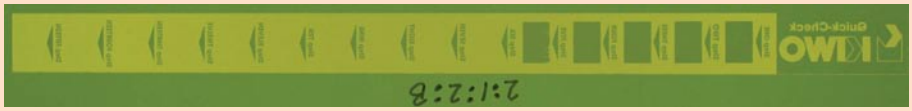
Figure 8: SPTF Washout Technique Test Exposure Control Film Photos



2.1 A - Underexposed: Pressure Washer: Half and Half



2.2 A - Correct Exposure: Pressure Washer: Half and Half



2.1 B - Underexposed: Garden Nozzle: Conventional Side to Side



2.2 B - Correct Exposure: Garden Nozzle: Conventional Side to Side

Figure 9: SPTF Washout Technique Test Exposure Control Film Photos



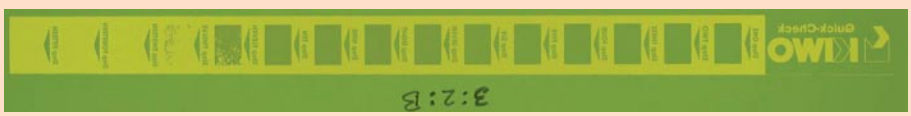
3.1 A - Correct Exposure: Pressure Washer: Half and Half: Short Washout



3.1 B - Correct Exposure: Pressure Washer: Half and Half: Long Washout



3.2 A - Correct Exposure: Garden Nozzle: Conventional: Short Washout



3.2 B - Correct Exposure: Garden Nozzle: Conventional: Long Washout

Figure 10: SPTF Washout Technique Test Exposure Control Film Photos

SPTF Washout Results: 90 lpi Printed Images: Correct Stencil Exposure

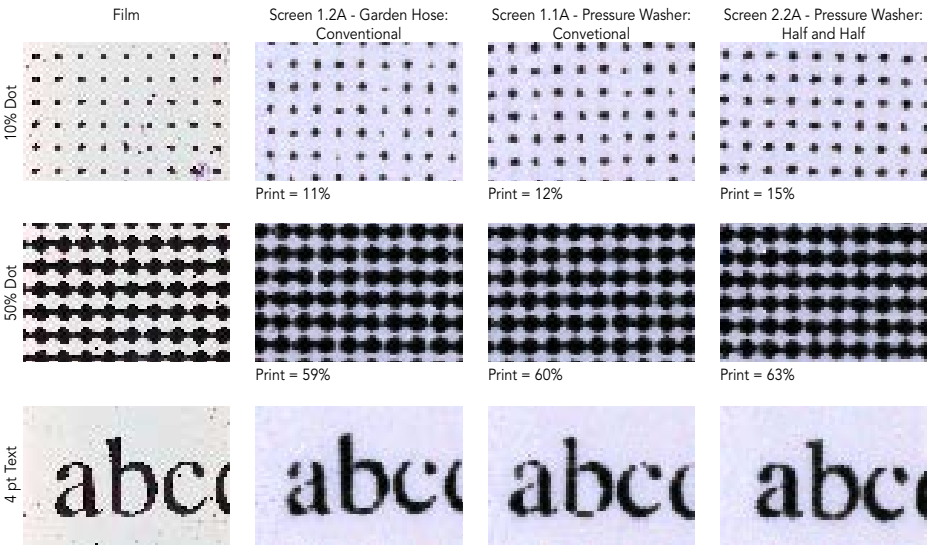


Figure 11: Dot Area Measurements taken with X-Rite 530 Spectrodensitometer in Murry-Davies. Common dot gain target values are 18% for a 10% dot and 68% for a 50% dot.

SPTF Washout Results: 90 lpi Printed Images: Correct Stencil Exposure

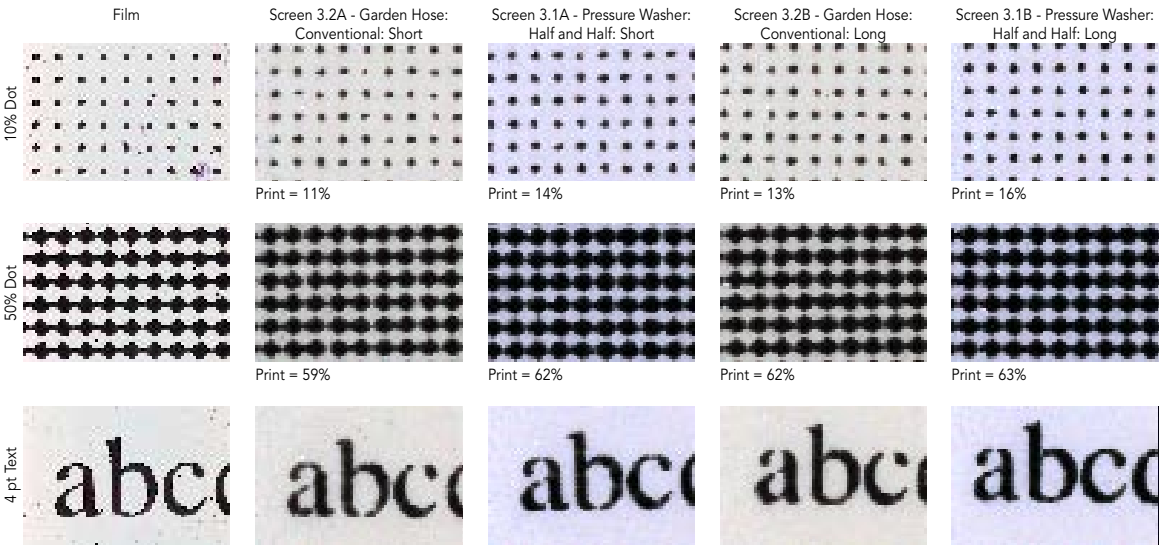


Figure 12: Dot Area Measurements taken with X-Rite 530 Spectrodensitometer in Murry-Davies. Common dot gain target values are 18% for a 10% dot and 68% for a 50% dot.

instant indication something changed, either with the exposure or washout. Unfortunately, the scales cannot tell you what has changed, so troubleshooting skills become important. But knowing that a change has occurred is definitely worth the time investment it takes to use the exposure scale.

Lamp deterioration, insufficient stencil drying, coating thickness changes, mesh count and diameter changes, lamp distance changes, emulsion changes and inconsistent washout are just a few issues that can change the scale results. SPTF's stencil troubleshooting guidelines can aid in the process of finding the problem source.

Exposure scales are an excellent quality control checkpoint, ensuring that each screen has been exposed and washed out to specification before it enters production. While exposure-related changes are more concerning, changes in washout techniques can produce surprisingly large variations in the scale and can be misleading if washout is not consistent. These scales are not only an indicator of exposure but of consistent washout practices, and are useful to ensure washout occurs to the same degree on each screen.

SPTF Washout Testing

SPTF completed testing on washout techniques, specifically, a comparison between pressure washing and conventional garden-hose pressure, washout time on each side and washout length. A total of six screens were tested, each having two distinct washout techniques applied to an identical test image that was exposed on the screen.

The screens were constructed from the same mesh and coating, which is used to print 85 lpi in SPTF's Four-Color Process Workshop. The frames measured 1-m-by-1.25-m (39-inches-by-49-inches), and had a 380/31 plain-weave mesh stretched to 26 N/cm. A high-quality, dual-cure emulsion was coated two-on-two on an automatic coater, with one face coat on each side, which was applied when the screens were dry.

Exposure times were determined with an exposure calculator and identical films containing tonal spectrums of 11 line counts and various text and line sizes were exposed side-by-side on each screen. An exposure control scale was put under each of the two film positives as well. A 5KW metal halide lamp at a fixed distance of 76 cm (30 inches) was used for exposure.

A matrix and description containing the washout conditions for each screen is shown in Chart 1. Since two images were exposed on each screen, a magnetic mask was used to block half of the screen from receiving water during the first washout procedure (see Figure 6, page 13).

Water temperature was between 21°C to 27°C (70°F to 80°F) for all of the procedures. The screens were dried, measured and printed under near-identical conditions to observe any differences. Indicators measured for each test included dot gain, stencil thickness, Rz, screen tension and exposure-control scale hard-step. The images also were magnified for comparison (see Figure 7, page 13).

Washout Test Results

Stencil Thickness

Stencil thickness was measured with a Fischer Deltascope using a screen printing probe. All six test screens showed only a minimal stencil thickness change. Average Emulsion Over Mesh (EOM) was measured at 3 microns +/- 0.5 microns. No significant trends were noticed.

Stencil-Surface Profile Rz

Average Rz was 9.11 microns +/- 1.0 micron for all the stencils. Pressure-washed screens had a slightly higher Rz on average than garden-hose screens.

Screen Tension

Using a pressure washer for development did not cause any drastic drop in screen tension. The screens had been allowed to sit and stabilize — for 24 hours after gluing — before they were processed. The normal tension drop seen between cut away and 24 hours occurred before testing, (see Chart 2).

Chart 2 SPTF Washout Test : Screen Tension N/cm

Screen #	After Cut Away	After 24 Hours	After Washout
1.1	25.9	23.0	23.0
1.2	26.5	23.5	23.2
2.1	25.8	23.4	23.1
2.2	26.4	23.4	23.0
3.1	26.5	23.9	23.8
3.2	26.0	23.4	23.0

(Average of Warp and Weft)

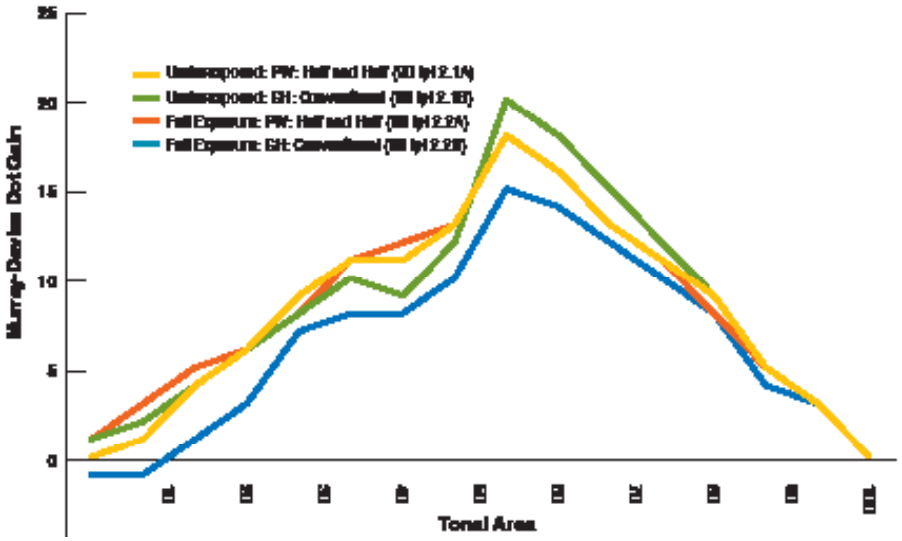


Figure 13: SPTF Washout Study - Measured Print Results

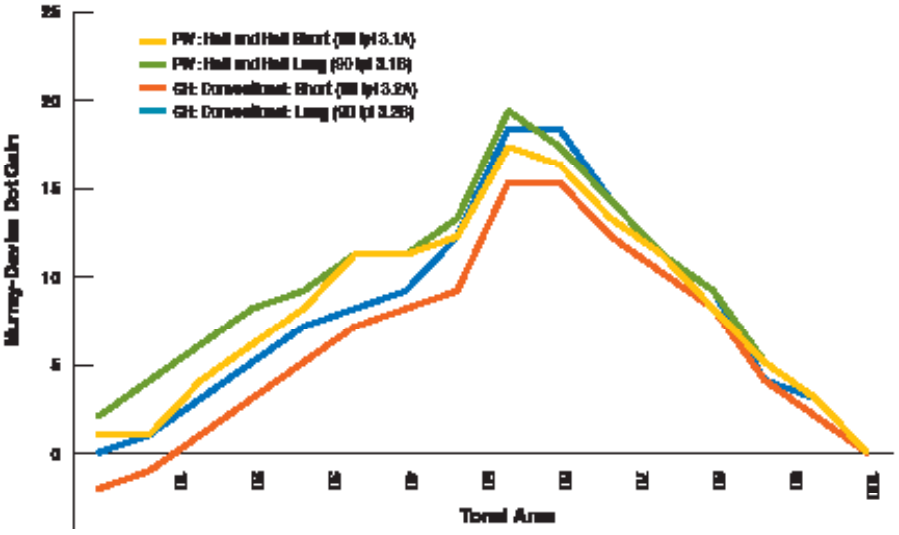


Figure 14: SPTF Washout Study - Measured Print Results

For even greater control and verification, a new device called the ScreenReader can measure dot area on the actual developed stencil to verify dot size present in the screen.



Figure 15: A new device called a ScreenReader can measure dot area on the actual developed stencil to verify the dot size present in the screen.



Figure 16: Use a wet/dry vacuum with a special suction tool to remove excess water for speedy screen drying.

Exposure Scale Hard Steps

Exposure scales were placed on each side of the tested screens to demonstrate how washout variations and underexposure changed the apparent-hard step. In Figure 8 (Page 15), both scales were equally exposed on identical emulsion coatings. However, they show two distinct hard-steps because of the washout. The top scale, 1.2A, was developed using a garden-hose technique with conventional side-to-side concentration and duration, while the bottom scale, 1.1A, was pressure-washed. The screen is properly exposed in both cases, but the referenced hard step is evidently dependent on the washout practice.

The scales shown in Figure 9 (page 15) show the effects of underexposure when using the same washout procedures. Both the pressured-washed pair, 2.1A and 2.2A, and the garden-hose pair, 2.1B and 2.2B, show the hard-step changing. But because washout was the same, we can determine it was an exposure difference instead of stencil development variation. On closer examination, the underexposed stencil, which was washed with the pressure washer, was missing some small shadow dots. The pressure and weak stencil allowed them to be washed off. The fully exposed stencil did not show this effect.

In Figure 10 (page 15), results from a short and long washout time are compared. The top two scales, 3.1A and 3.1B, show development after using a pressure washer for two different lengths of time. The short washout was only 15 seconds on each side while the long one was one minute. Note the hard-step is different even though the exposure was the same. The bottom two scales, 3.2A and 3.2B, were done with a garden hose for 45 seconds each side on the short washout, and 3 minutes each side for the long washout. Again, we see a drastic hard-step difference between the high- and low-pressure groups.

Print Results

As they say, the proof is in the print — so two groups of magnified areas on the prints are shown in Figures 11 and 12 (page 16). The 10 percent and 50 percent area on the 90 lpi tonal scale are pictured, as well as 4-point serif text. Measured dot percent values (Murray-Davies method) also are indicated under each respective photo.

In Figure 11, the garden-hose print clearly has less detail opening up in the dots and text than the pressure-washed prints. You'll also notice the two pressure-washed prints are slightly different because of the amount of washout that occurred on each screen side. For the conventional method, most of the washout occurred on the substrate side as opposed to the half-and-half method, in which equal time was spent on both sides. The dots are more defined and accurate when using a pressure washer for equal time on both screen sides.

The short versus long washout print results are shown in Figure 12. When comparing the garden-hose short- and long-methods, the longer washout duration produced improved dot accuracy. Improvements also are noticeable when extending the washout time of the pressure washer. Without a doubt, longer washouts are needed to remove the emulsion from the halftone areas. Of the four print samples, the last screen that was pressure-washed on both sides for a longer period of equal time produced the most accurate rendition of the film.

For a more complete look at the tonal range results, two graphs containing the 90 lpi measured dot area are illustrated in Figures 13 and 14 (page 17). Figure 13 compares the underexposed with the correct exposure results for both garden-hose and pressure-washer development. The underexposed screen washed out with the garden hose shows improvements in the highlight dots when compared with the fully exposed screen that was washed out using the same methods. However, the fully exposed, pressure-washed screen matches the results on the garden-hose underexposed screen in the highlight areas. Here we can provide some proof that fully exposing a screen can match an underexposed screen in tonal range when a pressure washer is used for development.

In Figure 14 (page 17), longer washout times are compared with short times. Again, the longer washout times open up more highlight detail than shorter times for both washout methods. So regardless of the washout pressure option used, extending the time of washout is definitely a good practice.

Recommended Stencil Development Practices:

1. Use an exposure calculator to determine the correct exposure for each mesh count/thread diameter, emulsion and coating combination used. Expose longer and develop harder to produce an expanded tonal range.
2. Use an exposure-control scale on each exposed screen. Determine the resultant hard-step after developing the first properly exposed screen with the production washout procedure. Document the results and post them by the washout tank.
3. Wash out the screen as soon as

possible after exposure. If immediate washout is not possible, screens should remain in a dark room or under yellow safe lights until they can be developed.

4. Use cold to lukewarm water, 15°C to 32°C (60°F to 90°F). Do not use hot water to washout stencils. A clean, backlit booth is preferred.
5. Completely flood both sides with low-pressure water to begin softening the unexposed areas of the stencil.
6. Direct emulsion: Starting on the squeegee side, wash out the stencil using a pressure washer (2,000 psi or lower with a fan-shaped spray nozzle) and holding the tip at a distance of 30 cm to 45 cm (12 inches to 18 inches) from the screen surface. Start the pressure-washer off the stencil area, and then move it in a consistent rate and pattern across the screen for a predetermined number of minutes or repetitions. Another option for timing is to spray the squeegee side until it begins to open up, and then move to the substrate side to complete the washout. If the screen is intentionally underexposed or a soft SBQ or low-quality emulsion is used, do not use a pressure-washer. A hard fan spray on a garden hose can be used instead to safeguard the more sensitive stencil.

   Repeat the same washout process on the substrate side. Ultimately, it should take one to three minutes on each screen side (depending on the screen size). A timer can be used to ensure a consistent time is spent on each side. Observe the exposure-control scale and make sure the correct hard-step appears.

   Capillary Film: For properly adhered and exposed capillary film, a pressure washer also can be used, but only from the substrate side. Only street-pressure spray should be used on the squeegee side, where the stencil is more vulnerable.
7. Spray both sides of the screen with a final low-pressure wash to remove any blow-back debris from the sink that may have landed on the screen, especially if reclaiming occurs in the same sink. A final rinse also will help remove any residual emulsion scum.
8. Examine the stencil edges and highlight dots with a 30-50X magnifier to determine if they are clear. A 10X loupe is simply not strong enough to see any stencil residual still remaining.

   For even greater control and verification, a new device called the ScreenReader can measure dot area on the actual developed stencil to verify dot size present in the screen, (see Figure 15). The instrument is literally a screen densitometer, while also able to measure film, CTS images and litho plates. The ability to measure the stencil is the ultimate verification of exposure and washout consistency before a screen enters production. The ScreenReader is available through Ripware Ltd. (www.ripware.co.uk) and KIWO.
9. Use a screen vacuum to remove water residue on properly exposed stencils. Water marks can be caused by hard water deposits. Removing the water will reduce this possibility as well as speed drying. You can use a wet/dry vacuum for this purpose, but get a suction head designed to safely contact screens, (see Figure 16). Rhino Tech and SaatiPrint both offer one. If a screen vacuum is not available, blank newsprint can be used to blot the water. If the newsprint sticks at all to the screen's squeegee side and shows emulsion color, the stencil is most likely underexposed. Use caution here because the stencil will swell after washout and, therefore, be sensitive until it thoroughly dries.
10. Create a written washout procedure — chances are you don't have one in place. Train screen making employees on exactly what is expected during the stencil development, and, more importantly, why it is so significant.

Bottom Line: Be Consistent

The washout method is part of the stencil process and will impact image accuracy as shown. Four-color process color control can be compromised if the washout is erratic. The bottom line is: Repeatable procedure should be implemented for developing screens, particularly if they carry halftone or fine-line detail. Whatever washout viewpoint you hold, be consistent in how the task is performed across shifts and by various employees. Automatic equipment can help, but settings must still be set consistently for repeatable results.

Hopefully the information presented here has provided a new perspective on developing a stencil. Take the time to address this unsung variable and enjoy improved print quality and a more repeatable process in the future.

References

"The Benefits of High-Pressure Washes and High-Tension Screens," Mark Coudray, Screen Printing, July 2006.

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