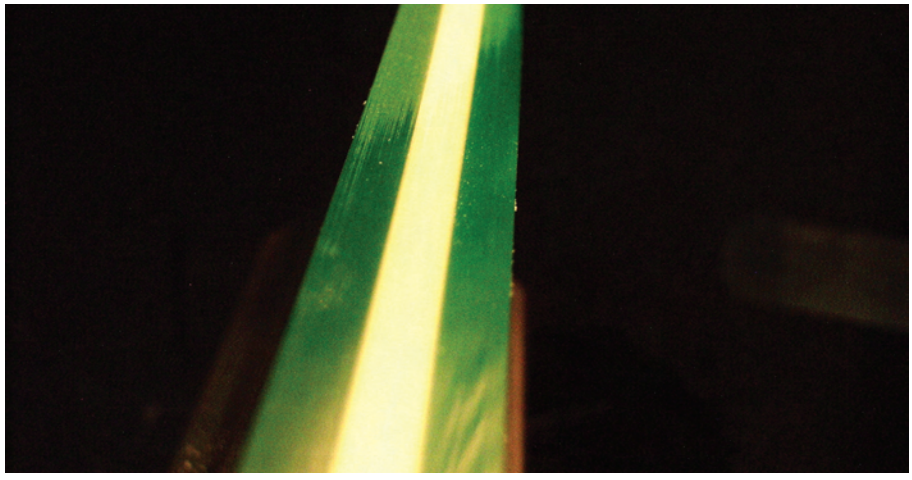
Maximize Your Screen Printing Quality...And Profits

The Imperative Need for Proper Squeegee Maintenance for High Quality Graphics & Industrial Screen Printing Applications – Part One



Despite the article's title, the former practice of sharpening a squeegee by abrasive means will no longer exist in many up-market printing operations. Before I go any further about a squeegee blade's edge, I propose the question: What do car tires and squeegees possibly have in common? More specifically, how important are the tires on a car?

Most people assume there is a crucial relationship between the two. Responses typically include: "they're very important," "they're critical" and "you can't drive without them." In reality, however, how much time do people really invest in thinking about the tires on their car? When was the last time you inspected the condition of your tires, or let alone put a pressure gauge to them? When it comes down to it, the majority of us drive daily without ever giving tires a second thought!

The commonality between tires and squeegees is closer than you may realize and is the basis of this article. To a large extent, the universal condition of squeegee blades is treated in the same way as our tires — they get you where you want to go, but few people are concerned about how they perform. At best, press operators may run their fingers down the squeegee before printing to get a "feel" for its edge quality.

In the workplace, it is precisely this lack of consideration about the squeegee condition that limits many companies from acquiring superior printing skills. Lack of squeegee care may lead to soaring production costs, undeliverable prints and the loss of valuable time. This is bad for any business, but especially bad in the competitive world of screen printing where profit margins have never been that great in the first place.

For example, one company who was considering a new automatic screen printing line almost doubled their entire production throughput by using a new squeegee sharpener. Utilizing better control and pride of their squeegee edge with regular sharpening made them realize that this is what separated them from improving quality, productivity and bottom-line profit. In return, the company abandoned their original quest for new printing equipment due to their newly-found fortune. The squeegee is more powerful than you may think and you should never underestimate the influence it has on final products or businesses' bottom lines.

Coming back to the analogy, there is a distinct connection between tires and squeegees. Tires (squeegees) are the only

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Figure 1: Diamond wheel squeegee grinder (Fimor).

thing separating the driver (screen) from the road (substrate).

Variables

In the screen printing process, there are two types of variables: Fixed (factors not adjustable by the operators once in production) and adjustable (factors which can be altered).

Fixed variables include (but are not limited to):

- Section profile of screen frame (to withhold desirable fabric tension)
- Overall size of frame (to provide a healthy image-to-frame-size ratio)
- Fabric type and grade (threads per inch/cm and tread diameter, which gives the percentage opening area of the fabric)
- Tension level (once glued into place is fixed and starts to relax from that point)
- Emulsion thickness (EOM—emulsion over mesh)
- RZ value (degree of roughness on the emulsion surface)
- Integrity of image to be printed (anywhere between extremely fine patterns or thin lines to heavy solids, such as floods)
- Substrate type, condition and surface topography (some conditioning may be possible by the operator)
- Ink or coating type (if specified for the job, although some modifications are possible)
- Printing machine type (you own it, as they say)

Adjustable variables include (but are not limited to):

- Ink or coating's ever-changing viscosity (ideally to be fixed within a suitable range for production)
- Press setup parameters (including off-contact and peel-off)
- Squeegee type and setup (hardness, length, angle, pressure, speed, etc.)
- Floodcoater type and setup (as a pair with the squeegee)
- Workplace environment (temperature, humidity and number of air changes)

Regardless of which variable it is, they all come together at the tip of the squeegee blade! As a result, the squeegee is like the car tires on the road — the only component that separates the whole process and printing equipment to the substrate's surface.

Lawnmower Experience

Now for another analogy, what does a lawn mower have in common with a squeegee blade? My friend's experience is a great example. When his lawnmower failed to work, his next door neighbor kindly lent him his. The neighbor's mower functioned similarly to his own except for one small thing — all four tires were almost flat. Unfortunately he went ahead and used the mower, which turned out to be a big mistake!

As you can probably guess, mowing was hopelessly difficult at best and took much longer despite having newly sharpened blades. The lawn looked rough and a complete mess. The small front wheels made large gashes as they dug into the ground when making tight turns at the end of each pass, while the large rear wheels created trench-like lines over the entire landscape.

It wasn't until much later that my friend observed the full extent of damage caused by the mower. Following his normal lawn treatments, he noticed grass was growing healthy, but only in narrow strips — resembling trench-like rows similar to the kind of rows that under-inflated tires can create! A perfect lawn was ruined entirely because the mower's tires were not properly inflated. Three years later, he still sees proof of the tires ruining the lawn.

The scenario of the inflated tire resembles a squeegee having to be properly sharpened for a job. If the squeegee blade does not have a smooth, solid, nick/burr-free, crisp or straight edge prior to use, many problems can occur during production. It ultimately becomes as destructive as my friend's awful lawnmower experience with one major difference — you make a living on the screen printed products that clients order and are willing to pay for if produced properly, compared to a poorly looking lawn.

A sharp squeegee edge is "king" in the final stages of printing, followed closely by painstaking care and effective procedures to improve overall print quality while preventing potential problems from occurring. Regardless of how one analyzes the situation, having a good squeegee edge carries a similar responsibility to driving with correct tire pressure to obtain optimum performance.

Making a Plan

Screen printing is a very ambiguous process. What appears to work fine one day, doesn't the next. One operator will swear an adjustment works better in one direction while a fellow printer will claim the opposite, and both might be right according to their experience under the

circumstances of the day. Unfortunately, our industry is full of contradictions for no apparent reason. One of the principal causes of print finish inconsistencies is that people overlook recording specifics of the squeegee's operating profile (its physical condition and setup parameters during production), particularly at times when everything appears to be working well. Without print profiles, we don't always know for sure what an ideal setup looks like. When there is pressure to get production moving along, it is usually pre-press or make-ready steps that were changed or not properly followed that is to blame for startup problems.

To demonstrate the point about recording setup parameters, take a trip to your own screen printing department, particularly if it operates under an ISO 9000 environment. Review the press setup parameters for each job and see what physical parts of the squeegee blade and mechanical squeegee settings are listed. Does it cover pressure, speed or mechanical angle, or even blade hardness/color used? Length should be noted as well, since this could alter the end print results, including distortion, to a certain degree. For some crucial printing requirements, what about the depth of blade measurements outside the holder? I am not suggesting that each and every factor be recorded, but some factors will have an enormous impact on the print result, particularly with registration, edge resolution, deposit uniformity and fine intricate detail.

Additionally, is there a place to provide comments on edge condition of the squeegee blade, such as the number of times it has been used (or prints printed) since sharpening or the time between jobs to reuse? What about the lapsed time between cleaning (with aggressive solvents) and sharpening or even the time when it was sharpened? Yes, even the rest period can have an adverse effect on print finish, making repeated results difficult to duplicate and sharp detail all but impossible to render satisfactorily throughout the production run. Many printers scratch their heads in disbelief when they set up a press with a freshly sharpened squeegee only to find it is no good. The examples given here are precisely the issues that foster the "it worked great one day, but not the next day" attitude in the workplace!

Edge Quality

While these factors can be controlled and documented to a large degree, there is an aspect of the blade that is rarely mentioned — edge quality. Perhaps such a quality is subjective and depends on who checks the squeegee. It's true that if you hand the same squeegee to five different experienced press operators for their quality assessment of the blade, you will receive five different opinions ranging from great and okay, to completely unacceptable.

Why does this happen? Try the test yourself and you will be amazed at the wide range of answers you receive. We all know squeegees are not the easiest type of material to feel; however, for quality-conscious printing operations, individual subjectivity must be removed from the equation by adhering to a more trusted procedure, one that can be handled with greater accuracy, regardless of who is in the driver's seat.

In reality, there are no standard "critical procedures" for checking the edge quality of a squeegee blade. It is entirely up to each printing operation to set their own standards to follow based on the job's

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Sharpening Systems

Not too long ago, many printers thought that only four distinct systems were available to sharpen the edge of a squeegee blade:

- Belt sander in "landscape" orientation (squeegee blade fully in contact with an endless sanding belt)
- Belt sander in "portrait" orientation (squeegee blade in a single-point contact with an endless sanding belt)
- Grinding wheels of all types and sizes (although most bands utilize a diamond wheel)
- Hot-knife (pre-heated single-sided industrial razor blade)

(Look for Part Two of the series, which will review both belt sander sharpeners.)

These sharpeners are appropriately named according to the physical mechanism employed to sharpen: by a sanding belt, grinding wheel or hot-knife (which is actually a razor). They are broken down into two separate classifications — abrasive means or sheared. Such a distinction is critically important for every discriminating screen printing operation. Despite the fact that each sharpening system and model type is made to varying levels of quality, features, options, automation and sophistication, each of them have their own pros and cons based on the improvements wanted, the skill level of the operation and the cost involved. The levels of functions and optional features, as with any brand and model of sharpeners, have a direct bearing on reducing misuse in the sharpening process and therefore, have a greater impact on obtaining a better quality edge.

All four methods have something in common from a language standpoint. When "dressing" a squeegee, it is simply referred to as "sharpening" because that is what the devices are doing, just like sharpening a kitchen knife. However, while the basis of this article is to update the industry with squeegee sharpening systems and methods used for high-end printing applications, it also welcomes another system to the exclusive club of squeegee sharpening devices — known chiefly as a "rotary cutter."

Although the methodology of how this cutter impressively operates will be discussed in Part Two, it can be argued that one is cutting rather than sharpening with such a system, like a hot knife. Yet, it appears that the references to "sharpening" have not changed in high-end printing operations, with more and more now "cutting" with the rotary system today!

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needs, equipment and skills employed. Under normal operating situations, operators will randomly select a squeegee, run their fingers down the edge and, if it feels good, may eyeball it up to the light for confirmation to ensure that it has no significant waves or bumps. Holding the squeegee up to the light can show many defects, which fingers cannot feel. However, what is it that they are looking at and how can they tell if it is good, bad or indifferent? How many times have you seen an operator hold the squeegee blade up to the light?

Perhaps one of the best ways to learn this "feel technique" is to have a set of four squeegees of the same length and of the same hardness. One blade has just come off a press following a lengthy run, the second has just been washed with aggressive cleaning solvents (to deliberately swell the edges a little), the third has just been sharpened immediately after cleaning with solvents and the fourth sharpened to standard procedures following a long rest (24 hours or overnight at least). One company I know even went further by printing out large colored 100x magnified shots of the edges and displayed them by the sharpener, so each operator can be reminded of what a good edge looks like compared to the others.

This will allow comparisons to be made by feeling the four different edges and then looking at them against the light. Use a loupe so operators can get a good close-up of the edges and they can make a better judgment of what a good edge is supposed to look like. Practicing this a few times will help remove subjectivity, but keep in mind that procedures should dictate the need to sharpen. Becoming better at judging what represents an acceptable edge helps prevent the use of squeegees that are not up to house standard. One only needs to look at how many times an operator, who has never made proper comparisons, sets up a press only having to remove the squeegee because the initial startup prints were not good enough. They may shake their heads and not believe what they printed when they swear the blade had a good edge to start with. The fact is that everyone feels differently with their fingers and eye sight may not always be the best indicator.

This scenario plays out daily in too many operations, when it doesn't have to occur at all. This happens often because many cannot differentiate between a bad edge from a good one, unless it hits them in the head! To make matters worse, how many times have we seen printers discard a squeegee blade because it was not good enough, only to find another printer picked up the discarded one and used it without a problem? This is a daily event that probably occurs in the majority of printing operations.

We're often told by clients when the performance quality of a print has deteriorated particularly with repeated jobs where nothing changed in the way it was set up and printed. Clearly, something must have changed, but you can't put your finger on it. One factor could be none other than the condition of the squeegee.

Three typical causes are:

- A previously good edge could be damaged by aggressive solvents upon cleaning (softening the edge and causing some swelling — the reason for resting before reuse or sharpening).
- The substrate was switched from a paper/board base to a clear smooth base such as film, polyester, polycarbonate, etc., where edge deformities of the squeegee are more likely to be highlighted as impurities (streaks, marks, etc.) and can be more readily seen through the material when held up to the light.
- Ink has been switched to a low solid-content coating, such as tints or transparencies, which tend to highlight blemishes more readily than with heavy pigmented colors. The squeegee edge might have been acceptable for the original substrate or ink, but not after being switched.

Defining Value

If we can simply check tires with a pressure gauge to ensure it has the correct pressure, how do we check a squeegee blade and get a precise number or quantifiable value regardless of who conducts the check? This is a good question for any high-demanding, quality-conscious printing operation, and one that generally leads them to resharpen after a fixed amount of prints as part of their SOPs.

For companies using a grinding wheel sharpener and who have a Rz meter (a device that measures emulsion's surface roughness) available, consider conducting this additional, but simple experiment:

Have an experienced operator sharpen two squeegees of the same length and hardness, in the normal manner, until the optimum edge has been reached. One at a time, secure the squeegee by clamping it firmly with the blade uppermost.

With care, run the Rz meter along its length in several places — the middle

Squeegee Material

Although the squeegee represents nearly the smallest of all materials used for printing, it is the most overlooked and can make or break a job — the difference between profit and loss. Since this article concerns high-end screen printing applications, selection of the squeegee material is paramount. The majority of squeegee manufacturers have at least two to three or more blade qualities available to better meet the specific needs of discriminating printing operations. Following countless involvement with demanding applications, it is not ordinarily possible to achieve any type of repeatable print performance or deposit control, at least consistently, with basic/entry level squeegee materials.

It has been proven many times that superior blade materials resist the aggressive stress from on-press friction, vibration, ink chemistry (pigments and solvents), screen wash, sharpening and abuse infinitely better than their cheaper cousins. Not only will they last longer, require less sharpening between use and yield finer results, but they are a lot cheaper in the long run. Just consider the cost alone for wasted prints, materials and time to make-up the shortfall or reprint of the entire job because the squeegee material was not up to its job!

at about 4 inches (10 cm) in from both ends. Average the results and repeat with the second squeegee. Considering it is impossible to actually do this on the very tip of the blade — the area that is used to print (the edge) will give a good representation of what the tip is like and you will be shocked to see how bumpy it actually is.

Now, take the squeegee that had the higher value (the least smooth), re-sharpen it, but this time, spray a very light mist of water directly between the blade and grinding wheel during two or three slow sharpening cycles (not to expose water to the motor housing). When finished, take the numbers with the Rz meter and average the values.

See how much the values have dropped once lubricant was introduced to the grinding action. Actual values recorded on the squeegee blade are probably meaningless, but the difference in the amount before and after lubricant has been applied is what counts. Lastly, with your fingers and loupe, see and feel the differences between the two squeegee blades.

As an alternative to using two production squeegee blades for this test, one can be used instead with a blade that is ready to be replaced. Sharpen it in the normal way and measure the edge in several places along the length with a Rz meter. When re-sharpening with water as a lubricant, sharpen only half the blade two or three times. This will still give an indication of the varying edge qualities. Although the suggestion is to sharpen in the normal way, it is a good practice with grinding wheels to slow down the travel speed for the last few cycles ("polishing cycles"). This practice is highly recommended when spraying water on the blade.

While this suggestion may seem like a neat trick, please note that it is not intended to become a practice to improve edge quality as a new in-house procedure. It's mentioned merely to demonstrate that lubricant has a direct positive impact on obtaining a more desirable smooth edge.

The Need

I understand that not all printing operations need a squeegee edge sharpened to the highest degree of quality. A lower level of sharpness may meet your particular market needs. However, I want to stress that the edge condition of your squeegee must at least match the same expected quality level sought for the job — nothing less will do.

In many printing operations, quality of squeegee edges may not be a priority because they may print just fine for the types of jobs at hand. However, as demands for higher quality, fine line resolution, holding edge definition and halftones throughout the run and achieving superior deposit uniformity becomes more critical against the destructive damage that substrates, ink and solvents play on the squeegee, the issue of quality sharpening becomes foremost.

Regardless of whether a printing operation believes that a high degree of squeegee edge quality is not necessary for their typical jobs, it can be safely said that a good sharpened one will always provide companies with the most cost-effective benefits. A quality edge will always reduce the pressure needed, amount of ink used, lead to superior registration, crisper edge resolution, clearer appearance of printed color, reduce the need to re-sharpen and, best of all for production numbers oriented managers/supervisors, it increases productivity since a superior edge will allow the squeegee to print at a much higher speed.

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A squeegee that never dulls or wears out

Regarding the influential role the squeegee plays in obtaining the highest quality printing, in a perfect world, the squeegee should never dull or wear out. Wishful thinking perhaps, but it turns out the next best thing is a reality today. As operators set up their presses and run all day, all week, month after month, they would love an infallible squeegee; a perfect tool that never alters under any operating condition. Once set up to do the job, it should return the same results, job after job, week after week. In truth, however, this is not possible.

As the so-called "perfect" squeegee hardly exists in quantifiable terms, it is possible to create a situation where the squeegee can accomplish three things that no other sharpening device can: A 'perfect' sealed edge, linearly straight along the entire length and a significant reduction in the need to re-sharpen so frequently. The adjective "perfect" is emphasized because, while everyone has their own ideas as to what a good edge represents, it is used here to effectively express an edge that most experienced printers would agree to be faultless in every imaginable way. Except for its physical condition, perfect has no technical or mechanical bearing.

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