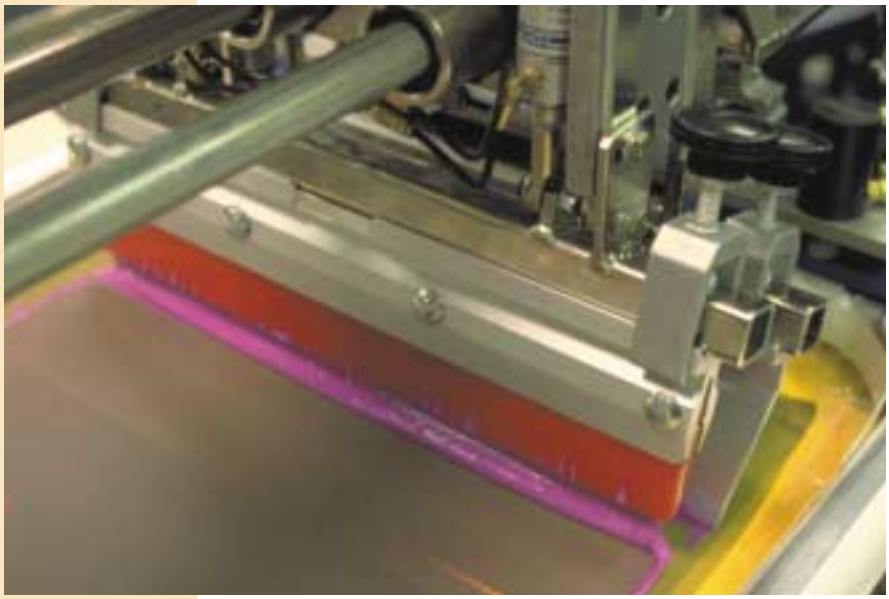


Squeegee Selection, Maintenance and Innovations in Squeegee Technology



The squeegee is only one of the variables, but a very important one. Don't let it be the difference between scrap and sellable product.

Of all the components involved in the screen printing process, the squeegee is one of the most important. A squeegee is a simple piece of rubber that can affect the overall quality of the end product. A dull or nicked squeegee will not allow the ink to transfer evenly through the screen. If the inside of the screen is wet with ink residue, the squeegee is not performing as well as it should or could.

A number of factors affect squeegee performance. Abrasion with the screen slowly dulls the squeegee, reducing its ability to shear the ink from the screen. Harsh solvents will also degrade the squeegee. Solvent-based inks and UV inks can drastically limit the life expectancy of a squeegee, often causing the squeegee blade to swell or soften on the press. In fact, manufacturers use some ink ingredients, such as NMP, to dissolve excess polyurethane in their storage tanks. All of these factors can ultimately affect print quality.

Selecting a Squeegee

Squeegees are made from three basic types of materials: rubber, neoprene and polyurethane.

The least expensive squeegees available are those constructed of natural rubber. While commonly used in the education part of the screen-printing industry, rubber tends to suffer from poor abrasion resistance and poor resistance to strong solvents.

Neoprene, a synthetic rubber compound made from a chroline derivative of acetylene, is also a popular squeegee material. Neoprene is slightly more expensive than natural rubber, and it offers better chemical and abrasion resistance.

Polyurethane, a synthetic plastic material, is often used to make squeegees designed for extended use, and for automatic and semi-automatic equipment. While urethane is more expensive than rubber or neoprene, it offers a much better resistance to both physical and chemical abrasion. Most urethanes used in the screen-printing industry are MDI-based polyester — the reason being that MDI urethanes offer the best abrasion resistance of any urethane on the market. Polyurethane squeegees are the most popular of all squeegees. They are cast in liquid form in open molds, closed molds or centrifuges. The material is a thermoset plastic that cures when exposed to heat for a period



George Rogers, *President,* Printer's Edge Ltd.

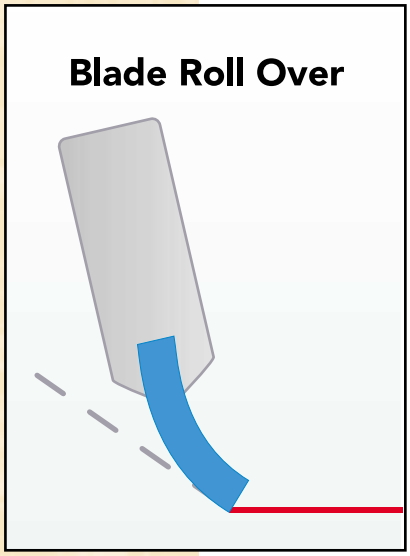


Figure 1

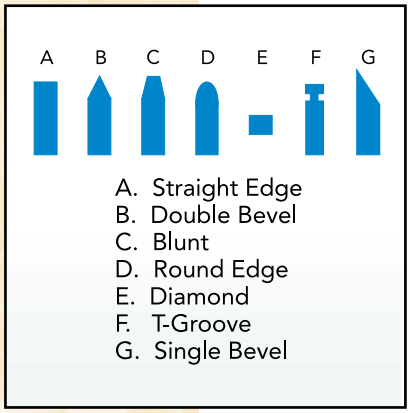


Figure 2

of time. The material is made in sheets or individual sections and cut to size for shipping. The most common sizes are 3/8" x 2" for general screen printing (graphics, textile, glass, electronics) or 3/16" x 1" for bottle, CD and high speed automatic presses.

Durometer

When selecting a squeegee, the first task is to determine your desired durometer, or hardness. The durometer is the value that reflects the physical hardness of the squeegee material. The squeegee durometer values from 50A to 95A. This is measured by a durometer gauge, based on standards established by ASTM (American Standard Testing Materials) procedures. For simplicity, we will call 60A soft, 70A medium, 80A hard and 90A an extra hard squeegee.

Plastics/squeegees are measured in various scales of hardness. Shore A scale is the most widely used for measuring squeegee material. The values are based on readings.

There are many different styles of durometer gauges available on the market. All have a dial indicator with a small needle head that measures the hardness of the squeegee. A durometer gauge is identical to a tension meter. Like a tension meter, a durometer gauge should be calibrated on a regular basis — once a year. The small needle head penetrates the material and indicates the hardness of the rubber.

Typically the substrate and the screen mesh will directly determine the durometer selected. For example, if the substrate has an irregular or rough surface and requires a coarse mesh, then a squeegee with a durometer between 60 and 70A is recommended. If the substrate is smooth, however, and a high mesh count is being used, a harder durometer squeegee between 80 and 90 should be used. The most popular durometer regardless of industry specific, is the 70 durometer blade. Why? The squeegee's job is to shear the ink, and transfer the ink through the screen. So, the blade needs to be rigid enough for this, yet needs to be soft enough to adapt to the contour of the screen. A 70 durometer blade gives the printer the best of both worlds: A softer blade, but not soft to the point where it will roll over and lose ink shear (see Figure 1). Middle-of-the-road makes the most sense when it comes to squeegee selection.

Ink is also a determining factor, however, when selecting the durometer of the squeegee. The more aggressive inks such as UV inks cause more harm to the blade than a standard plastisol or water-based ink. The harder the material, the more solvent resistant the blade. Therefore, to eliminate swelling and chemical breakdown, use a harder durometer squeegee.

The printing equipment itself can also affect squeegee choice. Hard durometer squeegees are normally recommended for use on high speed automatic presses due to the high degree of abrasion that occurs during a production run. Softer durometer squeegees are typically used for low-pressure, low-speed, manual and semi-automatic presses.

The harder the material, the lower the coefficient of friction, and the less abrasion on the screen. The squeegee durometer directly affects the way the ink is deposited. A soft squeegee will deposit a thicker layer of ink than a harder squeegee. Thus, a soft squeegee would be used for putting a full coverage image onto the substrate.

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Most manufacturers of polyurethane squeegees color-code their squeegees based on the hardness of the material. By color-coding, it makes the squeegee easier to define for a particular job. For example, one manufacturer has a color scheme of 60A red, 70A green, and 80A blue. Others use an orange, blue and red color-code system. Unfortunately, there aren't any standards for colors. The printer knows if they want a heavy ink deposit, they should use a 60 durometer, but it could be red, orange or even another color. For best results, the printer should invest in a durometer gauge.

Squeegee Profile

A screen printer can purchase a squeegee with many different profiles. The profile of the squeegee determines the thickness of the ink deposit laid down, and the effectiveness of the

squeegee on different substrates. See Figure 2. Available edge profiles include a square edge, a square edge with rounded corners, a round edge, a double-sided beveled edge, and a single beveled edge. Squeegees with a square edge are the most common, and mainly used on cylinder, textile and manual presses. Rounded squeegees are generally limited to the textile industry, and are used when a very heavy deposit is required.

Beveled blades are typically used for printing rounded surfaces where fine definition is required. While double sided beveled blades are more efficient on high-speed automatic machines, single beveled blades produce excellent results when printing heavy solids.

Some printers will round the squeegee with a small radius to get more ink deposit. There are tools or grinding wheels available for putting different radiuses/ profiles on squeegees. The most effective and the best shearing edge, however, is still a 90-degree or a straight-edge profile. The reason is, any time you round a squeegee or put a tapered edge on it, the blade loses its sharpness or cutting edge. A rounded squeegee isn't really shearing or transferring the ink, but rather the blade is now spearing the ink across the screen. A good test of the principle is to look at the screen when the blade is done printing: is there any ink left in the screen? There are many different parameters that can be changed in the printing process to achieve the same results: ink viscosity, mesh count, mesh tension and off contact. I am a firm believer that a squeegee's job is to transfer the ink, and the best angle of attack is a 90-degree edge. If you want to lay an adhesive down, then I will agree a rounded edge may be the right choice.

Maintenance & Storage

Proper squeegee maintenance is vital to producing quality printed images. For example, when printing with aggressive inks, each side of the blade shouldn't be used for more than four hours. Implementing a rotation schedule with the blades will dramatically increase the overall life of a squeegee. By using the squeegee for four hours at a time, and then replacing with a new one, the blade will last much longer. Squeegees are like car tires. If you rotate them every 5000 miles, they will last longer. For squeegees, rotating them every four hours, they will last longer, and not develop a curl or swell to them. Do not use the squeegee until failure. This will cause problems with the blade when re-sharpening. Excessive swelling and softening can result from printing with the same squeegee edge for an excessive period of time. If ink residue begins to build up on the inside of the screen, the squeegee should be replaced with a new one.

A used squeegee will recover after 24 to 48 hours, and can be resharpened and

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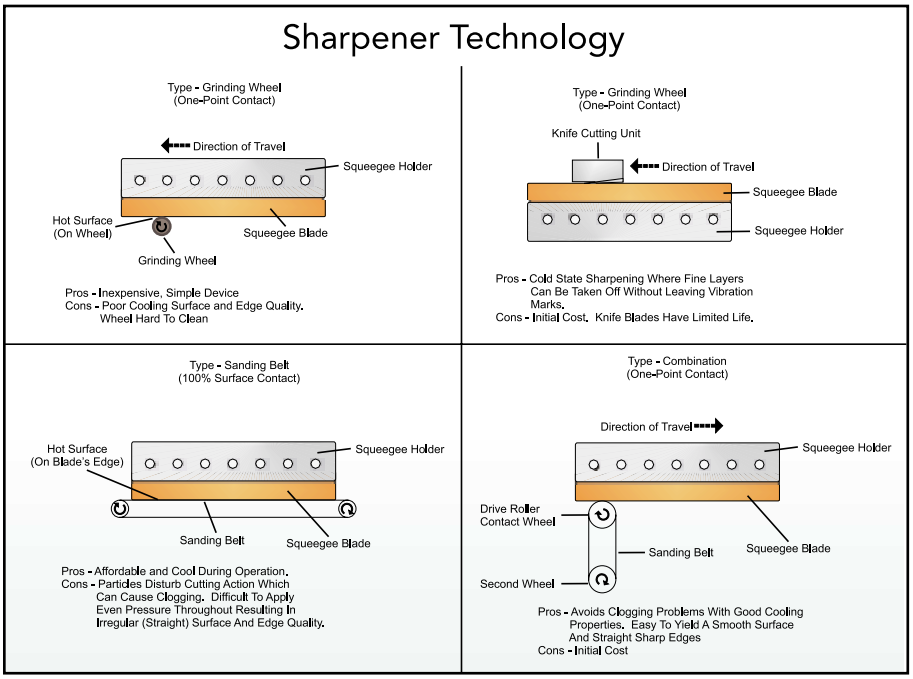


Figure 3

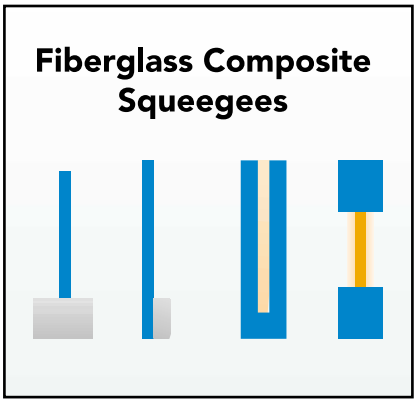


Figure 4

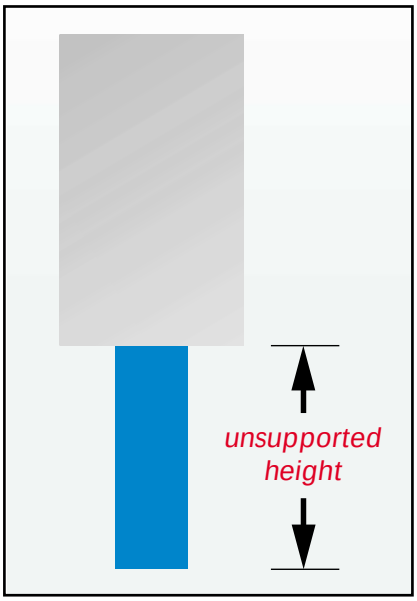


Figure 5

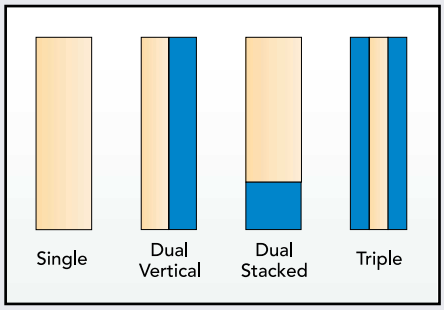


Figure 6



returned to the printing press. The squeegees should be laid out flat when not in use. Polyurethane squeegees should always be stored in a dry and relatively cool area (60 to 70 degrees Fahrenheit). The material should be laid out flat to eliminate any curl to the squeegee rubber. Manufacturers and distributors ship the material in coil form for shipping purposes only. You should always lay the material out flat as soon as the material is received in your facility. Occasionally, squeegees stored below 60 degrees Fahrenheit will increase in hardness. This will not affect the performance of the rubber, but it will affect the ink deposit performance of the blade. It is a good idea to test squeegees with a durometer gauge during a long production run. Some materials will soften when exposed to solvents for a long period of time. If the rubber softens to more than 5 to 7 points, it is recommended that you replace the material.

Resharpening can be performed with either a belt sander, grinding wheel, diamond wheel, hot knife, cold cutting blade or rotating blade. All methods have pros and cons. Some squeegees sharpen better than others on different sharpeners. For example, some polyurethane materials have more elastic properties than others do. Some have better abrasion properties, and some cut easier than others. Some melt when put under pressure on various grinding wheels or sanding belts. Every squeegee should be tested on a sharpener prior to use.

There are many different ways to sharpen a squeegee, and each blade should be tested with the sharpener of choice. The best way to evaluate a sharpener is to have an equipment company sharpen a blade for you, and test the sharpened blade on your most critical job. See Figure 3 for various types of sharpeners on the market today. Other factors to consider in choosing a sharpener are repeatability, cost and consistency in height (is the sharpener true to the squeegee holder?). The most important factor in evaluating a sharpener, however, is print results.

Most companies will set some guidelines on how low or how much material they will sharpen off a squeegee before it starts affecting print quality. A normal press will accommodate as much as a 1/2" of variance from one blade. The industry norm is a 3/8" x 2" blade depending on the equipment being used, and most companies will sharpen a squeegee until it goes down to 1.6" to 1.75" in height. This is, however, a case-by-case basis. Most companies printing t-shirts will allow more of a variance in the height of the rubber. Electronics and CD printers can't allow much height variation at all. High end printers choose to throw the rubber out after a production run. Remember, the durometer of the rubber is important, but the unsupported height of the squeegee rubber ultimately determines how much flex a squeegee will have on the press, and how much ink will be deposited. It all depends on the application, and how critical the level of ink deposit is. One must look at the parameters involved, and set height standards for the squeegee.

Squeegee Innovations

One of the biggest innovations in the past 15 years is the increase in composite squeegees, or multi-durometer blades. There are many products on the market that incorporate fiberglass inserts and multi layered blades. The reason stems from the increased need for better print quality. More and more printers are being pushed to the upper limits of screen printing — thus the increase in the number of squeegee innovations to the market place. Repeating an earlier fact, the most popular blade regardless of industry is the 70 durometer, or medium hardness blade. The reason is that a 70 durometer is in the middle of the road (not soft, not hard). However, when problems arise on a press, most printers will increase the squeegee pressure to get more ink lay down. The increased pressure on the blade will cause the blade to bend or roll over. Therefore, by using a dual durometer stacked, dual durometer vertical, triple durometer, or a fiberglass composite squeegee, the printer can get better print quality by using a blade that is supported right down to the edge of the squeegee. Multi-durometer squeegees and composite squeegees use a softer material on the printing edge, and then use a harder material or fiberglass product to give the blade some rigidity. (See Figure 4)

Dual durometer blades were the first real innovation in squeegees. By casting a hard durometer on to a soft material, the printer ultimately benefited by having a

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squeegee that had a soft print edge, and a rigid backing material supporting it. This had been done for years with stainless steel backing plates on many presses. There is a big disadvantage of a dual durometer blade. The blade can only be used in one direction, and after long periods of time, the blade will eventually develop a curl or set in one direction. Triple durometer squeegees have taken the place of dual durometer squeegees. The triple blade (sandwich style) has the harder durometer in the middle of the squeegee rather than one side, and a soft or medium hardness on the outside. This blade can be used in both directions.

Durometer isn't as important at the unsupported height of the blade. Unsupported height is defined by the distance from the edge of the squeegee to the point where the squeegee goes into the holder. See Figure 5. Understanding this parameter will answer why there has been an increase in squeegee innovations. One manufacturer, Printer's Edge, has developed squeegee holders that will maintain the same unsupported height of the squeegee even after the blade has been sharpened. This is called an indexable squeegee holder. Why is this important? If your customer is requesting a color tolerance on a particular graphic, it is very important to control the height of the blade. This will ultimately give you more ink deposit control. In addition, flex control squeegee holders have been introduced over the years to help with blade buckling. The advantage of a flex control holder is single durometer blades can be used, and the printer doesn't have to spend the extra money on a triple or multi-durometer squeegee.

All of the innovations come with a price so one must weigh the advantages over the costs. The fiberglass blades are very expensive, and sometimes difficult to sharpen. Being a multi-layered blade with two different materials creates problems for both grinding wheels and sanding belts. In fact, you can't cut the fiberglass blades with any of the cutter style sharpeners on the market. In addition, they have limited life span because the urethane is only 3/8" to 1/2" thick on the blade. Triple durometer blades work well for printing fine half tones, or four-color process work. The blade is soft enough to conform to the screen, and the substrate rigid enough to transfer the ink through the screen onto the substrate. Stacked dual durometer blades give the printer two edges to use, and more support in terms of unsupported height. Triple- and dual-durometer blades are approximately double in price to single durometer blades. The fiberglass blades are approximately four to five times the cost of a single durometer blade. Single durometer blades are still the most cost effective. See Figure 6. In conjunction with special squeegee holders, the printer can achieve the same results as multi-durometer blades or fiberglass blades. However, this also comes with a price. The indexable and flex control holders (See Figure 7) that are available are approximately 30 to 40 percent more expensive than conventional squeegee holders, but the big advantage is you can use a less expensive single durometer squeegee.

If your customer is requesting a color tolerance on a particular graphic, it is very important to control the height of the blade.

Selecting a squeegee is not the easiest job. As a printer, you must consider all the parameters involved. The squeegee blade brings the total printing system together: Pre-press, image, ink, substrate and press: all of these variables can be controlled, and should be looked at individually and together. The squeegee is only one of the variables, but a very important one. Don't let the squeegee be the difference between scrap and sellable product. □

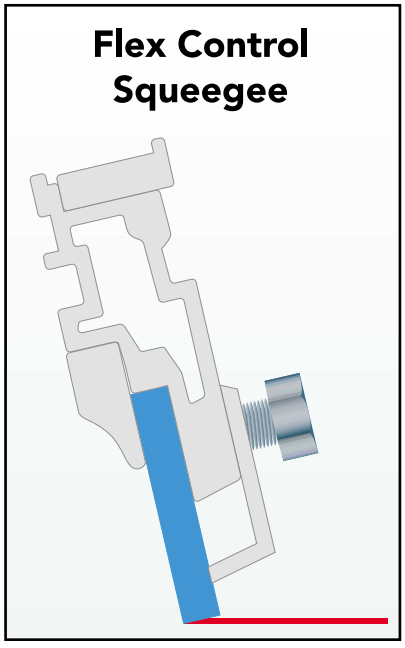


Figure 7