



Wallpaper rotary screen printing line, manufactured by SPGPrints.

Flatbed or Rotary Screen Printing? That is the Question!

There are several fundamental differences — in characteristics, operation and application — between conventional flatbed and rotary screen printing.

As a versatile technique to transfer an image to a substrate, screen printing is excellently suited for industrial printing or printing electronics. Conventional flatbed screen printing is commonly used to aesthetically print on individually-fed sheets or cards. A sheet can be placed manually or is fed automatically to the screen printing machine. These print jobs are usually relatively small- or medium-sized.

Conventional flatbed screen printing is a popular decoration method in which the substrate is fed piece-by-piece to a press with the image carrier made of a stretchable polyester or stainless-steel fabric.

In this process, a flatbed stencil — a square frame with a stretched polyester or stainless-steel fabric or screen — consists of the exposed and developed image, which is created by the coated emulsion or applied capillary film on its fabric. The

image side of the stencil is the printing side, the other is the squeegee side.

The squeegee pushes the fabric down in contact with the substrate, allowing the ink to be transferred from the fabric's surface to the substrate. The gap between the substrate and the stencil allows the creation of a wedge-like shape, which results in an artificial tension build-up in the fabric during the print stroke.

The purpose of this gap, called snap-off or snap distance, is to finally deliver a crisp and sharp print quality. The tension of the fabric's wedge-like shape separates the fabric from the substrate, which is usually flat and positioned parallel to the image carrier.

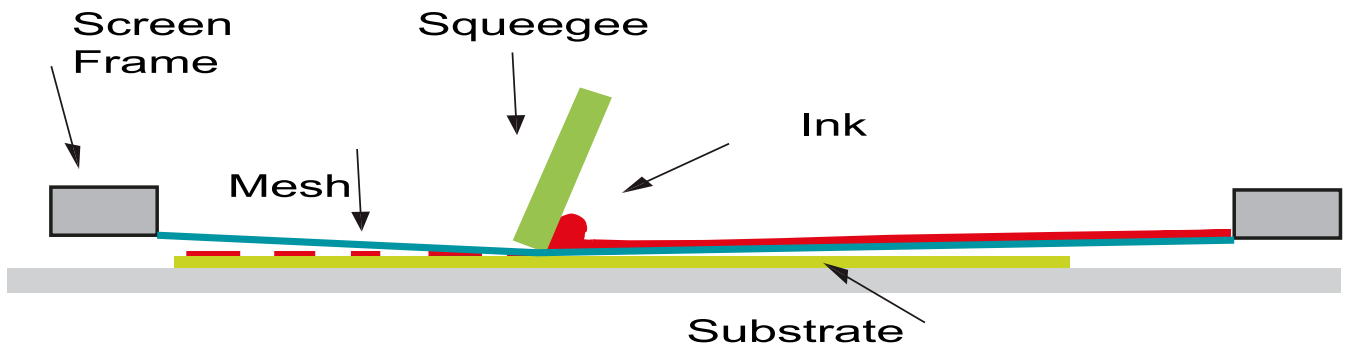
The ink transfer process can be done in two steps. The first step is to wet (to flood) the substrate using ink and, if present, a flood bar or a print squeegee. The second step is to transfer the ink onto the substrate using the print squeegee. Depending on the execution of the press, the substrate may be loaded, positioned and unloaded manually or automatically.

Sophisticated screen printing machines

The substantially faster rotary screen printing process may be used for mass production of high-end decoration jobs or may take part in several industrial processes.

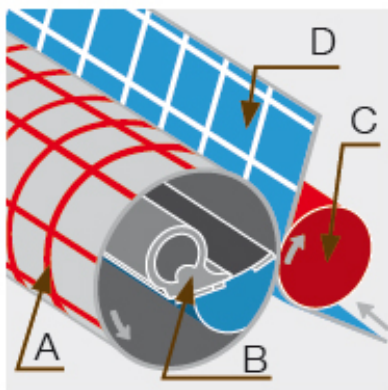


By Wim Zoomer, Industry Author



Basics of conventional flatbed screen printing.

Rotary screen printing principle



- A = screen
- B = squeegee
- C = impression roller
- D = substrate

Basics of rotary screen printing.

enable all of these processes to be executed automatically.

Screen printing uses any kind of ink, such as UV-curable, water-based and solvent-based ink. A printer once said, "If it is a fluid, it is screen printable."

Variable ink deposits make screen printing the preferred technique to transfer images. This technology enables wet ink deposits between thicknesses of approximately 5 and 300 microns.

The substantially faster rotary screen printing process may be used for mass-production of high-end decoration jobs or may take part in several industrial processes.

Rotary Screen Printing

Roll-to-roll rotary screen printing is a way to increase productivity if the print job increases from small to medium or large size on a flexible substrate.

While unwinding a roll, the flexible substrate is fed to the rotary screen printing machine with a stationary squeegee and a rigid rotary screen with a cylindrical shape. With its circumference speed equal to the substrate's linear speed, the electroformed nickel screen spins around the stationary squeegee.

In every cycle, the spinning screen starts with a clean, inkless screen surface. Deposited on the web, the ink is subsequently dried in line and possibly followed by other converting techniques, such as laminating, slitting or die cutting. Eventually the rewinding unit rewinds the printed substrate at the end of the printing line. Depending on the requirement, the printer selects the most suitable screen for the job.

Printing electronics or other functional features requires a high degree of accuracy compared to printing decorative applications. A slight deviation of the thickness or registration accuracy could make the functional device unworkable. The strength of rotary screen printing is the printing machine combines productivity with performance.

Flood Bars

Flatbed screen printing is a two-step process. Namely in flatbed screen printing, the flood bar distributes a defined thin ink film on the squeegee side of the screen. At the same time, the flood bar fills the mesh openings with ink. Subsequently in the opposite direction, the printing squeegee moves across the screen and pushes the screen down to create physical contact between the screen and the substrate, transferring the image.

Rotary screen printing's lack of a flood bar makes for a remarkable difference. Instead, the squeegee acts as the flood bar, combining this with its own function to spread the ink. Another striking difference is that in rotary screen printing, the squeegee does not move. The squeegee is stationary at a fixed position and continuously touches the inside of the cylindrical rotating screen. The rotary screen rotates in a fixed position around the stationary squeegee, rather than raising and lowering the squeegee of the rotary screen. As a result, the squeegee:

- Moves the bead of ink in a forward position in the screen cylinder without interruption.
- Fills the mesh openings with ink.
- Cuts off the ink, filling the mesh openings.
- Transfers the ink from the screen onto the substrate.
- Leaves a clean mesh after ink transfer.

The squeegee establishes contact in a tangent position where screen, substrate and impression roller meet. The ink, fed through the squeegee to the screen's center, is forced by the squeegee through the stencil openings to enable a clean ink transfer onto the substrate. The amount of ink is controlled by the automatic ink level control.

Web vs. Sheet Substrate

Flatbed screen printing requires the manual or automatic piece-by-piece loading of sheets to the press, whereas the

composition of the rotary screen printing press allows the use of a web to be printed continuously.

Roll-to-Roll

Conventional flatbed screen printing is mostly used as a sheet-printing process that may involve manual or automatic material handling. The material throughput is limited since every sheet must pause a moment to receive the image. In conventional flatbed screen printing, the screen printer sacrifices productivity.

In a rotary system, a cylindrical screen — rather than that of a flatbed — is used, which rotates during the printing process to print the web substrate. Just as the flatbed screen prints the substrate that is fed onto the printing table, the rotary screen prints onto the substrate that continuously moves between the screen and the stainless-steel impression roller. The circumferential speed of the cylindrical rotary screen is equal to the linear web speed. The web is wound on a cardboard core to allow roll-to-roll printing.

Speed

The linear speed of rotary screen printing is substantially higher than flatbed screen printing. In practice, the flatbed

screen printing speed is approximately 10–15 meters per minute, while rotary screen printing speed varies at approximately 30–100 meters per minute, depending on the application.

Snap-off Distance

As mentioned earlier, in conventional flatbed screen printing, the snap-off creates a certain wedge-like shape of the fabric during the squeegee's print stroke. The higher the snap-off, the steeper the angle of the fabric's wedge-like shape and the higher the mesh's tension to separate the stencil and the substrate during the print stroke of the squeegee.

The purpose of the snap distance is to create a crisp and sharp image and clean screen during ink transfer. A larger image area, larger frame size or stickier ink requires a higher snap-off, which results in a higher separation tension of the mesh and more deformation of the print image.

Since rotary screen printing technology does not require a snap distance, it does not have any type of adjustment tool for it. In this method, a continuous moving web is printed. As depicted, the web is fed between the rotary screen and the impression roller. The squeegee just touches the screen's inside in tangent. The diameter of the impression roller and its

position determine the wedge-like shape of the substrate, which is supposed to be constant.

Registration Accuracy

This is obtained by continuously rolling the stencil across the substrate. In flatbed screen printing, the off-contact or snap distance between screen and substrate determines the performance of the print. The smaller the off-contact, the greater the control in achieving print sharpness and a certain registration accuracy.

As the distance between screen and substrate increases, the printed image shows a growing image distortion. The printer loses control on print sharpness and registration accuracy. A snap distance up to several millimeters is quite common, resulting in substantial image distortions. On the other hand, the lack of a snap distance in rotary screen printing results in an extremely accurate and controlled image transfer process.

As the rotary screen has a cylindrical shape, the snap distance, compared with flatbed screen printing, is a completely different aspect. Flatbed screen printers mostly use polyester fabric, which is tensioned on a frame. To achieve a sharp print, a small gap snap-off must be created between the stencil and the substrate.

M&R's Stryker™ Oval & Digital Squeegee® THE BEST OF SCREEN & DIGITAL PRINTING



Stryker™ Oval Automatic Press

- The most versatile T-shirt and cut-piece press on the market today
- All-new index-drive system combines outstanding performance and greatly simplified design

DS-4000™ Digital Squeegee®

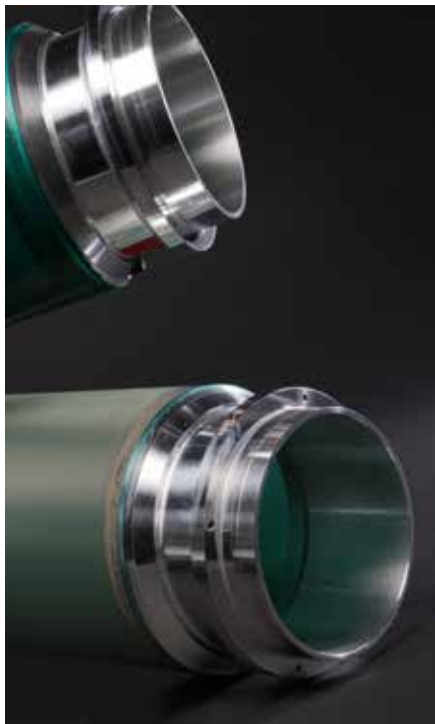
- Full color CMYK prints on screen printed underbase at **400 shirts per hour!**
- DS-4000 is compatible with Stryker™, Challenger® III, & Gauntlet® III automatic presses
- Maximum image area 38 x 48 cm (15" x 19")

The M&R Companies 440 Medinah Rd • Roselle, Illinois 60172

For more information, please visit
MRPRINT.COM/SGIA

800-736-6431

2018 SGIA EXPO BOOTH 2547, 2631



RotaMesh® rotary screen cylinder.

To transfer the ink, the squeegee moves forward, simultaneously pressing the fabric downwards to achieve contact between the screen and the substrate. The extra tension in the fabric, achieved by the snap distance, causes the fabric to pull away quickly from the freshly printed ink deposit on the substrate. A screen sticking to the ink deposit would cause a blurred print. The downward movement of the squeegee results in a deformation of the fabric, as well as a distortion in size and shape of the image. The larger the distance between the squeegee and the center of the screen, the larger the image distortion. Although several precautions can be taken to minimize this effect in flatbed screen printing, a certain image distortion will remain. In different screen printing magazines, several articles have been published about the ways to improve registration in flatbed screen printing.

In rotary screen printing, the web substrate moves between the screen and the impression roller. Since the rotary screen just touches the substrate, printers operate with a minimum of line contact. It is sometimes called “kiss printing.” The squeegee is positioned where the rotary screen and impression roller touch, obviously on the inside of the screen. The snap-off in this case is virtually zero since the rotary screen is automatically rotating or moving away from the printed ink deposit post-printing. No fabric pulling is

required. In rotary screen printing, there is less image distortion compared to flatbed screen printing.

Screen Cylinder

The rotary screen cylinder, RotaMesh®, allows a continuous transfer of the printed image onto the substrate, repeating with every screen revolution. With a cylindrical shape, the non-woven rotary screen is manufactured by electroforming nickel. The screen’s basic hexagonal structure adds geometrical stability, which, after a thermal treatment, results in:

- Ease of handling. When end rings are mounted on the screen, the system features an intrinsic rigidity. The end rings (and gearwheels) connect the screen to the drive of the printing unit. After printing and cleaning, the screen can easily be stored for repeat jobs or the emulsion can be stripped down to eventually re-image the screen for another job.
- High dimensional stability, with a high degree of repeatability and consistency. The screen’s repeat sizes vary from 12 to 25 inches with increments of 1/8 inch.
- A long lifetime, enabling printing long runs with increased press-up time. The rotary screens are available in almost any mesh count. Today’s finest mesh count is 405, which prints lines finer than 70 microns.

In-House Screen Making

The electroformed nickel rotary screens do not contain any stainless-steel woven threads, but must be considered as a plate with holes in a hexagonal pattern. Like flatbed screens and depending on the kind of ink a rotary screen is coated with, a light-sensitive emulsion is successively exposed and developed.

Reusability

Screen making equipment for in-house ‘in the round’ screen preparation is available. Due to the screen’s stability and rigidity, the screen making facility is primarily based on long runs and reusability.

No ‘Drag’

In contrast to a flatbed screen with a woven fabric, and due to its stability, a nickel non-woven rotary screen does not suffer any ‘drag’ and does not deform during printing.

On the other hand, conventional flatbed screen printing may experience an excessive squeegee pressure or a wide squeegee in contrast to the inside frame width. This so-called ‘drag’ may create an undesired pulling force in print direction on the stencil, resulting in a certain amount of deformation.

Continuous Coating

Rotary screen printing, without an image or stencil, is used to cover a large, continuous solid with ink. The requirement is a special, thermally-treated seamless screen. This print technique, coating, can be done with virtually every rotary screen. Coating means depositing a homogeneous layer of a certain thickness of a liquid medium onto a web substrate.

Logistics and Productivity

Roll-to-roll or reel-to-reel printing has a substantial positive impact on material handling, especially in multi-color print or multi-pass processes. After drying in flatbed screen printing, the printer stores the printed sheets in a drying rack or a stack of sheets on several pallets before feeding the substrate to the press to print the next pass. After printing and drying in rotary screen printing, the web is simply fed into the next printing station. Alternatively, the rewound roll then becomes the unwound roll of the second printing pass.

Rotary screen printing is an extremely productive process due to the continuous web movement and the lack of the flood bar to execute the flooding action. Depending on the print requirements and ink characteristics, speeds may vary between 60 and 100 meters per minute for wallpaper, textile, labels and printed electronics applications, such as RFID antennas, biosensors, passive components, flexible thin film solar cells, etc.

Textile and Wallpaper Printing

According to the characteristics of rotary screen printing, there are textile printing machines with speeds of approximately 100 meters per minute. The length of the screens is approximately 2–4 meters, while the repeat size of the seamless screens decorating continuous webs of garment is 64 centimeters. Leading press manufacturers include SPGPrints, Zimmer and EFI Reggiani.

Rotary screen printing is also the leader for producing wallpaper, though other print techniques include flexo, gravure and embossing. Wallpaper press manufacturers include Olbricht and Emerson & Renwick.



Two-color rotary screen printing press with vertical hot air dryer.

Combination Printing

The benefits of each individual printing technique can be applied to optimum effect to print labels, wallpaper, printed electronics or textiles.

Worldwide, there are three major manufacturers of rotary screen printing equipment and rotary screens. These global players are Gallus, Stork and Emerson & Renwick. Although they all supply rotary screen equipment, their individual market approaches are totally different.

Mass-Production with RSI

The workhorse for high-volume screen printed electronics is the Rotary Screen Integration (RSI) 600- or 900-millimeter-wide press. These printing units are

connected against a vertical frame carrying a hot air dryer. The hot air dryer, with a web capacity of approximately 10 meters, is positioned on top of the frame. After drying, a chilling drum cools down the web to ambient temperature to assure high registration accuracy standards. To increase flexibility, the chilling drum can be provided with a UV drying unit. A maximum of four printing sections can be connected to print almost 6 million square meters a year.

Conclusion

In summarization, the differences between rotary and flatbed screen printing are rather substantial. With respect to conventional flatbed screen printing,

rotary screen printing allows the following differences (and benefits):

- No flood bar.
- Prints on web substrate rather than on sheet.
- Prints roll-to-roll, using easy logistics.
- Transfers image by simply rolling the image, without a snap-off.
- Print form is a rigid, electroformed nickel, rotary screen cylinder.
- Prints without any stencil drag.
- A focus on reusability due to an in-house screen preparation facility.
- High-speed printing and high registration accuracy.
- Continuous coating.
- A stand-alone screen unit connected to any dryer.
- Combination printing with flexo, offset and letterpress for label and textile printing.
- Suitability for textile, label, printed electronics and wallpaper printing.
- Mass-production.

Located in the Netherlands, technical author Wim Zoomer writes stories on applications and various companies' successes. He has several published articles in screen printing and industrial technology magazines about flatbed and rotary screen printing technology for both graphic and industrial applications, such as printed electronics. He is the author of Printing Flat Glass, a book about architectural glass decoration processes.

Wim has been a consultant of the European Screen Printing Manufacturers Association (ESMA) and board advisor of the US magazine, iSP (industrial + Specialty Printing). He is a member of the Academy of Screen and Digital Printing Technology (ASDPT).

Contact wimzoomer@planet.nl.

Need higher output? Want an Automatic Textile Press you can rely on?

Designed for high-speed production

- Proven - over 30 years in production
- More than 20 features - standard
- Electrical indexer and print heads
- Lock-in heads and pallet tip supports
- Touchscreen PLC interface
- Internet-based Remote Diagnostics

Designed to last!

See us at SGIA,
Booth #3015, and
the unveiling of

**THE AMERICAN
ROTOTEX™
REDESIGNED**



773.777.7100

www.awt-gpi.com • sales@awtworldtrade.com

CENTURIAN