

# PRINTERS GUIDE

FOUR FUNCTIONS OF A SQUEEGEE	MAJOR INFLUENCES
Forcing ink through the mesh or screen	Ink Viscosity, ink particle size, mesh size-opening, speed, squeegee pressure, profile, hardness/durometer and blade tip deformation
Keeping the mesh or screen in contact with substrate	Screen tension and off-contact distance
Ensuring the mesh or screen adapts to the surface of the substrate	Substrate hardness and unevenness, squeegee profile and hardness/durometer
Removing excess ink from the mesh or screen	Ink viscosity and surface tension, thickness of ink layers, effectiveness of flood bar, snap speed and size of contact area

## INTRODUCTION

Screen printing is today a sophisticated industry covering a broad range of applications. To optimise the performance of the printing process there are a number of key factors to consider when choosing the right squeegee for a particular application.

Some of the most important technological developments of the last few years have been in ink chemistry. The range now available is vast and covers highly abrasive filled systems, aggressive solvent based systems and the use of chemical additives to enhance performance.

The advent of environmental legislation has also driven the development of UV curing systems with their high solid content and the use of alternative carrier media. Squeegees therefore have to perform in more aggressive environments both mechanically and chemically.

In order to span the comprehensive range of applications Unitemex manufacturers the world renowned Ulon range and has recently developed its complimentary Marathon range of squeegees.

- **ULON HP** offers the ultimate in abrasion resistance, quality and longevity plus the ability to re sharpen effectively. We and our customers would always recommend them as the premium squeegee.

## SELECTION CRITERIA

### HARDNESS OR DUROMETER

Hardness of squeegees is measure in Shore A° usually covering a range of grades from 55° - 95° and is a means of identification for the industry. A strict 5° hardness band guarantees the printer a more repeatable performance. Unitemex has built its reputation for quality by achieving the tightest tolerance band of hardness currently available in the industry.

Although hardness plays a dominant role in a blade's deformation and wear, the elastic modulus of the squeegee controls the stiffness or amount of flexing or bending. Differing squeegee manufacturers may produce blades with the same hardness, but the elastic modulus can differ from one producer's squeegee to another. This can have a marked effect on performance. The hardness value influences the way the squeegee aligns to the surface and determines the level of printing force required to achieve transfer of ink through the screen. The softer the grade the more adaptable the squeegee to the surface and less printing force is needed.

## BLADE PROFILE

The blade profile is the cross-sectional shape of the blade at the squeegee's printing edge which influences the amount of force transmitted to the printing surface. The affect of the profile will either force more or less ink through the screen influencing the ink thickness deposit. The profile also determines the squeegee's adaptability to the printing surface and directly affects the level of ink deposited and sharpness of the printed image. The sharper the squeegee's printing edge the less ink is delivered to the substrate and the higher the resolution. Rounded edges increase the amount of ink deposited.

## SELECTING A SQUEEGEE

The working surface of a squeegee is the blade edge that makes contact with the screen during the printing stroke. The hardness or softness of the blade material is critical to the whole process. It is the squeegee blade that performs the printing operation. Therefore the printer must carefully select the hardness and blade profile to optimise print performance. The following guidelines are good indicators of the blade type which should be used:

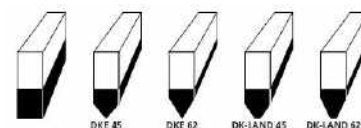
## PLAIN

Most commonly used profile for general graphics and textiles. Can be used on a variety of substrates with a wide range of inks. Provides medium adaptability and maximum force. Pushes the smallest amount of ink through the screen, tending to scrape the ink off the screen rather than push it through. Ideal for sharp line and half-tone dot production. The less ink deposited the sharper the printed image.



## COMPOSITE

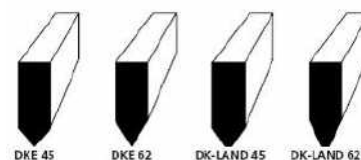
Squeegees have a stiffer backing and a blade edge of various hardness. As the blade only flexes at the printing edge, there is reduced screen pressure resulting in more contact distance and more even coverage across the substrate. Ideal on high speed machines in applications such as flat glass, solder paste as well as giving consistent film thickness on multi colour and UV lacquer products. In some applications composite squeegees will not be required, but as the industry is expected to provide high quality work, correct choice of squeegee is essential.



## D-CUT

Gives excellent control when printing on glass or plastic cylindrical objects and the Land version gives good control of printing angle. Also used for fine printing of textile cloth.

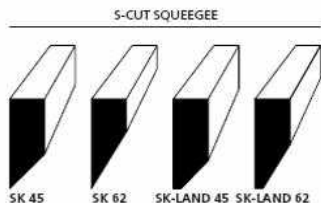
D-CUT SQUEEGEE



## S-CUT

Used extensively in container printing. Good adaptation to irregular surfaces and excellent ink deposit control.

There are generally three broad categories of hardness which includes soft, medium or hard.



### SOFT GRADES

Generally used for medium squeegee pressure with large mesh opening and low viscosity inks. Ideal for irregular substrates and uneven beds. Will deposit a high amount of ink with medium detail control. In general, softer squeegees increase ink deposit. Used for large coloured surfaces and glazes, in addition to glass and ceramics.

### MEDIUM GRADES

For higher squeegee pressure with a wide range of mesh count and inks. Will give good ink deposit and fine detail control and are used for nearly all applications.

### HARD GRADES

For maximum squeegee pressure and high viscosity inks. Gives lower ink deposit and very good fine detail control. Used mainly for fine-meshed screens and thin ink layers.

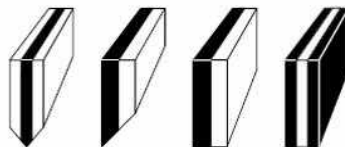
GRADE	HARDNESS SHORE A*	COLOUR
 PU 500/1	55-60	YELLOW
 PU 500/3	60-65	RED
 PU 500/3-4	65-70	RED
 PU 500/4	70-75	GREEN
 PU 500/8	75-80	BLUE
 PU 500/9	80-85	BROWN
 PU 101/9	85-90	FAWN
 PUS00/15	90-95	PINK

### SPECIALISED SQUEEGEES

#### ULON - TRIPLE AND DUAL

The triple and Dual hardness blade ranges are sandwich designed squeegees of a hard/soft/hard, soft/hard/soft and soft/hard construction and designed top overcome the problems associated with applying too much pressure onto soft and medium durometer squeegees. At higher pressures, softer blades will distort, decreasing considerably the attack angle and reducing the ability of the squeegee to shear the ink correctly. The blade edge may then aquaplane or ride over the surface leaving most of the ink on the screen. The higher durometer section (higher stiffness) of these blades prevents bending under pressure, therefore imposing a more uniform pressure on the softer section keeping

the contact distance between screen and substrate more constant – the result – a superior print. These blades are generally used for specialised applications and in high speed machines such as cylinder presses. In addition they perform exceptionally well in four-colour process printing together with half-tone work on automatic presses. A dual hardness squeegee is often used for UV process printing to optimise print quality.



#### ULON DIAMOND SECTION

This blade profile is specifically designed for the use on PCB machines as the squeegee is held close to the holder giving greater control of the squeegee. It enables very close control of the squeegee angle and shows very little squeegee bending under pressure.



#### SQUEEGEE ANGLES

The set squeegee angle is the measurement between the squeegee and the screen in the direction of the printing stroke. The operator, during set-up, determines the set squeegee angle when press is not in operation. The effective angle is the 'actual' angle of the squeegee during printing, (when the squeegee is deflected beyond the set squeegee angle due to the force of the print stroke). At a lower effective squeegee angles, a greater amount of ink is forced through the screen ahead of the printing blade and a lower amount of ink is scraped off the screen surface. Increasing the set squeegee angle consequently directs more ink into the mesh openings and a lesser amount is scraped away. The ink is under greater pressure pushing a greater amount of ink through the screen at a higher velocity and decreasing the ink's viscosity, allowing a greater degree of ink flow through the screen.

The squeegee profile does not affect the balance between the squeegee set angle and the effective angle. For example, the plain or square squeegee provides medium adaptability and maximum force and effective angles which can approximate the squeegee set angles. However, beveled squeegees such as the D-Cut and S-Cut provide maximum adaptability, minimum force and effective angles smaller than the squeegee set angles, allowing a greater amount of ink to pass through the screen.

The set angle also depends on the additional factor of blade hardness. Softer blades should be set more vertically while the harder blades can be set more horizontally.

A general rule is: "If the blade shows little or no deflection once the fabric of the screen touches the substrate, increase the set squeegee angle slightly". Alternatively: "If the squeegee blade deflects before the fabric touches the substrate, decrease the angle".

#### BLADE FLATNESS

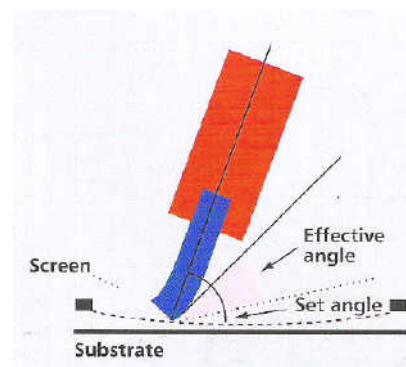
As important as a blade profile, in fact probably more so, is blade flatness. When the blade is set up ready, any deviation from a straight-line edge will result in differing pressures. This will make the ink deposit vary, the result of which will be easily seen, especially when using four colour process and UV inks. PCB printing will also suffer badly with an uneven layer across the board.

#### SPEED

The speed of stroke also effects the amount of ink pushed through the mesh of the screen. A fast stroke reduces the amount of time the ink spends in the mesh, hence the amount that may flow through the screen. Less obvious though is the change in viscosity, which occurs. A fast stroke reduces the viscosity of the ink and allows the ink to flow more quickly through the mesh ensuring a thin film can be deposited.

#### SQUEEGEE PRESSURE

All pressure should be directed at the printing edge of a squeegee. The more pressure, the greater the tendency to smear and spread the ink – increasing the potential for uncontrolled dot gains. If the pressure on the squeegee is not uniform, the rate of the dot gain and colour shift will be directly proportional to the increase in pressure. Pressure is only required to displace the stencil to a point where it contacts the substrate. The speed of the press must be slowed down before any increase in pressure to the squeegee. If the print quality improves, only limited adjustments in pressure are necessary.



#### SQUEEGEE DIMENSIONS

Thickness or width – typically range from 5mm to 10mm.

Height – the dimensions (perpendicular to the width) typically range from 20mm to 50 mm.

Free Height – the dimensions of the squeegee blade that is not clamped in the holder.



Length – the longest dimension of the blade.  
For ULON squeegees maximum length is 3.35 Meters (11feet) for PLAIN sections and 3.2 Meters (10ft 6inch) for 'D' and 'S' cut..

### SQUEEGEE SHARPENING

The shape of the squeegee's blade edge will eventually change due to the abrasion with the screen fabric.

Grinding the blade edge with a squeegee sharpener can re-sharpen the edge. It is recommended that when sharpening a squeegee edge these general guidelines be applied:

Remove as little squeegee material as possible with a fine-grit grinding tool. Try not to melt or smear the blade edge and keep the grinding wheel at low speeds.

Only use a coarse grit grinding tool when a lot of material has to be removed all at once.

Only polish the edge with ultra fine emery paper. When using a blade cutter to re-sharpen the squeegee make sure that the blade is clean and free from nicks or imperfection. A standard Stanley utility blade is often used which is available from most hardware stores.

When using a squeegee cutter make sure a suitable cooling lubricant is used in order to achieve a precise cut of the squeegee edge and avoid melting or smearing.

Never attempt to re-grind immediately after use – leave the squeegee blade for 24 hours until solvents have evaporated.

The more the blade is re-ground, the shorter the working life of a squeegee. Re-grinding will break down the material structure and will leave a larger surface area for solvent attack.

### SQUEEGEE CARE AND STORAGE

- Blades should be stored flat and not left in rolls.
- When unrolling a roll, only use after 24 hours, so the squeegee has time to relax.
- If possible, long lengths should be cut to size and then stored flat.
- When storing a squeegee still mounted in the blade holder, always store with the blade resting on the top end of the holder. It should not rest on the blade. The blade should not touch anything during storage.
- Store blade between 20 – 25 Celsius in dry conditional and away from inks – squeegees can absorb moisture and solvents from the air.
- Blades must not be left in solvents to soak. Although ULON squeegees are designed to withstand most solvents, soaking could cause temporary swelling and loss of resilience.
- Squeegees should be cleaned immediately after use to prevent accumulation of dried-up ink. The holder and squeegee blade should not have any remaining ink deposits after cleaning since this can cause squeegee marks during subsequent printing operations.

- When cleaning the blades use a soft cloth and do not wipe into the printing edge – the cloth could damage the fine edge – always wipe away from the edge.
- For prolonging the life of a ULON squeegee it is advisable that the blade is given a 10 hour 'rest period' after cleaning before the next printing operation starts.
- Blades should be changed every other day where solvents are being used – this allows the solvents to evaporate.
- Squeegees age and harden with time – test old blades every so often. Do not use old blades that are 5 degrees harder than their original designation.
- The shelf life of the new, unused squeegee is approximately two years.
- Do not use a squeegee without ink. It will quickly destroy the printing edge after a couple of passes.

### SOLVENT RESISTANCE

All blades are affected by solvents and swell in use. A general rule is the harder the blade, the less it will swell.

The ULON squeegees are widely recognised as having the best resistance against typical screen printing inks. ULON's resistance to solvent based ink is excellent. In addition, plastisol and water based inks have little or no effect on ULON.

### TYPICAL SQUEEGEE APPLICATION

#### GRAPHICS

Graphics are an important and very varied sector of the screen printing market and because of the diversity of the sector it is not a case of 'one need one product'. For this reason squeegees are supplied in various shapes, sizes and grades or hardness. Since there are numerous screen inks formulated from base resins specifically chosen for their performance and range of substrates, so there are a variety of squeegees available. The importance of any squeegee is that it has just the right amount of flexing to transfer ink correctly through the screen; has good solvent resistance and {essentially for high quality graphics} must be free from surface imperfections, air bubbles and have no edge irregularities.

#### PCB

The printed circuit board industry demands a squeegee that must be able to withstand high degrees of friction, wear, deformation and chemical resistance, particularly its interaction with solvents that may result in swelling.

#### BOTTLE

The printing of bottles or cylindrical containers usually requires a sharp edge definition on a range of substrates. The ULON S-Cut (SK 45 and SK 62) and D-Cut (DKE 45 and DKE 62) both plain and composite squeegees, play an important role in meeting the increasing demands on the bottle printer. These profiles provide the benefit of a

sharper edge for excellent ink deposit, in addition to maximum definition.

#### Compact Disc

Demanding needs of the compact disc industry requires squeegees with high durability, close tolerances, a wide range of sizes and no surface defects. The print quality must be high with maximum definition and machine set-up times kept to a minimum.



#### GLASS AND CERAMICS

For both glass and ceramics a harder squeegee is normally used with the exception of porous surfaces requiring high ink deposits when a softer squeegee is most appropriate. If fine definition is required a d-cut is recommended.



#### TEXTILES

Textile surfaces are porous and therefore generally require a high ink deposit using a softer squeegee. D-cut with a land is a good compromise between ink deposit and definition when textile printing.

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