

# Printers' Guide

## Screen printing

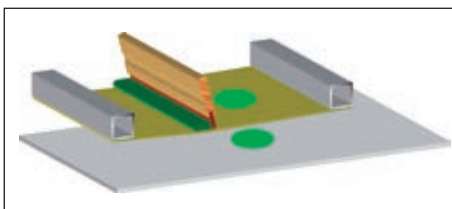
### Basic principles and fields of application

Screen printing is a comparatively young printing method. Taking the stencil technique as a model, screen printing began to become a printing method of its own at the beginning of the 20th century. The most intense development work was carried out in the USA. The demand for simple tools to decorate advertising boards and textiles gave rise to numerous inventions and patents. Since the 1920s, screen printing has found many adherents in Europe as well. At first, textile decoration and finishing was in the focus. From the 1950s on, the demand for screen printed items has grown, and the method spread and was widely appreciated thus becoming an industrially used printing method. The fields of application are so manifold that no other conventional printing method can keep up with it. What is more, the basic principles of this printing method are so simple that even an untrained person can soon manage to produce a screen-printed product without much trying. The basic method shall be explained here by the example of flat screen printing. The basic idea of this method is to transfer ink by means of a stencil. The carrier of the stencil is a mesh made of synthetic or metal threads, i.e. the screen. Once the stencil has been transferred to the mesh, the ink can be pressed through from the upper side to the lower side of the screen by means of a squeegee. Ink cannot be transferred at those areas of the screen that are covered by the stencil. The open meshes, on the other hand, let ink pass and, at the same time, ensure even application of ink by way of the thickness of the mesh and copying layer.

### The screen printing process

The stencil can be produced in different ways. In most cases, a viscous copying layer made of photopolymers is used. To produce it, a coating trough is filled with a copying emulsion which is then applied to the mesh on both sides. The number of coating runs determines the structure and thickness of the copying layer. First comes the print side of the mesh, followed by the squeegee side of the mesh. 2/1, for example, means that the print side is coated twice and the squeegee side is coated once. The layer thickness can be increased and smoothness can be optimized by applying the copying layer several times. After coating, the screen is dried in a circulation dryer at 40 to 60° C. Once the copying layer is dry, exposure is carried out. For analogue exposure, the printing motif is transferred to a right-reading positive film. The film is placed on a copying frame, and the print side of the screen is placed on the film. The copying frame is closed and a vacuum is produced. As protection against undercutting, the film must lie absolutely flat and without any air trappings on the copying layer. Exposure is carried out by means of a high-performance UV lamp. The exposure time depends on the type and thickness of the copying layer which is determined in advance by means of a suitable exposure test. More and more, digital exposure techniques are being used. The CTS (computer-to-screen) technology uses two processes for screen exposure. In the masking process, at first a light-impermeable coating varnish is applied as an exposure mask to a pre-prepared mesh. Then the exposure is carried out in the conventional way. With the direct exposure technique, the prepared copying layer is exposed directly with laser diodes line per line. After washing out, the screen must be dried again in the circulation dryer. The hygroscopicity

of the copying layer makes the surface slightly swell when being damped with water. The result is increased stickiness and lower mechanical resistance of the copying layer. When the screen is fully dry, the printing process can be prepared. The screen is taped at the edge areas. This technique offers two advantages. On the one hand, the edge areas of the screen that are not covered by the copying layer are protected from the penetration of ink during printing, on the other hand, cleaning of the corners of the frame is much easier later. If the copying layer has damages in the form of pinholes, they are filled with a screen filler and dried. Once the screen has been prepared, mounting needs to be started. Besides the correct position of the printing motif, setting of the off-contact needs the full attention of the printer. The off-contact is a small gap of 2 to 3 mm between the screen and the substrate. During printing, the screen is pushed down by the squeegee. The flexible mesh of the screen caves and thus enables direct contact between the mesh and the substrate. Directly behind the squeegee, the mesh retracts again and frees itself from the substrate. As a result, the ink is smoothly taken from the screen mesh and there is no smearing and creeping in of ink under the screen. Multi-colour printing is carried out – as in other printing methods – by printing units arranged one after the other or for single-colour printing on single-colour machines. In screen printing, both wet-in-wet printing (e.g., textile printing) and wet-in-dry printing methods (e.g., CD printing) are used. Intermediate drying during the printing process is possible and often necessary in order to prevent reverse splitting of the ink. For screen printing, all commonly used ink systems and their respective drying technologies can be applied.



The basic principle of screen printing



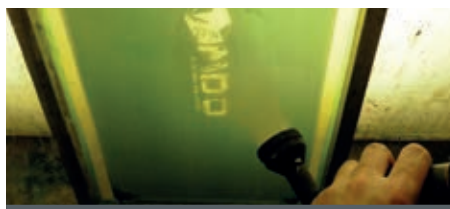
Filling of the coating trough



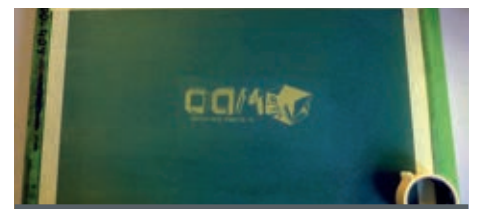
The copying layer is applied



Preparation of the film



Washing-out of the copying layer



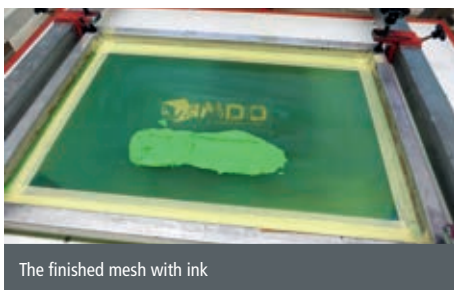
Affixing of the mesh with tape

Besides flat-bed screen printing with a flat screen and a flat substrate, the cylinder method with a flat substrate and a screen on a cylinder as well as the rotational method with both being on cylinders are used. The cylinder principle is, for example, used for three-dimensional printing. The motif that shall be printed is on a long, narrow screen. The impression cylinder is the substrate, e.g., a cup. A special machine spindle takes the cup and rotates it in sync with the screen movement. In this case, ink transfer is carried out by means of a fixed squeegee. Another example for this application is textile printing with a continuous motif for textile webs. In this case, the textile material to be printed on is first placed on a sticky transportation belt. Then the fixed substrate can be printed with a rotating screen. Like in three-dimensional printing, the squeegee is fixed in the interior of the screen. The rotating screen moves in sync with the substrate and transfers the ink. One example of the purely rotational process based on the cylinder / cylinder principle is

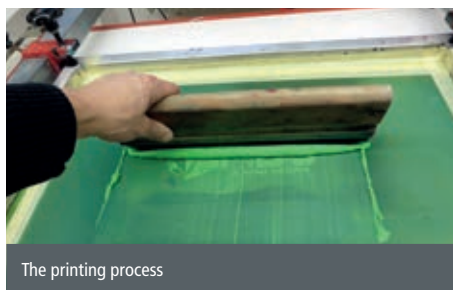
label printing. A rotating screen with a fixed squeegee moves against a conventional impression cylinder. The substrate is guided via the impression cylinder and printed. In contrast to flat-bed screen printing, the rotation-based processes do not use an off-contact. The dissolution of the printing ink is made possible by the curved surface of the round screen alone. The large number of printing principles shows the flexibility for the use of screen printing. There are a large number of examples of its application and they are not restricted to the graphics industry. Besides decorative jobs, screen printing is also often used for the application of functional layers, for instance in circuit board production or solar cell production. Therefore, the screen printing process is nowadays classified in two main areas. Graphical screen printing comprises all decorative fields of application like textile printing, the enhancement of offset printed products or label production. All coating jobs as well as, for instance, the production of functional layers are categorized as

technical screen printing. For instance, electro-conductive conduits (as, for example, window heaters in cars) or electrically activated fluorescent colours (for instance, OLEDs) are applied using screen printing. In the technical screen printing sector, above all the high ink layer thicknesses that no other printing method can produce are convincing. Also, specific minimum cross sections of conducting paths are an absolute prerequisite to the safe functioning of functional layers. In addition, the comparatively favourable reproduction technique and high production speed of screen printing are advantageous. Therefore, screen printing is an all-round method which will continue to hold its position in the graphics and manufacturing industry in future as well.

Ronald Weidel (azp Chemnitz)



The finished mesh with ink



The printing process



The screen-printed product

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VDMA  
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Postal address:  
PrintPromotion GmbH  
Lyoner Strasse 18  
D-60528 Frankfurt am Main  
Phone: +49 69 6603-1453  
Fax: +49 69 6603-2453

e-mail: [info@printpromotion.de](mailto:info@printpromotion.de)  
Website: [www.printpromotion.de](http://www.printpromotion.de)  
Twitter: [Printpromotion@promotion4print](https://twitter.com/Printpromotion@promotion4print)

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