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Challenges for Step Stencils with Design Guidelines for Solder Paste Printing

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Abstract

The stencil printing process is one of the most critical processes in the electronic production. Due to the requirement: "faster and smaller" it is necessary to place components with different paste volume close together without regard to solder paste printing. In our days it is no longer possible to control the solder paste volume only by adjustment of the aperture dimensions. The requirements of solder paste volumes for specific components are realized by different thicknesses of metal sheets in one stencil with so called step stencils. The step-down stencil is required when it is desirable to print fine-pitch devices using a thinner stencil foil, but print other devices using a thicker stencil foil.
The paper presents the innovative technology of step-up and step-down stencils in a laser cutting and laser welding process. The step-up/step-down stencil is a special development for the adjustment of solder paste quantity, fulfilling the needs of placement and soldering. This includes the laser cutting and laser welding process as well as the resulting stencil characteristics and the potential of the printing process. Influencing factors on the printing process for step stencils like squeegee speed, squeegee angle, squeegee pressure, squeegee material, printing direction and distance from the step-edge to the nearest aperture are shown in this paper. A test layout was developed with different step heights and different distances from the nearest apertures to the step-edge to give proposals and guidelines for future designs. The transferred solder paste volume was measured with highly sophisticated systems and the results which are gained in this study allow new design guidelines.
The focus of this paper is on the printing performance of step-up/step-down stencils and the paper ends up with a short outlook on 3D cavity printing.

Key words: stencil printing, step-up/step-down stencils, transfer efficiency.

Introduction
In the electronic production with mixed technology, fine pitch components of 0.4mm pitch are often beside devices which need much higher paste heights. This accounts for a remarkable amount of the whole SMT production. The printing of devices with a pitch of 0.5mm and at the same time print smaller devices like 01005 or CSP with 0,3mm pitch with much less paste heights is a growing factor in the electronic production. The solution to print different paste heights within one stencil in one printing step is a step stencil. Step stencils have been available on the market for more than 10 years and they are manufactured in different production methods. The oldest way to produce step stencils is the wet chemical etching process followed by laser cutting/welding - , milling- and electroforming process. While the chemical etching process is becoming less important due to its limited ability of miniaturization, laser cutting and electroforming are the most common technologies today. Both technologies differ substantially in their material, finishing process and manufacturing process. Stainless steel material is mainly used in the laser cutting process whereas nickel is the major material for the electroforming process. As a finishing technology electrochemical polishing, mechanical brushing and electroplating are used. The different technologies of step stencils are described in a short overview.

Wet Chemically Etching Process
Step stencils are produced by starting from a thick stencil material, mainly stainless steel. The thickness is reduced at selected areas while using a wet chemically etching process. The remaining areas which should not be etched are protected with a film or resist. This etching process can be applied on both sides of a stencil either from the top side or the bottom side or from both sides at the same time. Nowadays the apertures of the layout are produced with a following laser cutting process, because this process shows much higher accuracy than an etching process. As a finishing process, to generate smooth aperture walls, an electro-polishing step can be added, or a nickel plating instead. The advantages of this process are the price

and the short delivery time. The disadvantages are the inaccuracy and the limited stencil thickness. Step stencils below 100µm thickness in an etching process are difficult to produce.

Milling Process

The milling process is quite similar to the etching process. Starting from a thick stencil material, the thickness is reduced at selected areas with a CNC controlled system. Steps can be produced on both sides of a stencil. Later on the apertures are made with a laser cutting process for achieving smooth side walls an electro-polishing step is added. The advantage of this process is the accuracy in the step heights and the low tolerances of the laser cutting process.

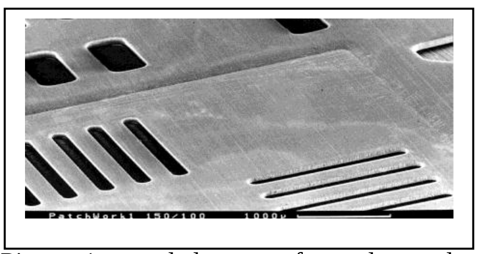
Electroforming Process

On a copper mandrel substrate a photo resist is applied which carries a negative photo resist image of the aperture design. After developing by light exposure a negative image is created on the mandrel which covers only the stencil apertures locations. A plating process builds up nickel to the required thickness around the resist areas. The remaining photo resist is removed from the apertures and the foil is separated from the mandrel. The advantages of this process are the smooth side walls of the apertures and the higher hardness of the nickel in comparison to stainless steel, which results in a longer shelf life of the stencil. High costs are the disadvantage.

Laser Cutting – Laser Welding Process

The technique is a combination of a laser cutting and laser welding process. In the first step a laser cut opening is produced in the size of the desired step-up or step-down area. In a second step a stainless steel material with the requested thickness is laser welded with exact the same size of the former opening. The apertures are generated simultaneously in the step area and on the base material.

Afterwards a finishing process is carried out. It is a brushing process which removes the burr from the laser cutting process. The stainless steel material for the step areas is available in 10µm steps starting from 20um to 300µm to adjust the solder paste volume for each specific component. To guarantee an exact foil thickness of ±3% and absolutely planarity of the step area a special pre-treatment of the stainless steel material is necessary. The spacing of the welding seam is around 200µm and the edges are automatically rounded off due to the welding process. No additional process step is necessary, see picture 1.



Picture 1- rounded corner of step-down edge

With this process the squeegee is easily adjustable to the step height or depth without damaging or abrading the squeegee blade. The flexibility of this technology is enormous, even used stencils step areas are replaceable and the costs for a new stencil are saved. With this technology step-down or step-up areas are possible on both sides of the stencil at the same time. The advantages of this manufacturing process are the flexibility, short delivery time –6 hour service possible- and the high precision of the laser cutting and laser welding process.

The production of these stencils takes place in air conditioned rooms with a fiber laser. The fiber laser is characterized by a significantly better laser beam than common used laser systems. The distinct lower cutting opening of 20µm with equal depth of focus sharpness allows a reduced heat input into the material. At the same time the edges are less coarse and the cutting of the stencils is more accurate. The precision of the lightly conical apertures allows a more efficient solder paste release and increases the process window in the pick and place operation. To produce true to size stencils it is necessary that the laser cutting process is carried out in strained conditions. With this procedure we guarantee an aperture positioning of ±10µm and an aperture size accuracy of ±3µm.

Description of the study

Two different test series are performed to demonstrate the optimum printing settings. The settings are squeegee pressure, squeegee speed, squeegee angle and squeegee material. The printing experiments are accomplished by observing the amount of paste residues on the surface of the stencil near by the step edge. Test series 1 is based on printing parameters that are similar to industrial conditions. Test series 2 is focused on the printing result in terms of transferred solder paste volume in dependence of the keep-out distance of the nearest aperture to the step edge. The parameters are listed in table 1.

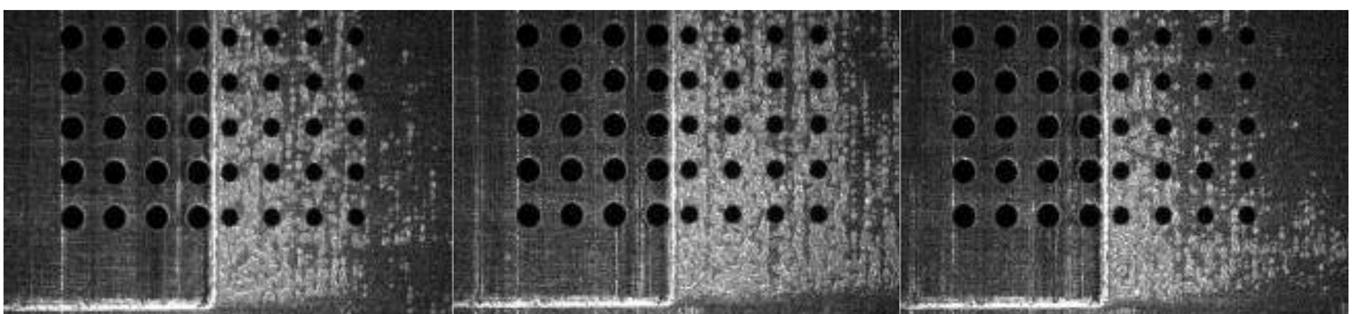
To achieve good printing quality with step stencils it is important to know the interaction of squeegee speed, squeegee pressure and squeegee angle on the printing results and on the transferred solder paste. The chosen step height for test series 1 was 50µm starting from a base thickness of 150µm (6mils) to a step height of 200µm (8mils).

Table 1- Experimental setup of test series 1 and 2

	Series 1 +2
Squeegee pressure	3N/cm
Squeegee speed	50mm/s
Squeegee angle	60°C

Test series 1
All printing experiments were implemented on a DEK printer Horizon with a HERAEUS type F640SA30C5-89M30 solder paste. A solder paste inspection system of KOH YOUNG is used to characterize the printing results. The inspection system determines the solder paste volume of each deposit on the basis of phase shift interferometry. After measurement the inspection system calculates the transfer efficiency of each solder paste deposit and writes the results into a database.
The resulting database is analyzed using the statistical software MINITAB. The transfer efficiency of all deposits is illustrated in a boxplot whereas the transfer efficiency is plotted on the y axis and the print number respectively the area ratio value is plotted on the x axis. Each box is defined by the median and the lower and upper quartile. Besides the so called whisker of the statistic program, the boxplot also illustrates the outliers of the distribution.
An optical microscope is used to visually inspect the paste residues on the stencil surface.

Squeegee pressure
The squeegee pressure plays a decisive role on the aperture filling. If the pressure is too high, the squeegee blade is scooping paste from wide apertures, causing insufficient solder filling. High squeegee pressures can cause “bleeding” of the solder paste which may lead to smearing of the bottom side of the stencil or on the print. A consequence of it is bridging. If the squeegee pressure is too low, paste is left on the top side of the stencil, causing insufficient solder paste deposits with ragged edges. In picture 2 you can see varied amounts of paste residues close to the patch edge with a step height of 50µm on the top side of a stencil using different squeegee pressures with the same squeegee speed.

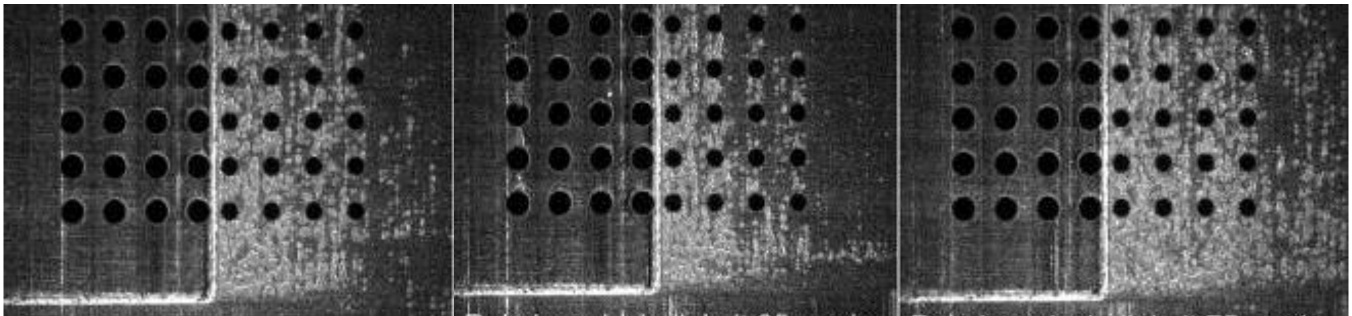


squeegee pressure =3N/cm, **squeegee pressure = 2N/cm** **squeegee pressure = 4N/cm**

Picture 2- influence of squeegee pressure on paste residues close to step edge

Squeegee speed
A similar influence on the paste residues on the surface of the stencil shows the squeegee speed. If the squeegee speed is too high the squeegee blade is not able to wipe off the paste from the stencil. Insufficient filling of the aperture is the result causing improper paste release onto the PCB; solder joint defects are the consequence of it. It is to be chosen the squeegee speed which illustrate the slightest paste remains on the depression of the stencil close to the step edge. Picture 3 shows the relation of different squeegee speeds of paste residues on the surface of the stencil close to the step edge.

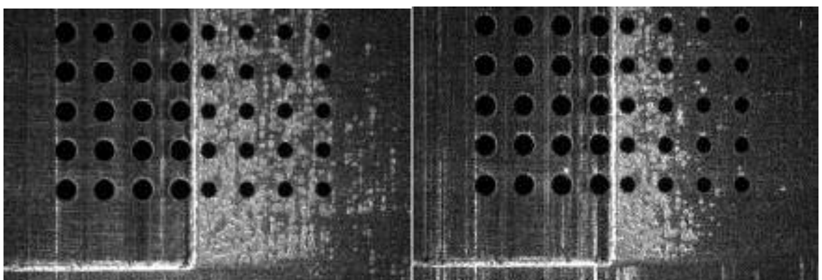
Squeegee angle
The squeegee angle influences the real actual force which impacts the solder paste and determines direct the transferred solder paste volume.



speed:50mm/s **speed = 25mm/s** **speed = 75mm/s**

Picture 3- relationship of different squeegee speeds on paste residues

A steeper angle means lower force impact - lower solder paste deposit -, a flat angle means higher force impact – higher solder paste deposit. Picture 4 illustrates the paste remains with different squeegee angles, 45° and 60°. It is obvious that the paste residues are less with an angle of 45°.

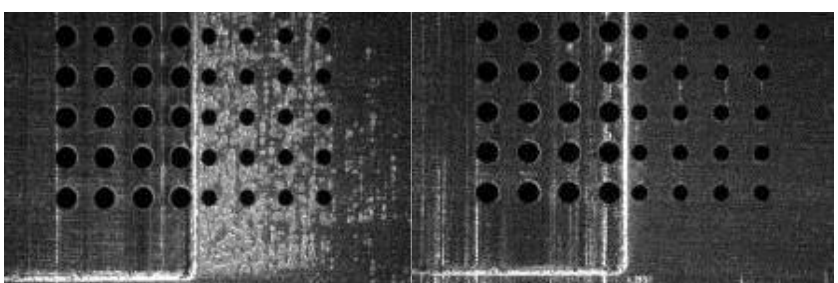


Angle:60° **Angle:45°**

Pictrue 4- Paste remains close to the step edge with squeegee angle of 45° and 60°

Squeegee Material

The squeegee material shows an influence on the wipe off behaviour of the stencil surface too. As a squeegee blade material both stainless steel and a polymer squeegee (Permalex squeegee) were used (see Picture 5). It is obvious that the Permalex squeegee shows a much cleaner stencil surface with nearly no paste remains visible.



Metal squeegee **Polymer squeegee**

Picture 5- Paste remains with close to step edge with different squeegee material

Regarding test series 1 it is quite evident that the chosen printing parameters play a major role on the amount of residues on the surface of the stencil and in consequence on the transferred solder paste. For this reason the most careful attention to process parameters have to be chosen to avoid an excess of solder paste near by the step edge in the step-down area to ensure a constant transferred solder paste volume. In this experiment the best results were achieved by reducing the speed to 25mm/s, by increasing the squeegee pressure up to 4N, by changing the angle to 45° and by using the Permalex squeegee.

Test series 2

The stencil layout is illustrated in figure 1 and includes step-up and step-down areas with different heights and depressions. Starting from a base thickness of 150µm (6mils) height differences of ±30µm, ±50µm and +80µm were chosen.

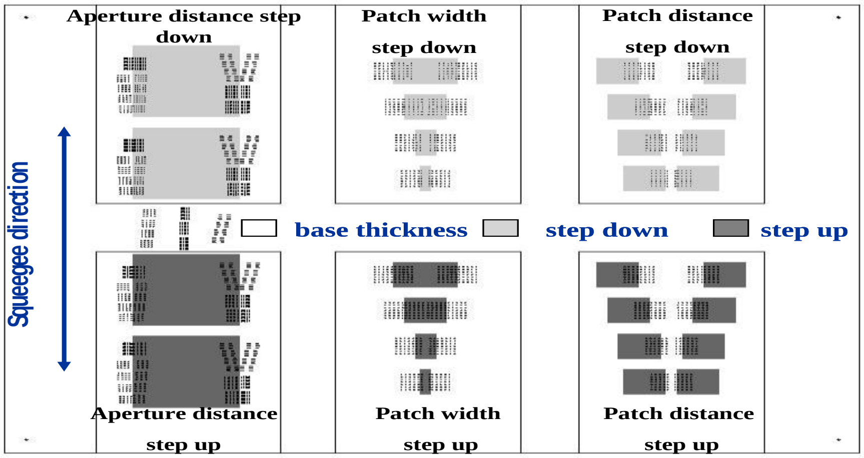
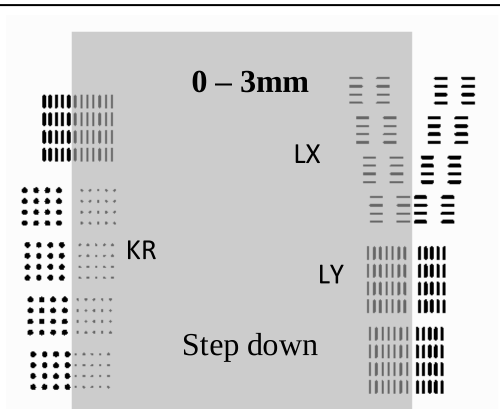


Figure 1- stencil layout with step-up and step-down areas

A detailed view of the step down area with the geometry of the apertures is shown in figure 2. Circular apertures marked as KR, oblongs with the long side of the opening parallel to the printing direction marked as LY and with the long side horizontal to the printing direction marked as LX. The aperture distance in the depression to the step edge started from 0mm up to 3mm (0,118"). All apertures in form of circles have an area ratio of 0.7 to achieve comparable results and therefore variable diameters. All oblongs have a constant length of 1000µm and an adjustable width on the stencil thickness (stencil thickness plus 100µm).

The corresponding step up area is shown in figure 3 with the same geometry and distances of the apertures to the step edge as shown in figure 2.



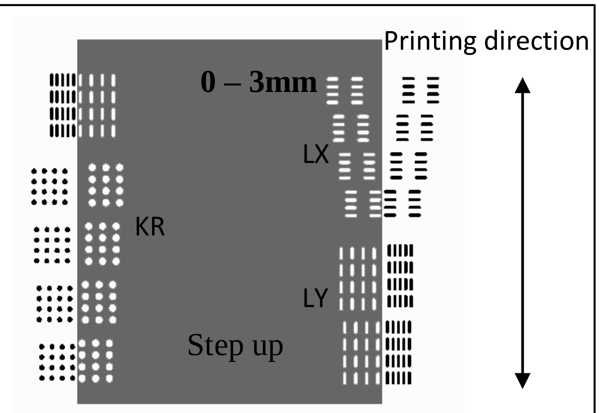


Figure 2- step down area with apertures

Figure 3- step up area with apertures

The transfer efficiency of the solder paste on the printed circuit board (PCB) was determined during the printing study and a comparison of the aperture geometries was drawn in dependence to step heights. The result is illustrated in figure 4. At a step height of -30µm transfer efficiencies above 80% were achieved on an average for circulars and oblongs. No influence of aperture geometry was visible at low height differences. At a step height of -50µm the transfer efficiency of circulars is much lower in comparison to oblongs. A transfer efficiency of 60% for circulars and 80-120% for oblongs were found on an average. But besides that the average deviation for circulars is higher too. A possible explanation for this behaviour is the increase of remaining paste residues in the very close area to the step edge by increasing step heights. This affects dramatic the paste release for circulars and therefore the transfer efficiency. However the transfer efficiency for the uncritical oblong structure LY increases (long side parallel to squeegee direction).

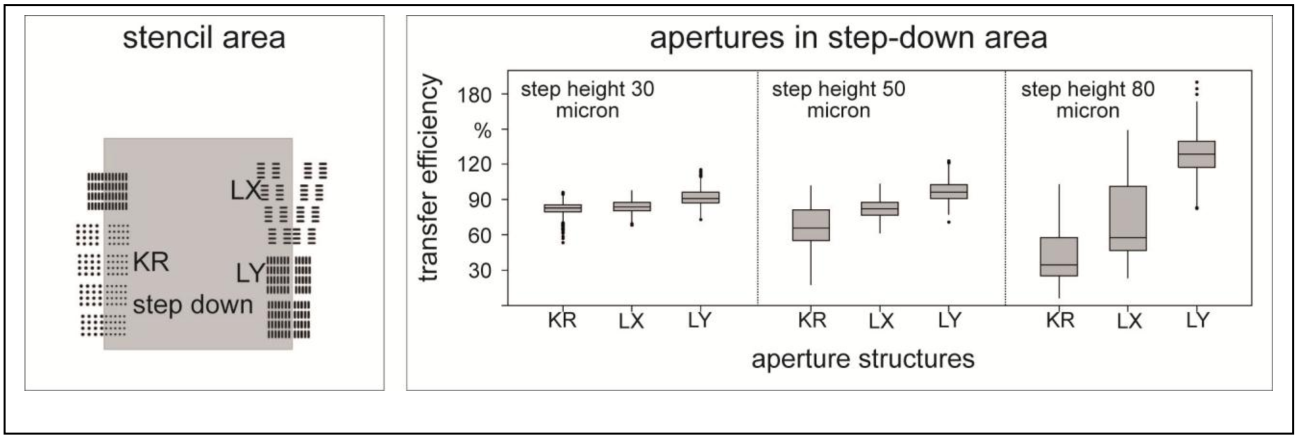


Figure 4- Transfer efficiency of circulars and oblongs in step down area

At the same time the transfer efficiency of solder paste was determined on the base thickness to the step-down edge. Step heights of -30µm illustrates a transfer efficiency of 80% independent of structure geometry. Even at step height of +50µm and +80µm the average transfer efficiency is around 80%. The result is shown in figure 5. The analysis of test series 2 is obvious and indicates that circular apertures in the step down area are more critical to print than oblongs, especially by increasing step heights. Increasing step heights affect significantly the wipe off behaviour of solder pastes in the depression and in consequence the printing result [1]. Picture 6 demonstrates the increasing amount of paste residues at step heights of -30µm and -80µm. All apertures on the base thickness of the stencil close to the step down edge are not critical to printing as long as the paste is wiped off properly. This observation is independent of aperture geometry.

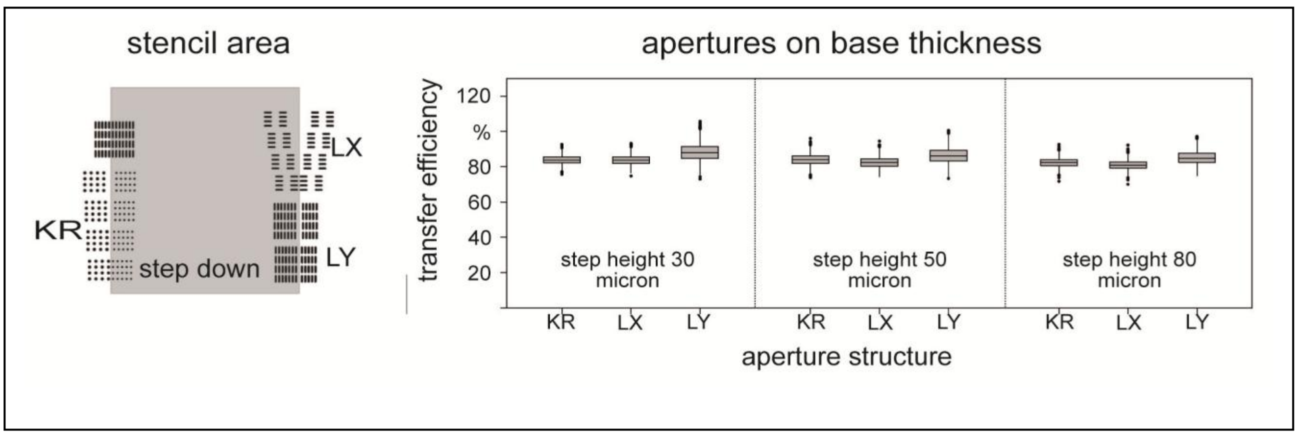
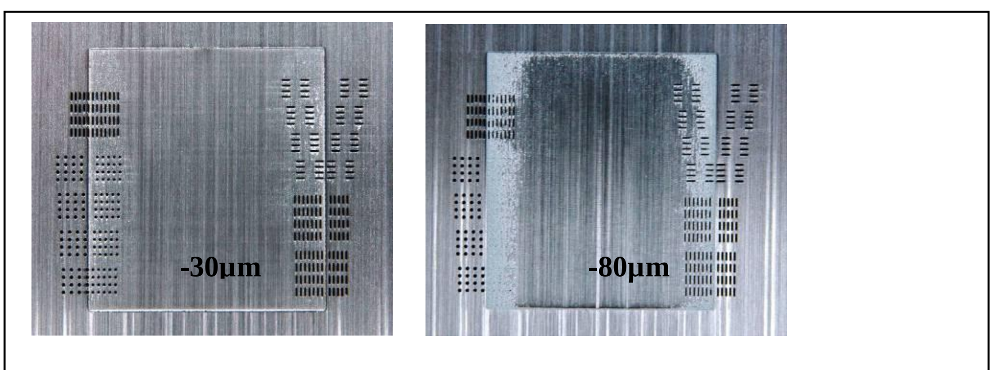


Figure 5- Transfer efficiency of circulars and oblongs on base thickness



Picture 6- paste residues in step down area at -30 and -80µm

Besides the comparison of transfer efficiencies of different aperture geometries, the experiment of keep-out distances from the apertures to the step edge was carried out. As a general design guide after IPC 7525A [2], the keep out distance should be 0.9mm (35.4mil) for every 0.025mm (0.98mil) of step down thickness. In table 2 an overview is shown.

Table 2- overview of keep-out distance of step-down stencils

Step down thickness in mm	Keep-out distance in step-down area
0.010 (0.397mil)	0.36mm (14.1mil)
0.020 (0.787mil)	0.72mm (28.3mil)
0.250 (0.984mil)	0.90mm (35.4mil)
0.030 (1.181mil)	1.08mm (42.5mil)
0.050 (1.969mil)	1.80 mm (70.9mil)
0.080 (3.14mil)	2.88mm (133.4mil)
0.100 (3.937mil)	3.60mm (141.7mil)

The test series of circular apertures is illustrated in figure 6, whereas the keep-out distances varied from 0.150mm up to 3.3mm. The analysis of the transfer efficiency at a step height of -30µm indicates an average amount of at least 60%,
at the very low distance of only 150µm to the step down edge. By using the IPC proposals for the keep-out distance, (see table 2) of 1.08mm, the experiment clearly demonstrates, even at this short distance of only 150µm, the transfer efficiency is the same as for the distance of 1.08mm and a keep-out distance is not necessarily needed for a step down height of -30µm for circular apertures.
At a step height of -50µm the average transfer efficiency is 60% at a keep-out distance of at least 500µm, which is much lower than the IPC proposes. At a step height of -80µm the achieved transfer efficiency at a keep-out distance of 500µm is minimum 60% with an outlier at a distance of 1.8mm. By increasing step heights the transfer efficiency is often above 100%. The relationship is explained by the fact that too much paste remains are present on the stencil surface in the very close area of the step-down edge, see picture 5. So be careful because with increasing step height more paste is transferred which can lead to bridging. The proposal of the IPC of 2.88mm is therefore a good guide.

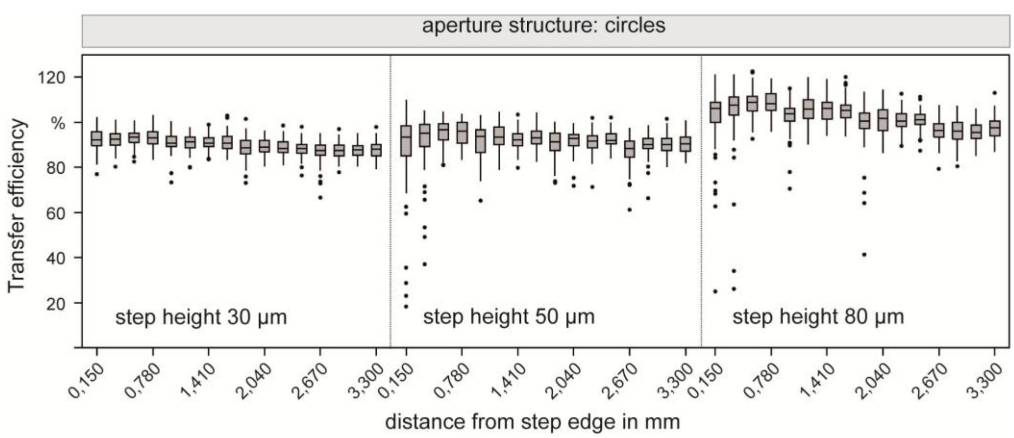


Figure 6- transfer efficiency of circles in step down area at -30µm, -50µm and -80µm

Figure 7 show the transfer efficiency for oblongs Lx (long side of oblong in a 90° angle to printing direction) and figure 8 for oblongs Ly (long side parallel to printing direction). Both oblong variations are uncritical to print independent of step heights of -30µm or -50µm. The transfer efficiency for both oblong types is above 60% regardless of step height and keep-out distance. For step heights of -80µm the high transfer efficiency of above 100% was again noted and a keep-out distance per IPC of 2,88mm should be used.

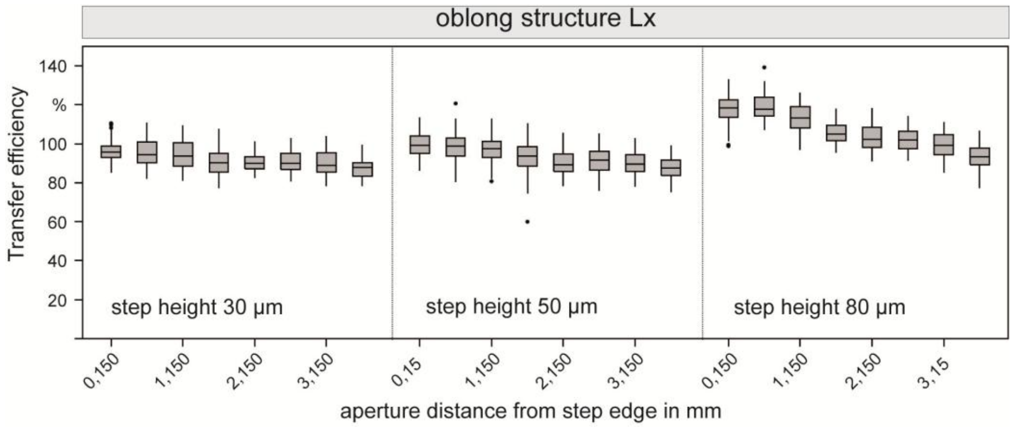


Figure 7- transfer efficiency of oblongs Lx in the step-down area

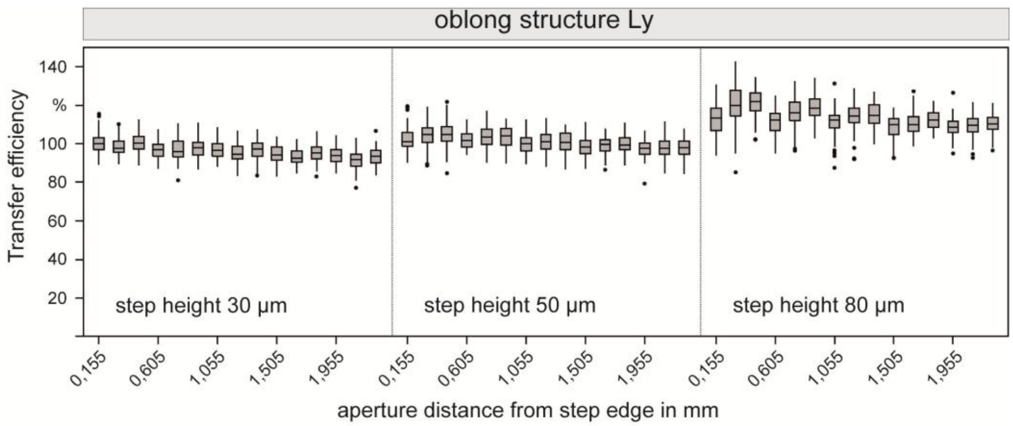
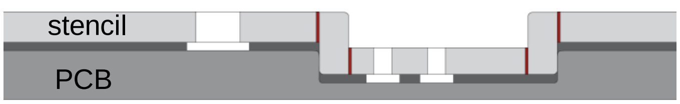


Figure 8- transfer efficiency of oblongs Ly in the step down area

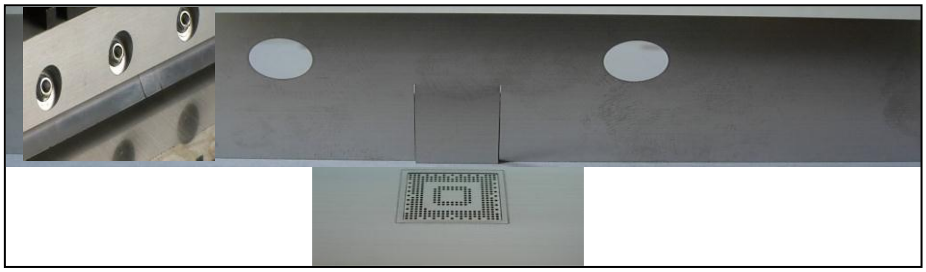
3D cavity printing

This type of stencil is used to print on deeper levels of a printed circuit board, by welding a stainless steel foil in form of a step on the bottom side of the stencil, see picture 7.



Picture 7- schematic design of a 3D cavity stencil

The application of 3D cavity stencils allows a simultaneous paste printing process on different levels on the PCB or substrate with different paste depot heights. The levels of the stencil can differ more than several 100 microns. At a decisive cavity depth the squeegee is no longer capable to dip in the cavity and wipe off the paste remaining in the depression. To insure a proper paste print with reliable paste transfer efficiency it is absolutely necessary to wipe off the paste in the cavity. Therefore you have to slot the squeegee blade to increase the flexibility of the blade at this point. The slots have to be adjusted to the cavity size, see picture 8.



Picture 8- squeegee blade with 2 slots adjusted to cavity size

Conclusion

The step stencil technology has been a well-established technology for years and offers a multiplicity of solutions and applications for a mixed component range. The flexibility of the laser cut and laser welding process is enormous and allows the application of 3D cavity as well. Even used stencils step areas are replaceable and thus offers a cost saving factor. Through the laser welding process the edges are automatically rounded off and the squeegee can easily adjust to step heights or depths without damaging the squeegee blade.

The settings of the printing process influence the transferred solder paste volume distinctly, especially in the depression of the very close area to the step edge with increasing step heights. The remaining paste residues in the depression affect the paste release and in consequence the transferred paste volume. The parameter settings like squeegee speed, squeegee angle, squeegee material and squeegee pressure show a significant influence on the wipe off behaviour of the solder paste in the depression of the step stencil and therefore on the transfer efficiency. Especially with uncritical aperture geometries the access of solder paste in the depression has to be considered.

The aperture geometry plays a significant role in the transfer efficiency of solder paste in step down stencils especially by increasing step heights.

Acknowledgements

The author wants to thank Dr. Michael Rösch from Institute FAPS, University of Erlangen-Nuremberg for carrying out the test series.

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[2] IPC 7525A: Stencil Design Guidelines

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Challenges for step stencils

with design guidelines for solder paste printing

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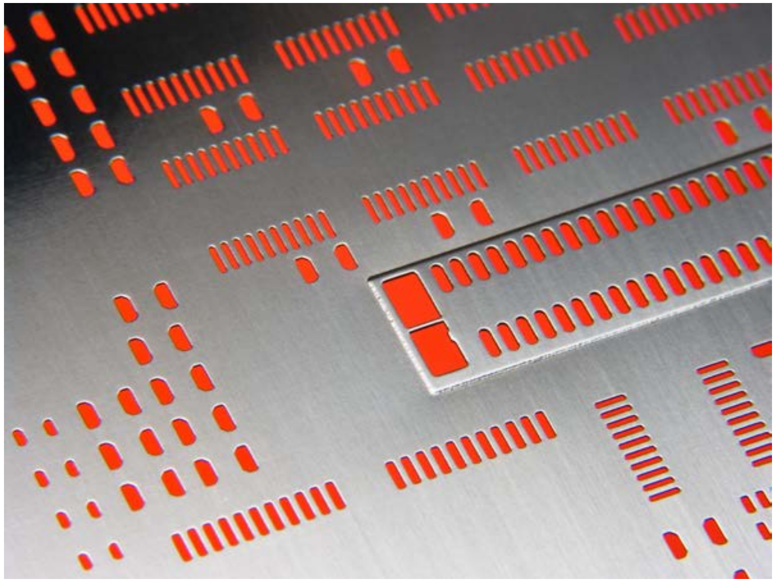
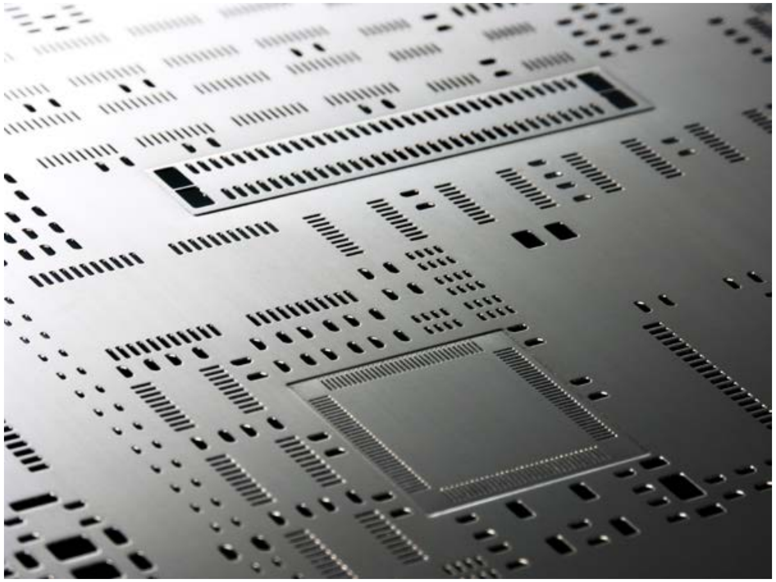




Contents

Introduction and application of step stencils

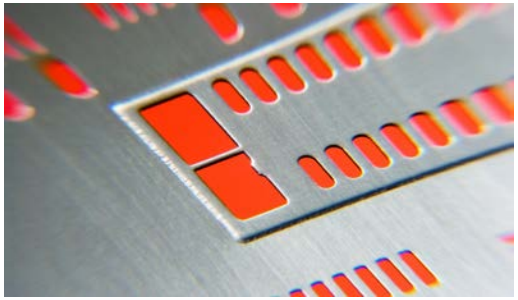
1. Manufacturing of step stensils in laser cutting and laser welding process
2. Influences and process guidelines
3. Experimental set-up
4. 3D cavity stencil
5. Summary

Introduction

Why step stencils?

- mixed assembly on one PCB e.g. fine pitch components besides connectors
- No longer possible to adjust solder paste volume only by changing aperture dimensions
- Manufacturing start: year 2000
- Filing of a patent in year 2000, EP 1187517

Application of step stencils

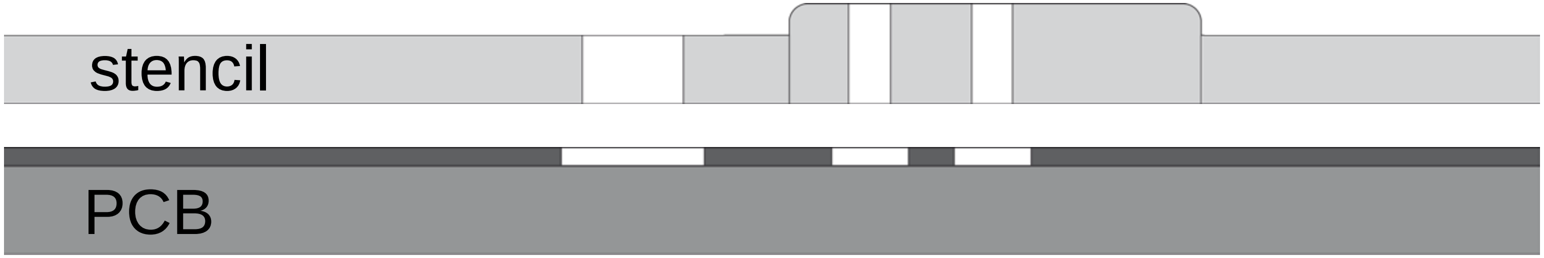


Step-up stencil

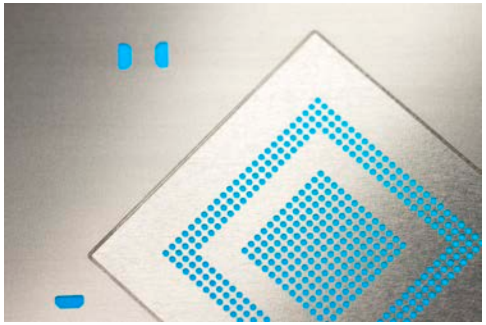
Application: (IPC 7525A)

This type of stencil is useful when it is desirable to print thicker solder paste in a small portion of the stencil.

e.g.: an ceramic BGA where it is necessary to get 0,2mm paste height because of ball coplanarity but 0,15mm height on all other surface-mount component pads.



Application of step stencils

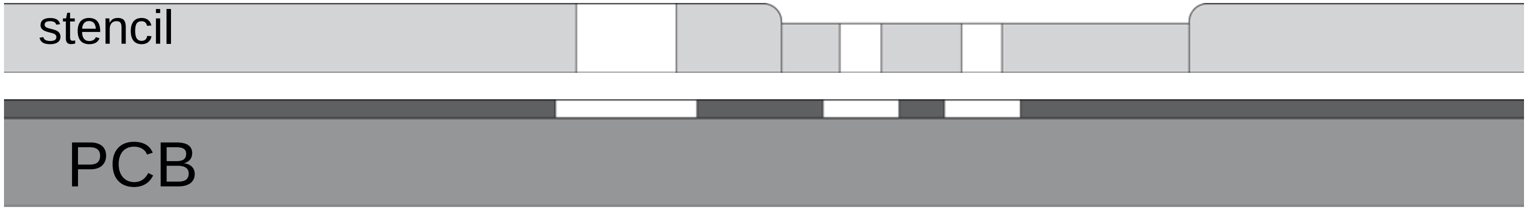


Step-down stencil

Application: (IPC 7525A)

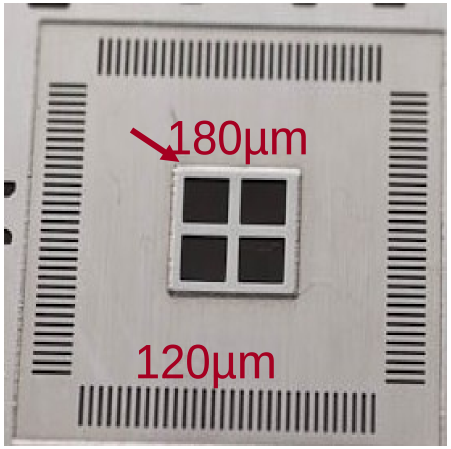
This type of stencil is useful when it is desirable to print fine-pitch devices using a thinner stencil foil but print other devices using thicker stencil foils.

e.g.: fine pitch BGA of 0,5mm (20mil) pitch that requires a stencil thickness of 0,1mm to achieve an area ration >0,66. At the same time there are devices on the same board that need a thickness of 0,150mm.



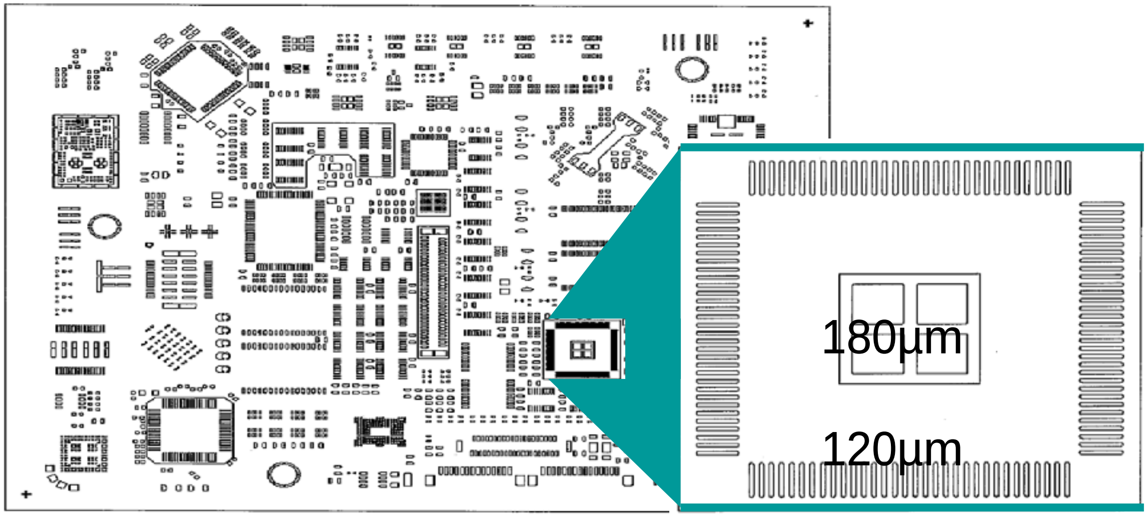
Application of step stencils

Step in step stencil



Application: QFP component

Base thickness of stencil: t=150µm
Thickness of heat sink area: t=180µm
QFP: t=120µm



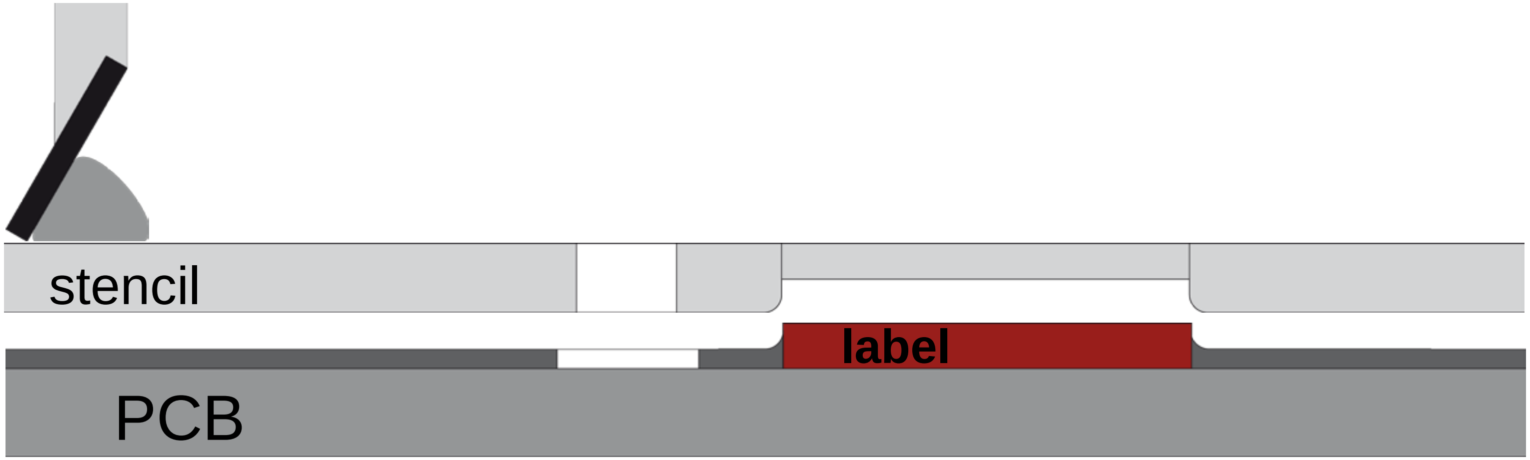
Pitch = 400µm
Pad width: 200µm
Keep-out distance: 700µm

Application of step stencils

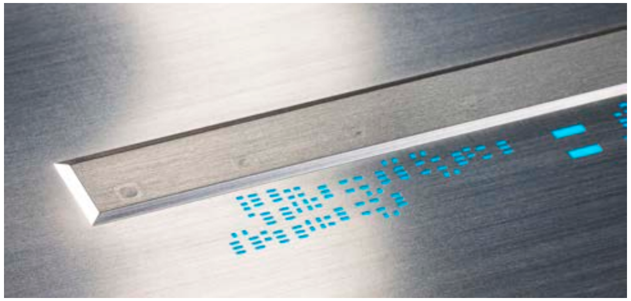
step-down stencil on PCB side

Application:

This type of stencil is used to hide thick labels on the printed circuit board, by welding a thin foil in the stainless steel sheet, e.g. for bar code labels



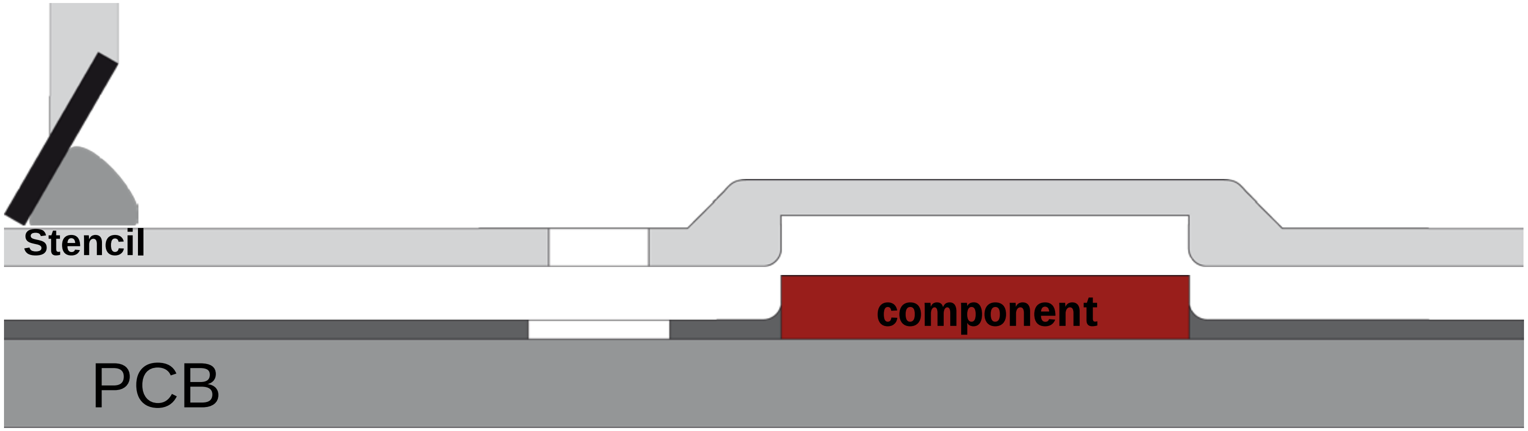
Application of step stencils



Step-up stencil on squeegee side

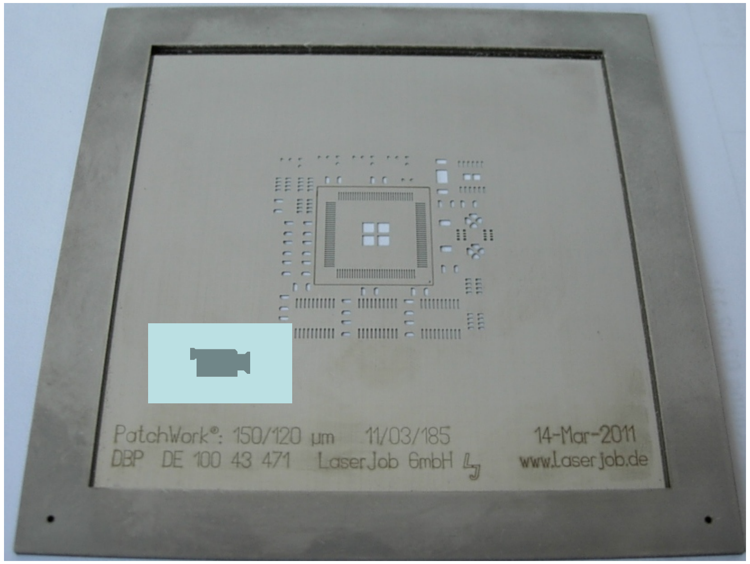
Application:

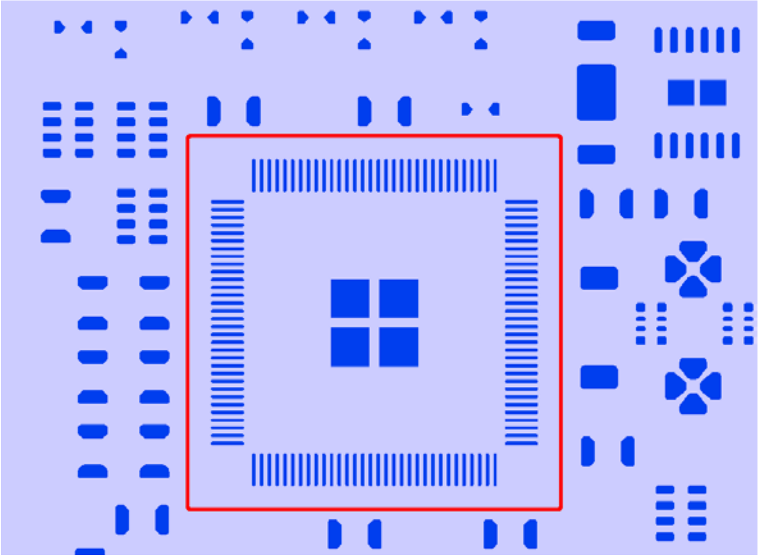
This type of stencil is used to hide components on the printed circuit board, by welding a thicker foil with bevel in the stainless steel sheet



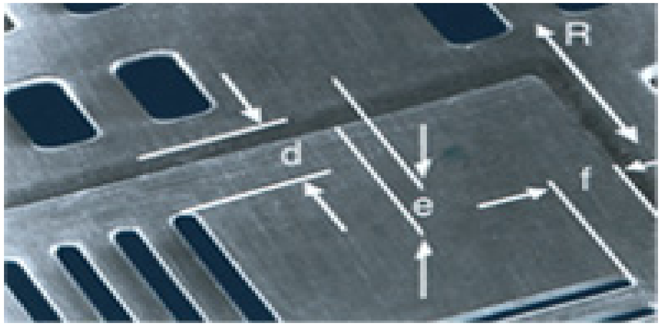
Manufacturing of step stencils

Laser cutting and laser welding process



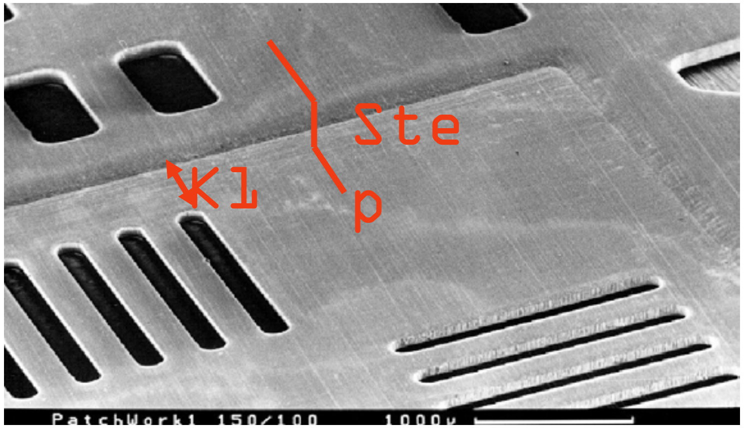


Benefits of laser cut and laser welding process



- Adapted paste volume in one print process
- 10µm- steps possbile up to 300µm
- Afterwards integration of patches in standard SMD stencils and PatchWork® stencils
- Available with NanoWork® coating
- Exact step thickness due to special pretreatment
- The same high precision in the step like rest of foil
- Rounded step edges due to laser welding process
- Step-up and step-down stencil is available on stencil- and PCB side

IPC 7525 stencil guidelines



As a general design guide K1 should be 0,9mm [35,4mil] for every 0,025mm[0,98mil] of step- down thickness.

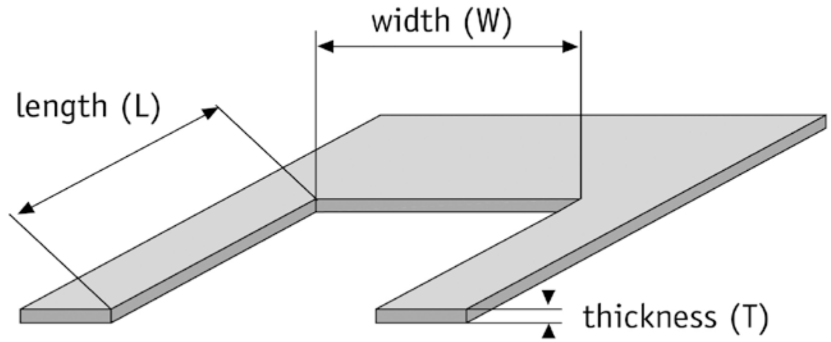
Step in mm	K1 is distance form the step edge to the nearest aperture in step –down area
0,010 [0,397mil]	0,36mm [14,1mil]
0,020 [0,787mil]	0,72mm [28,3mil]
0,025 [0,984mil]	0,90mm [35,4mil]
0,030 [1,181mil]	1,08mm [42,5mil]
0,050 [1,969mil]	1,80mm [70,9mil]
0,080 [3,14 mil]	2,88mm [113,4mil]
0,100 [3,937mil]	3,60mm [141,7mil]

IPC 7525 stencil guidelines for step stencils

A general desing guide for complete paste release is:

Area ratio: > 0,66

Aspect ratio: > 1.5



$$\text{Aspect ratio} = \frac{\text{width of aperture}}{\text{stencil thickness}} = \frac{W}{T}$$

$$\text{Area ratio} = \frac{\text{area of aperture}}{\text{area of aperture walls}} = \frac{L \times W}{2 \times (L+W) \times T}$$

Influencing factors for step stencils

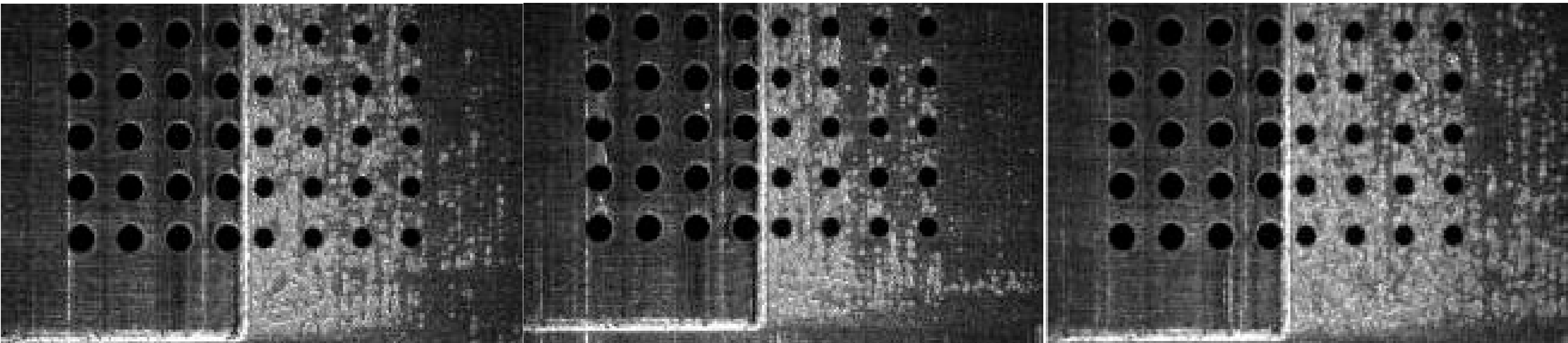
on the printing process

- Squeegee speed
- Squeegge angle
- Squeegee pressure
- Squeegee material
- Squeegee direction
- Distance from the step edge to the nearest aperture in the step down area

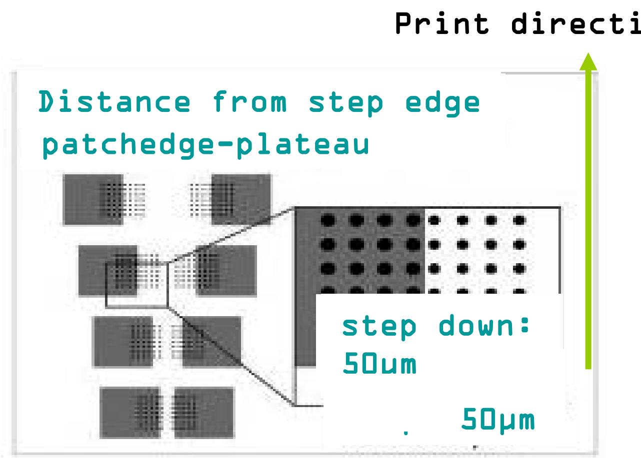
Squeegee speed

Squeegee speed

Basic settings: speed: 50mm/s,
squeegee pressure: 3N/cm, angle: 60°

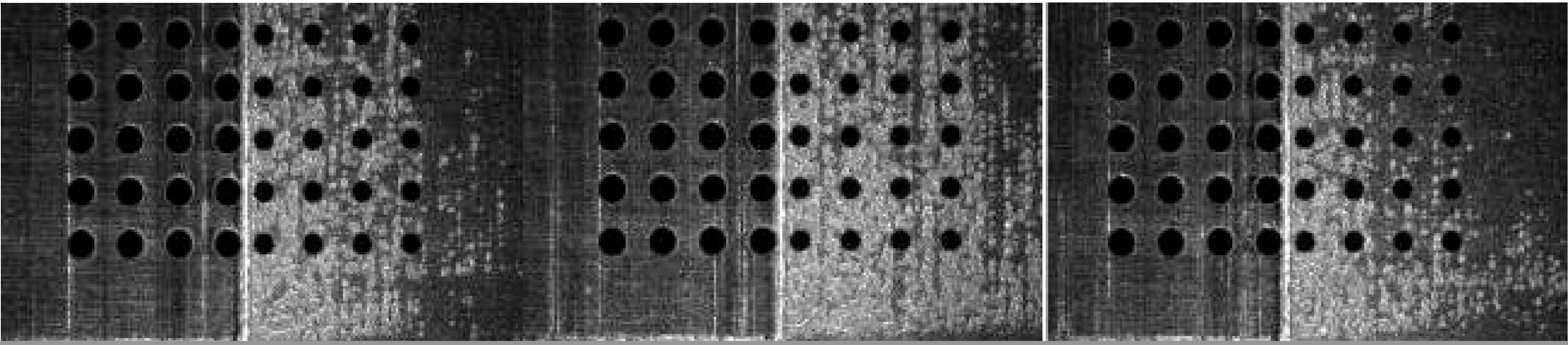


Basic settings: speed:50mm/s | speed = 25mm/s | speed = 75mm/s

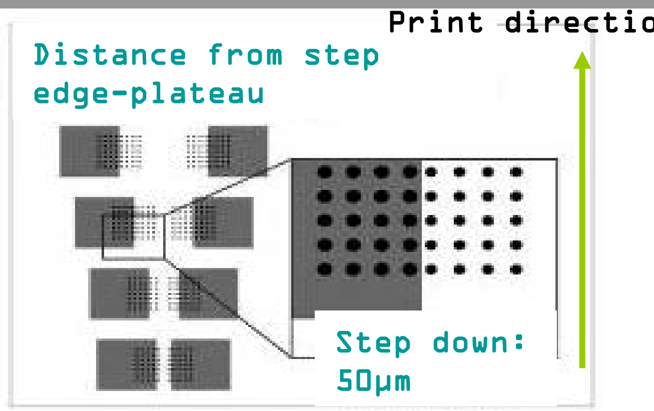


Squeegee pressure

basic settings: V= 50mm/s,
squeegee pressure: 3N/cm, angle : 60°



Basic setting: speed:50mm/s, sp=3N/cm, angle:60° | squeegee pressure = 2N/cm | squeegee pressure = 4N/cm



Squeegee angle

Angle between squeegee and stencil

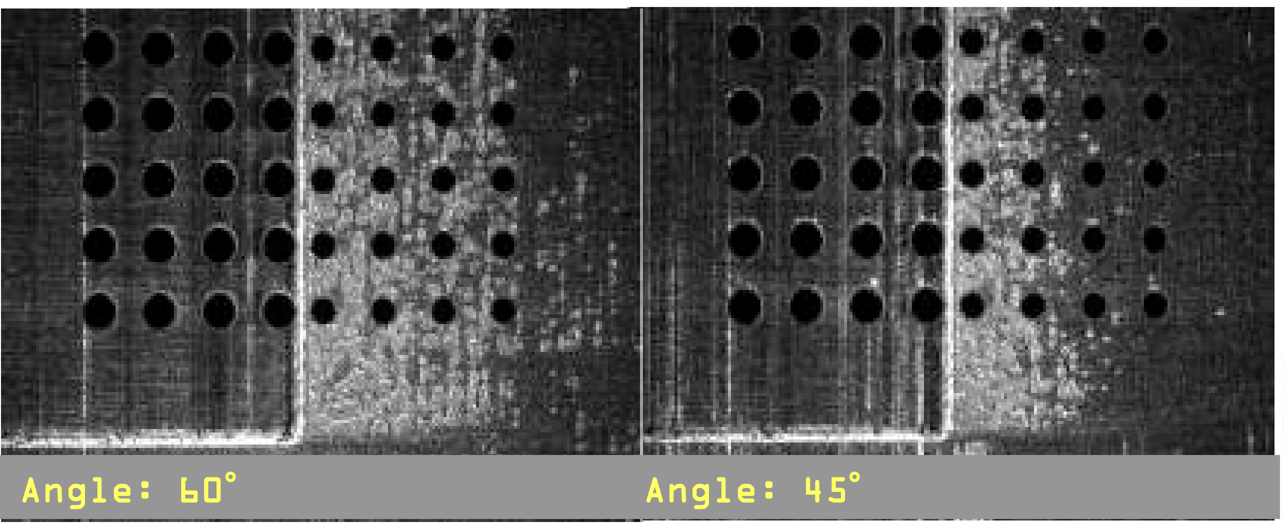
The squeegee angle influences the force effect on paste and therefore on transfered paste volume.

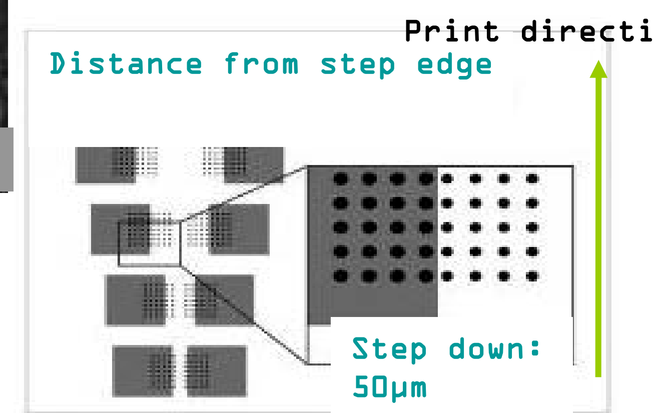
- steeper squeegee angle: less force effect → less paste volume
- flat squeegee angle: higher force effect → higher paste volume

Rakelwinkel

Squeegee angle

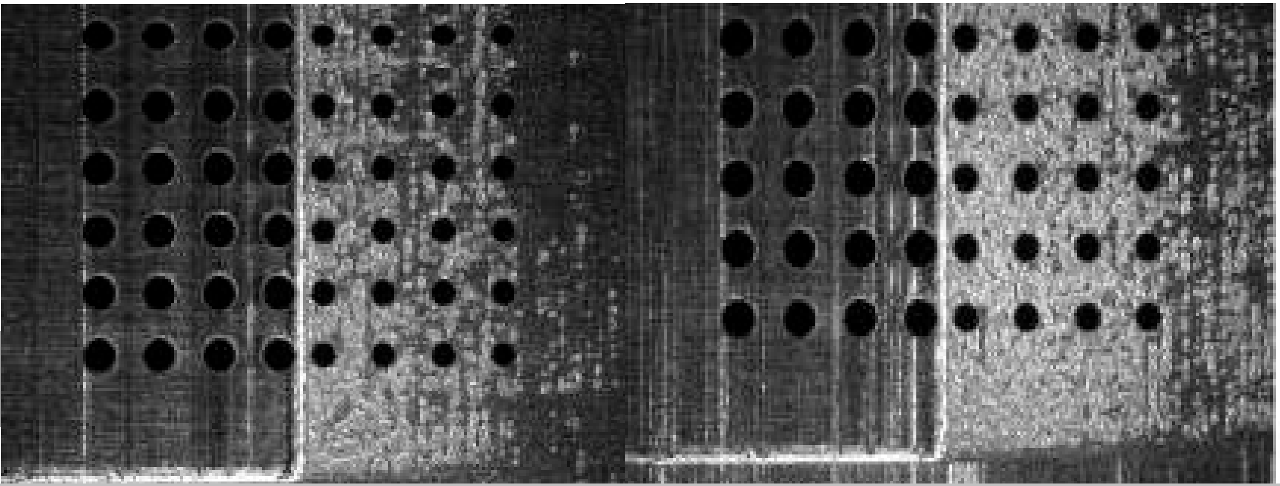
Basic settings: speed: 50mm/s, squeegee pressure: 3N/cm, angle: 60°



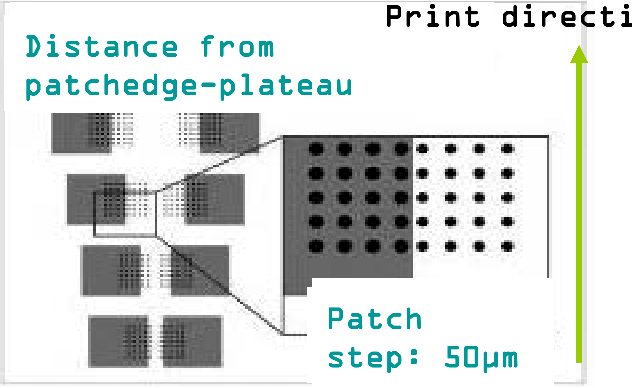


Powder size

Basic settings: speed: 50mm/s, squeegee pressure: 3N/cm, angle: 60°



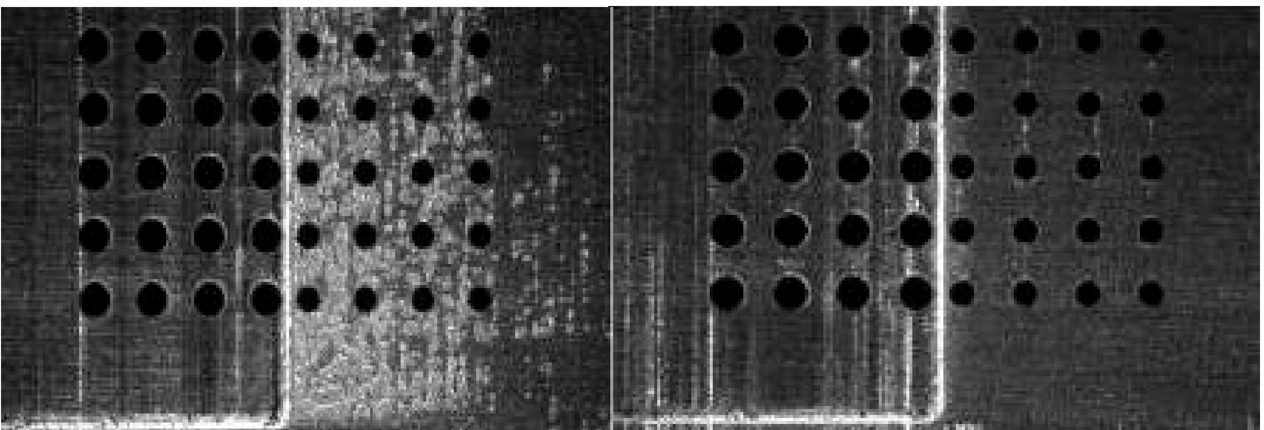
solder paste type 3 | solder paste type 4



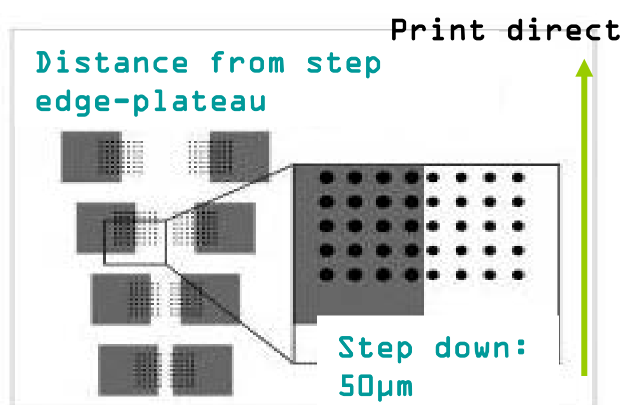
Rakelmaterial

Squeegee material

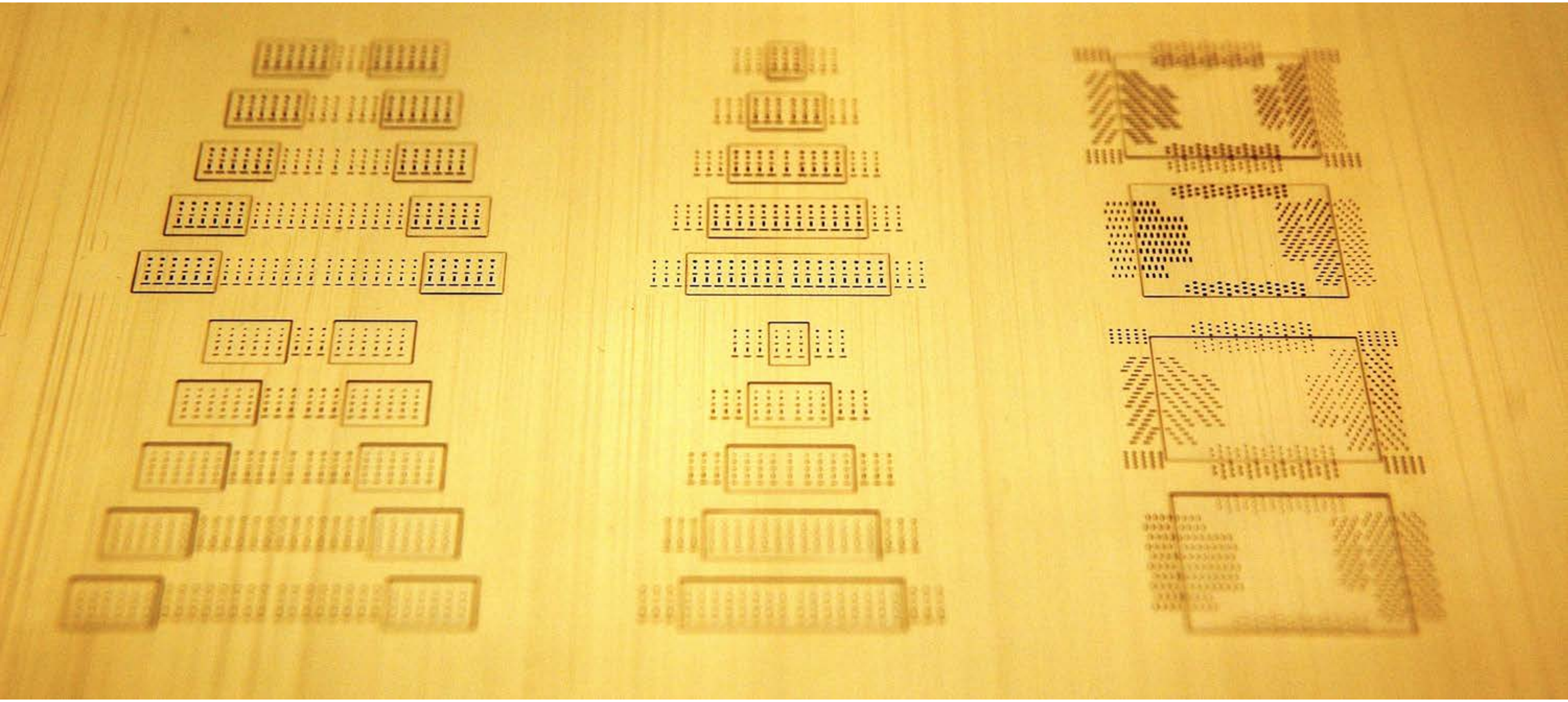
basic settings: speed: 50mm/s, squeegee pressure: 3N/cm, angle: 60°



Metal squeegee
Polymer squeegee

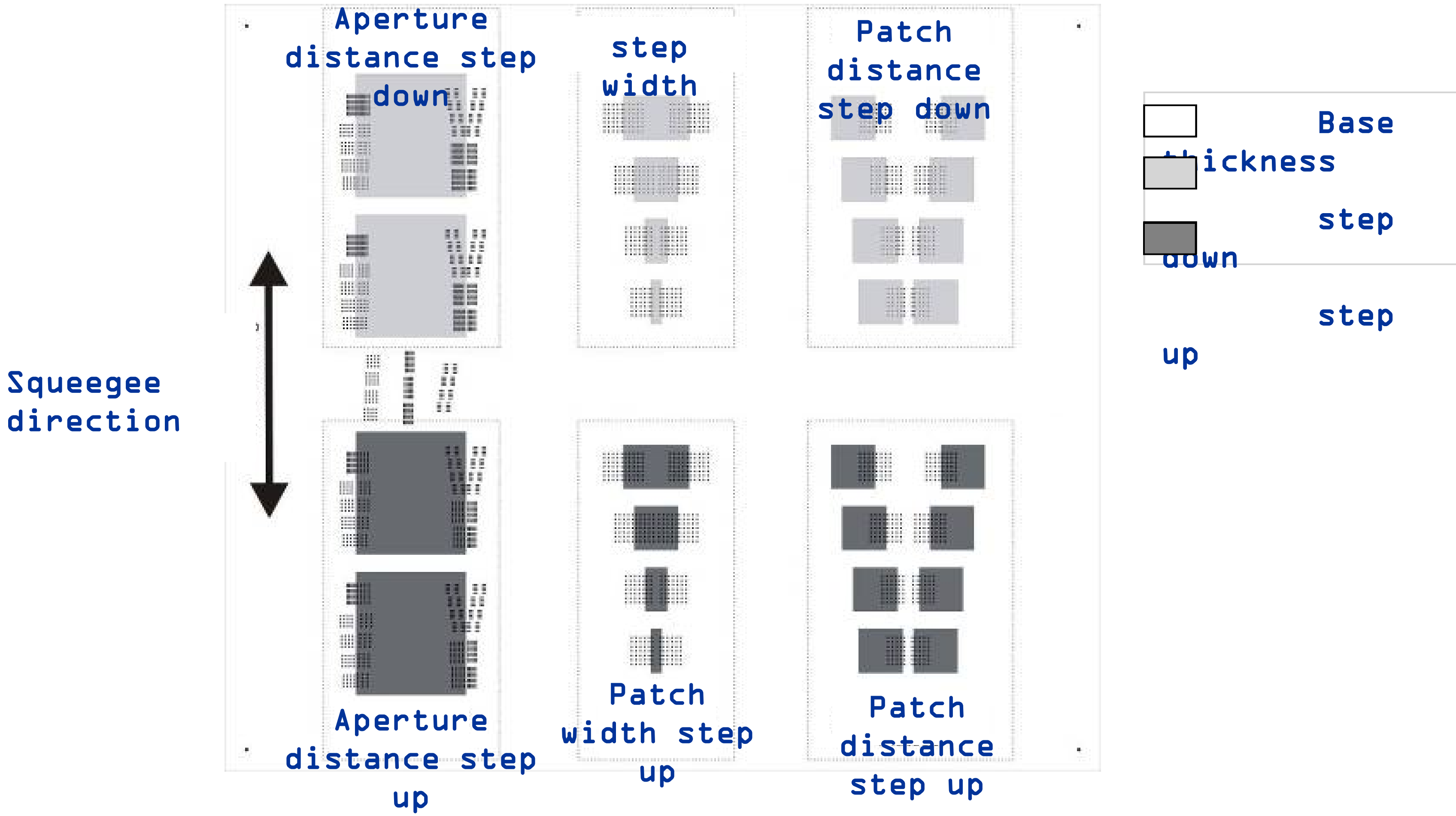


Stencil layout for step stencils



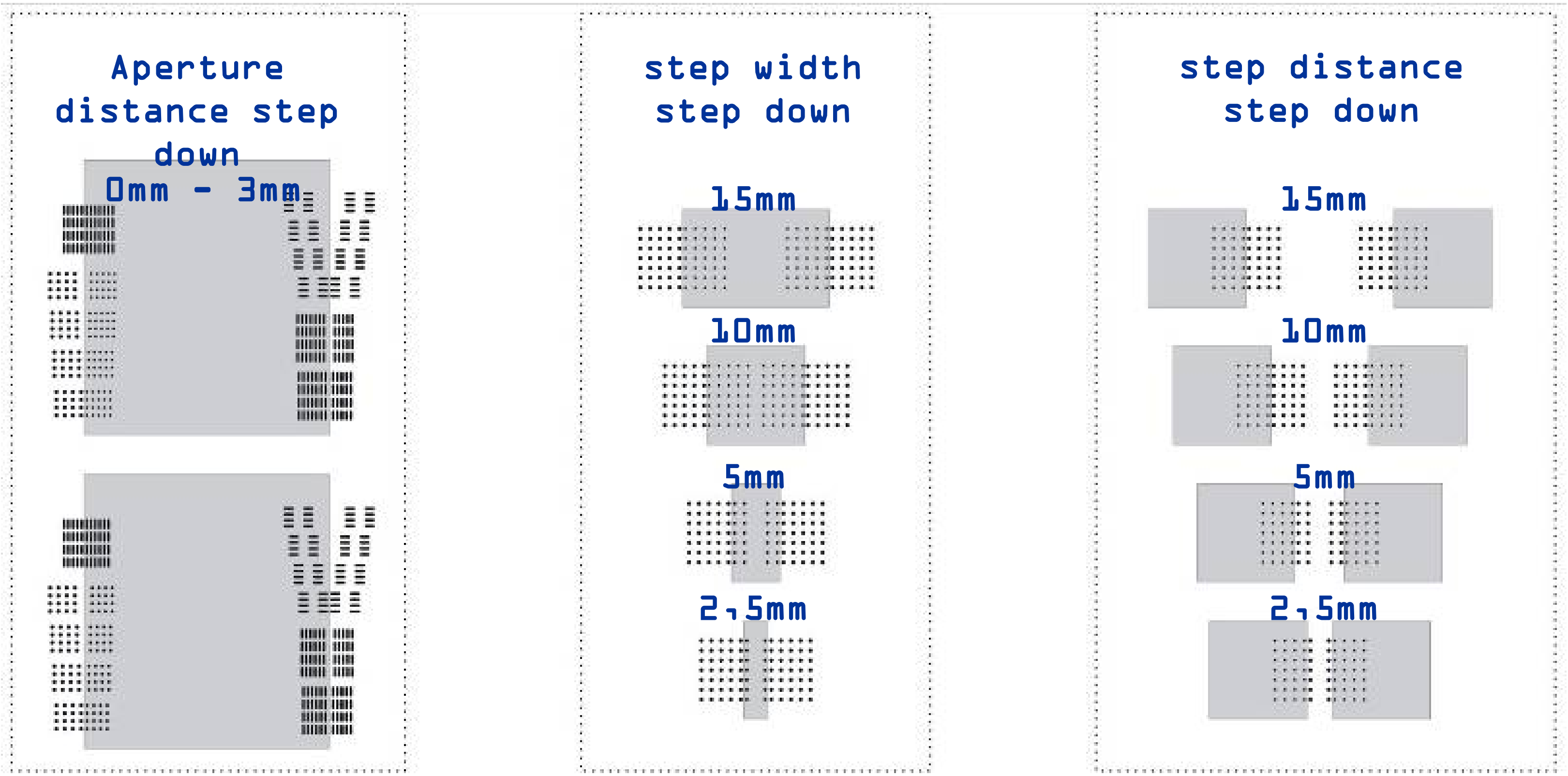
Testlayout to qualify step stencils

3 step stencils with different stencil thicknesses 150 µm ± 30 µm, 150 µm ± 50 µm and 150 µm ± 80 µm



Testlayout to qualify step stencils

Detailed view: step-down

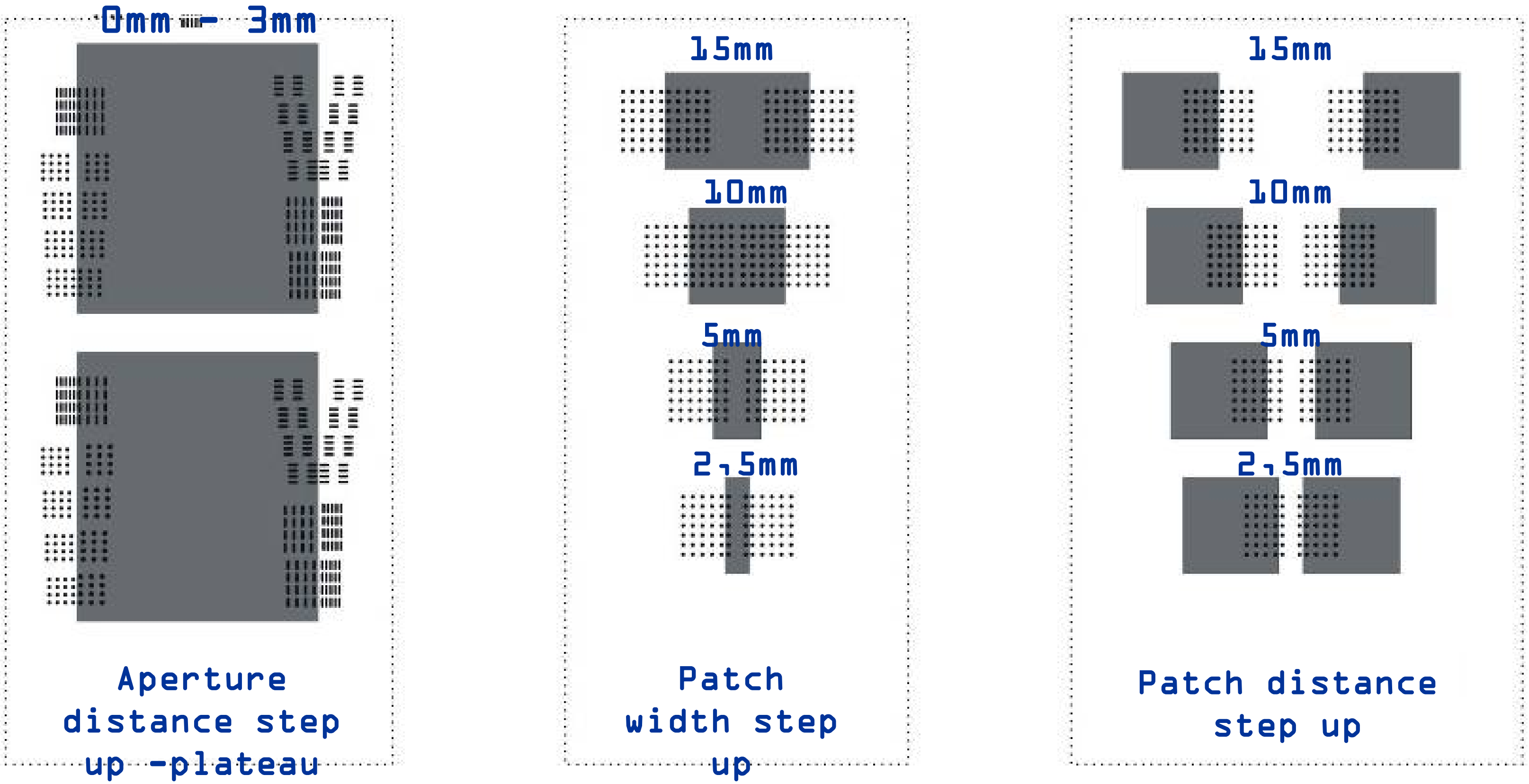


Step height difference: 30 µm, 50 µm, 80 µm

Paste transfer efficieny determined with Koh Young system

Testlayout to qualify step stencils

Detailed view: step-up



Step height difference: 30 µm, 50 µm, 80 µm

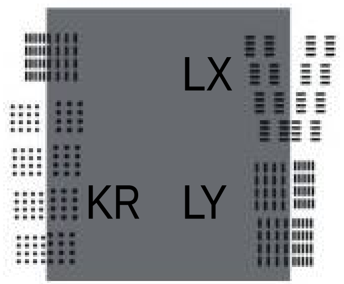
As originally published in the IPC APEX EXPO Proceedings.

Transfer efficiency on PCB :

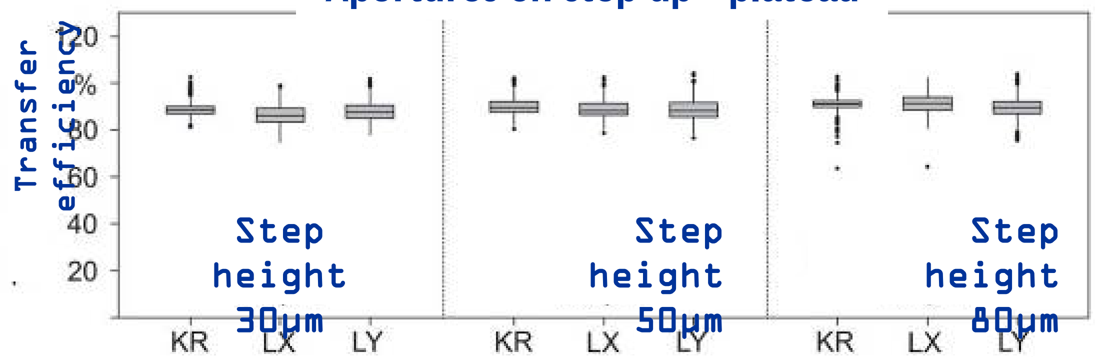
aperture distance step up „on plateau“

printing direction

Aperture distance step up- plateau

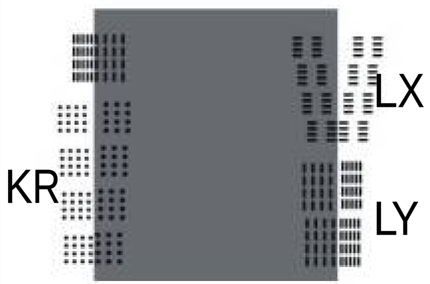


Apertures on step up - plateau

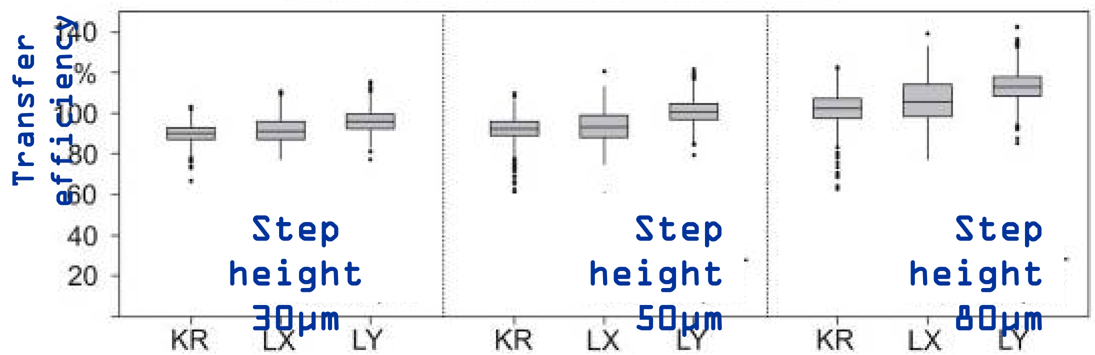


Apertures: KR=circles, LX= oblong, LY=oblong

Aperture distance step up- plateau



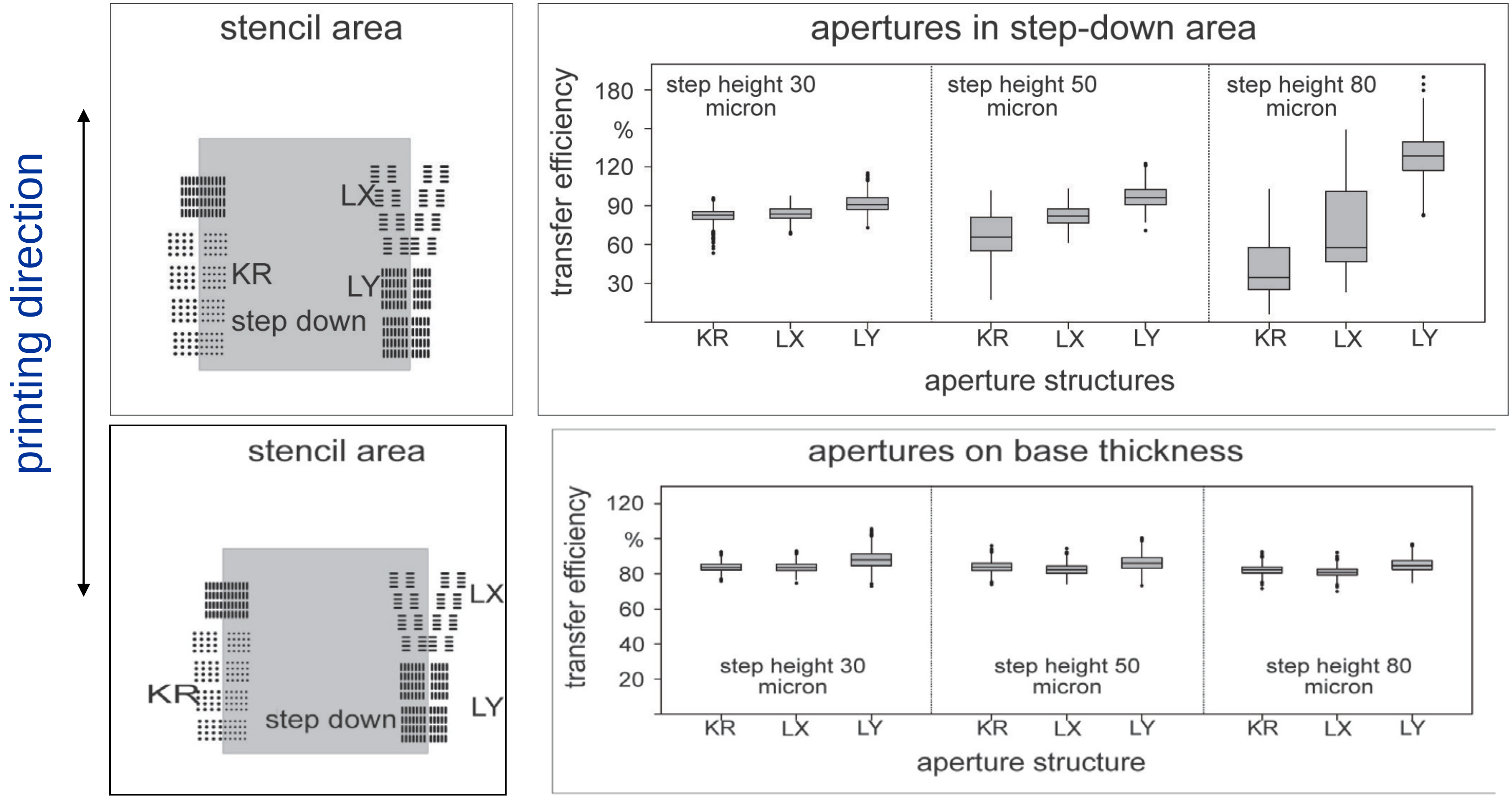
Apertures on base thickness



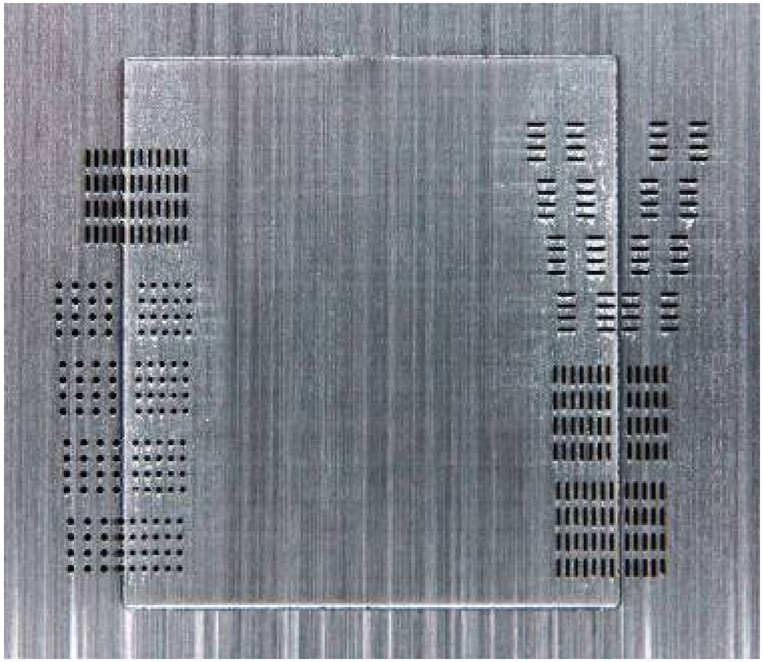
Apertures: KR=circles, LX= oblong, LY=oblong

Transfer efficiency on PCB –

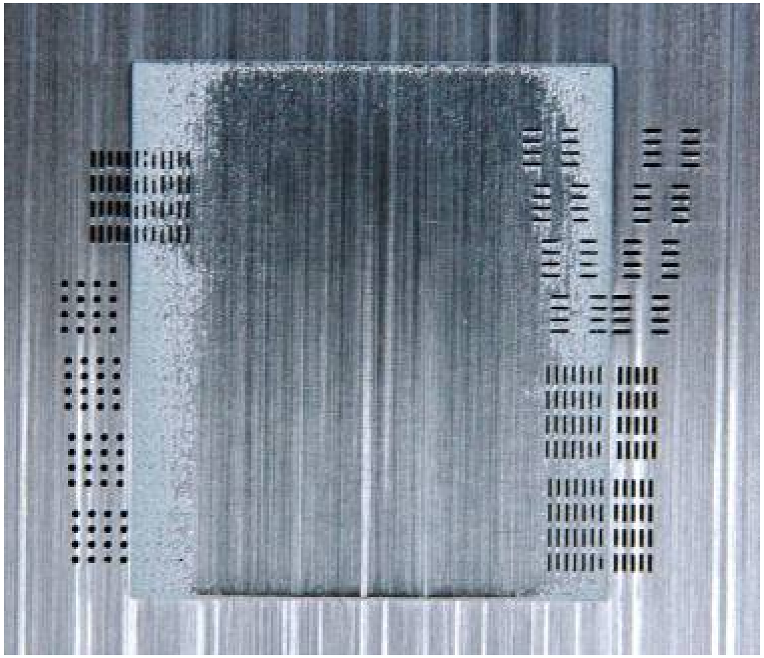
aperture distance step down „on plateau“



Influence of step height on wipe off
behavior of solder paste

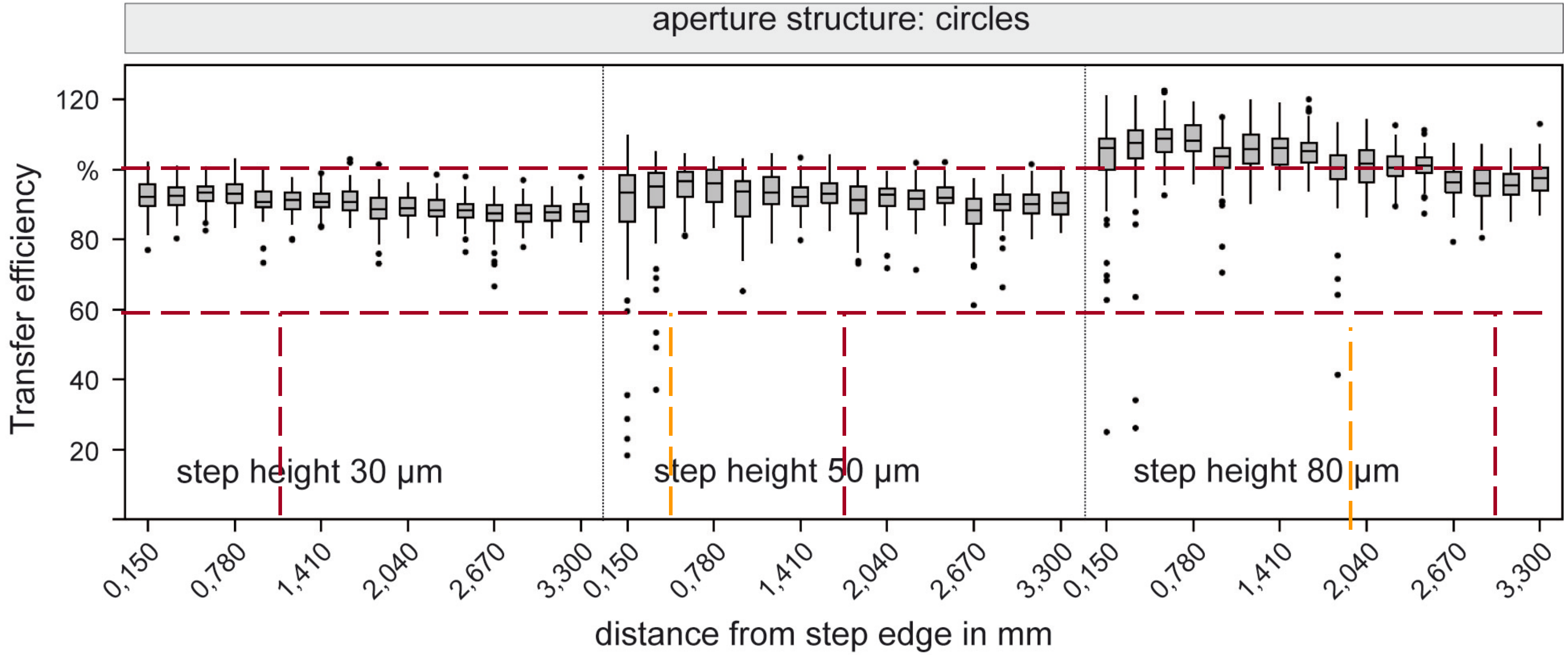


Step height 30 µm

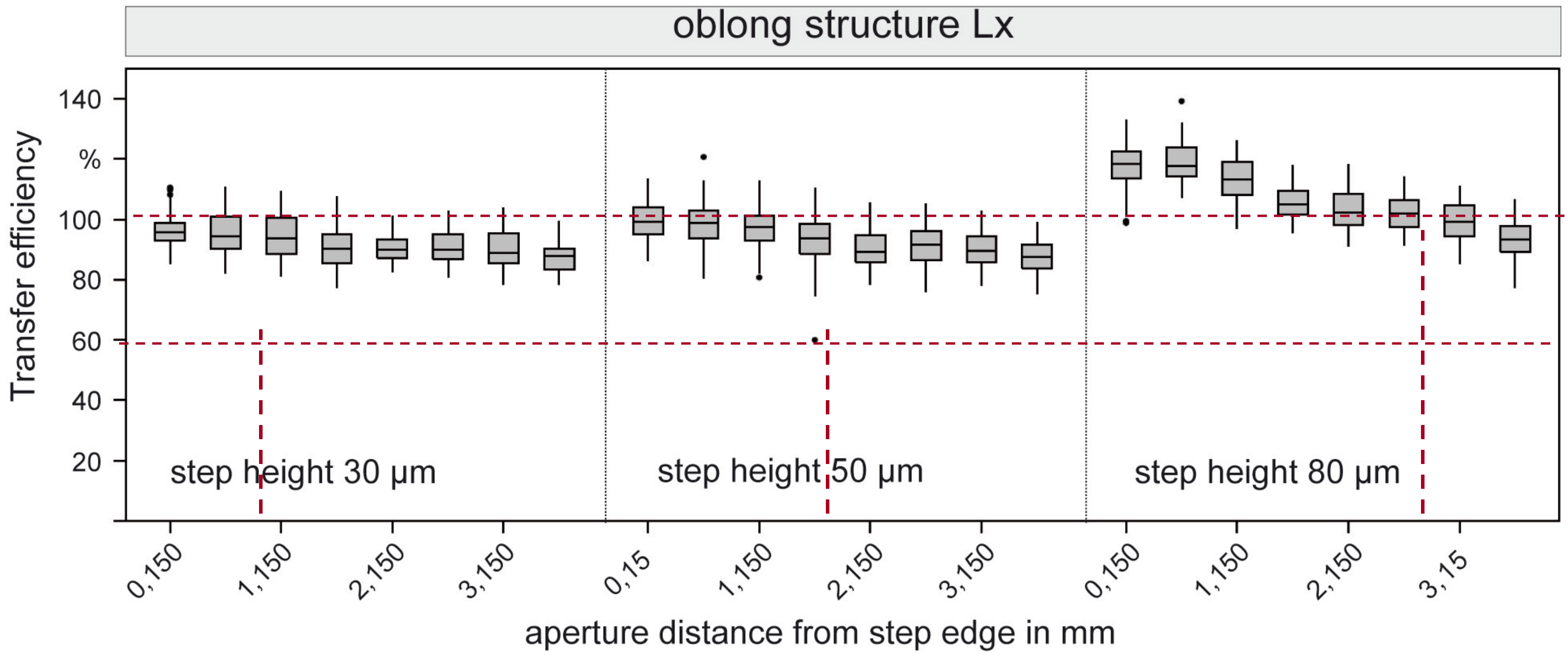


Step height 80 µm

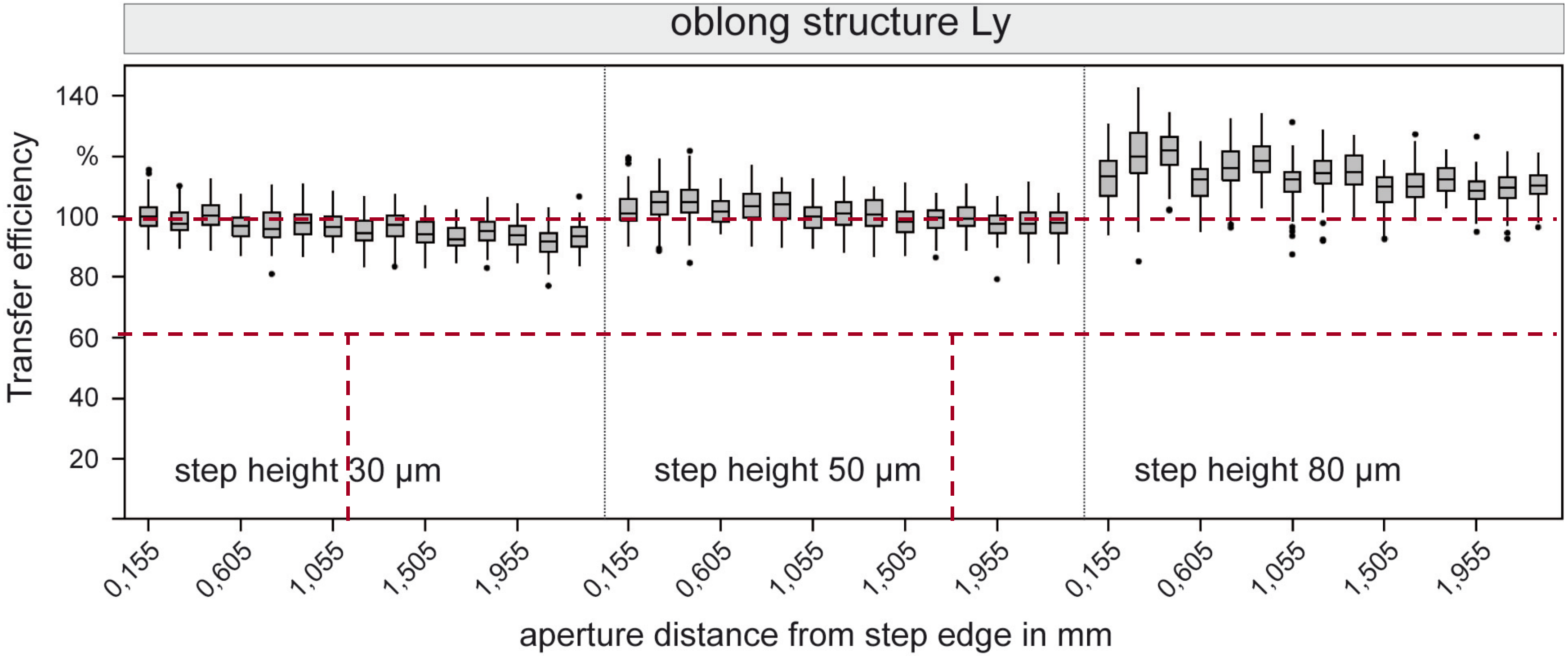
Transfer efficiency in step down area



Transfer efficiency in step down area



Transfer efficiency in step down area



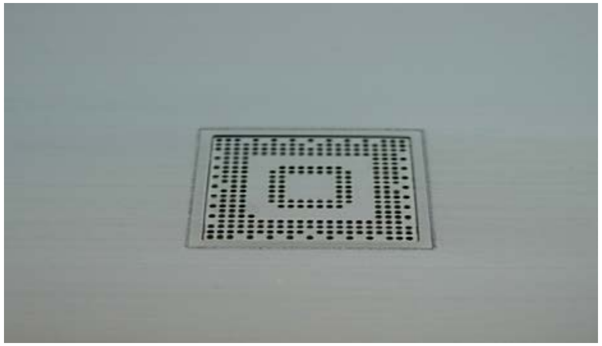
3D cavity stencil

Application: to print in deeper levels of a PCB

- Simultaneous paste printing process on different levels of the PCB
- Different paste depots heights on all levels
- Levels can differ more than several 100 microns

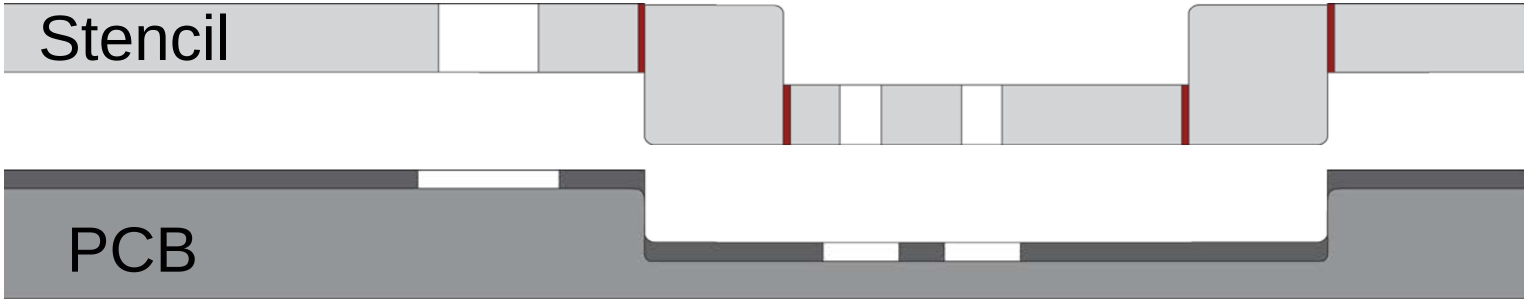
3D cavity stencil

Application:

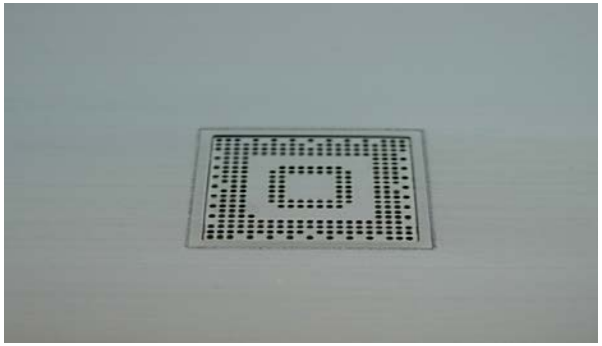


This type of stencil is used to print in deeper layers of a printed circuit board, by welding a foil in form of a step in the stencil

Problem: the sqeegee is no longer capable to dip in the cavity

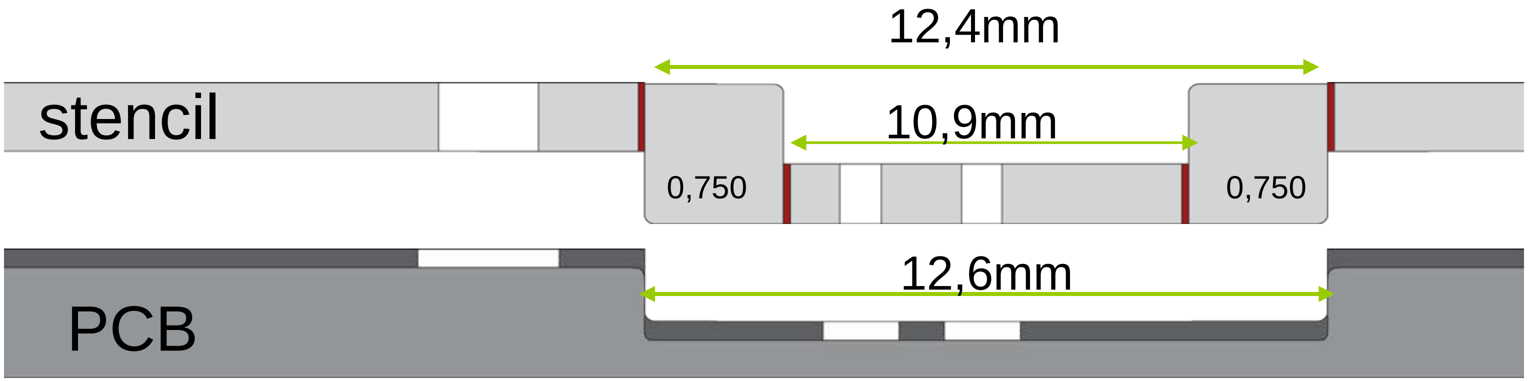


3D cavity stencil



Solution:

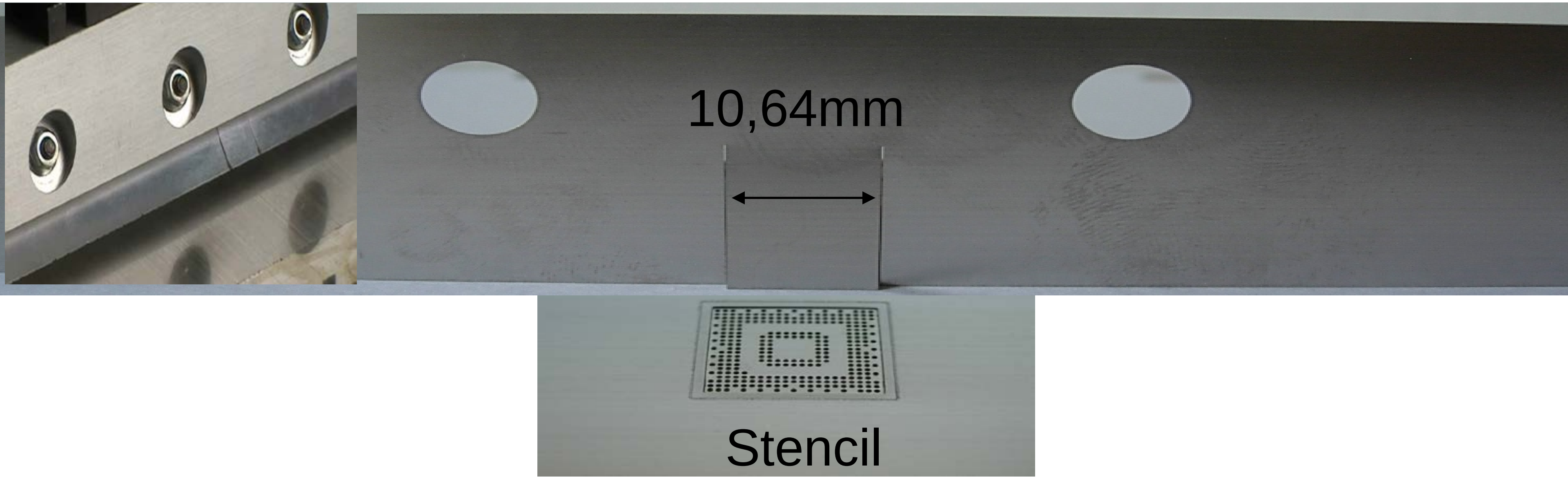
Two slots in the squeegee blade to increase flexibility. The slots have to be adjusted to cavity size.



3D cavity stencil

Solution:

Two slots in the squeegee blade to increase flexibility. The slots have to be adjusted to cavity size.



Summary

The laser cut and laser welding process is an innovative technology for step stencils and offers a multiplicity of solutions.

Critical apertures in the step-down area close to the step edge should be avoided, because the paste remains can affect the paste release.

Uncritical apertures in the step down area close to the step edge show an increase of transfer efficiency. The IPC guidelines are a good reference.

The wipe off behaviour of solder paste is influenced by the squeegee speed, -pressure, -angle and –material. A reduction of squeegee speed or –angle improves the wipe off.

Many thanks for your attention!