

Frames and tensioning systems for SMD stencils

Production process of SMD stencils in frames

Overview

The vast majority of today's SMD-technology stencils are mounted inside a stencil frame. Different types of frames such as: light aluminium, cast aluminium, and stainless steel are available. Cast aluminium is used exclusively when a very high-mesh tension is required and high tensile strengths are necessary. The screen or stencil printing machine usually determines the frame size requirement. Customers can request a host of frame sizes, with a maximum working area of 600 mm x 800 mm (23.62 x 31.50 inch). LaserJob keeps a large stock of frames, oriented toward our customer's demands, in order to react in a fast and efficient manner. And a customer can inquire, at any time, as to the current warehouse stock. In recent years, tensioning systems have become quite common, each with their own unique support fixtures and perforations. The tensioning systems were developed as a cost-saving and storage-space reducing alternative to frame-mounted stencils. Framed stencils are characterised by their high durability, stable handling and high tensile strength in comparison to tensioning systems. Also, because of their fragility and required tolerances, stencils with low material thicknesses [ $\leq 100 \mu\text{m}$  (4 mil)] are typically produced in a stencil frame.



Picture 1: Slope-Profiles

Picture 2: Anodized frames

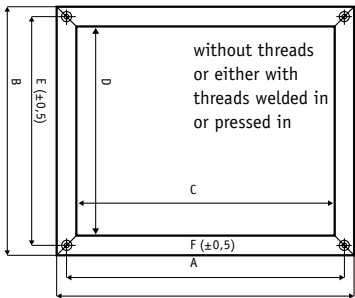
Standard aluminium frames

The standard aluminium frame profile is well established in the electronic production industry. Depending on the application (and on the size of the stencil printer) multiple frames and profiles are utilized. An overview is given in table/view 1. Aluminum frames are characterized by stable and robust production handling requirements. The shelf life is extremely good and, the frames can be used several times over many years. The stainless steel material is bonded to the frame under high tension, eliminating the risk of buckling. The aluminium frame is extremely strong and non-pliable, allowing tensioning forces above  $40\text{N/mm}^2$ . If a higher aluminium frame stability is required, frames with „Slope“ profiles can be implemented (see picture 1). Based on these profiles, higher mesh tensions can be obtained. To distinguish between RoHS-conform and standard products, color-marked frames can be provided. Working in conjunction with their key supplier, Laserjob developed a green-anodized color, which shows a high resistance and compatibility with most cleaning agents (see picture 2).

Advantages

- stable handling
- longevity and durability
- high tensile strength
- low net weight

Outside dimensions (mm, A x B)	Internal dimensions (mm, C x D)	Profile (mm)
736 x 736 29" x 29"	656 x 656	40 x 40
400 x 300	340 x 240	30 x 30
650 x 680	590 x 620	30 x 30
530 x 470	470 x 410	30 x 30
540 x 540	480 x 480	30 x 30
21.65" x 21.65"		
550 x 470	490 x 410	30 x 30
21.65" x 18.50"		
584 x 584	524 x 524	30 x 30
23" x 23"	534 x 508	25.4 x 38.1
600 x 500	540 x 440	30 x 30
23.62" x 19.68"		
600 x 550	540 x 490	30 x 30
550 x 400	490 x 340	30 x 30
700 x 570	640 x 510	30 x 30
27.56" x 22.44"		
340 x 290	280 x 210	30 x 30
550 x 550	490 x 490	30 x 30
21.65" x 21.65"		
490 x 490	410/430 x 430	40/30 x 30
800 x 580	740 x 520	30 x 30
500 x 500	440 x 440	30 x 30
19.68" x 19.68"		
400 x 450	340 x 390	30 x 30



Table/view 1: Sizes and views of standard aluminium frame

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## Production process of SMD stencils in frames

### Cast aluminium frames

Cast aluminium frames are primarily used when high stability and consistency with high mesh tension are required. Upon special request, frames can be provided with thread holes for better handling, for special screen printing machines, or with threaded bushings or fitting bushings. For maximum durability, the adhesive side of the frame is sand-blasted for optimum adhesion of the mesh to the frame. Cast aluminium frames are delivered in many sizes (see table/view 2). The trade-off for obtaining the proven benefits of cast aluminium frames is a higher price and a high total weight. Cast aluminium frames can be used multiple times over many years, just like light aluminium frames.

#### Advantages

- high stability
- high consistency
- high mesh tension

### Stainless steel frame

An additional alternative to aluminium is the stainless steel frame. Stainless steel frames do not differ in size and shape from standard aluminium frames. They are, like tubular aluminium frames, water-proof welded with polished welding seams. The adhesive surface is sandblasted to ensure an optimum adhesion from the mesh to the frame. If required, the frames are provided with thread holes for better handling in special screen printing machines. Fitting bushings are also possible. Stainless steel frames are extremely durable and can be used multiple times.

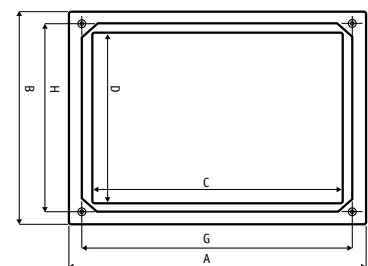
### Profile

For standard aluminium frames, the most commonly used square and quadratic profile tubes are either 30 mm x 30 mm or 40 mm x 40 mm with a wall thickness of 3.0 mm/1.8 mm or 2.8 mm/2.0 mm (see picture 3). The corresponding sizes can be seen in table/view 1. A special alternative is the „Slope“ profile with a diagonal inner-edge (see picture 1). The Slope profiles are extremely stable and can accommodate a higher-mesh tension (similar to stainless steel profiles). Slope profile frames are lightweight, easy to handle, and the diagonal inner edge helps to provide fast and easy cleaning of the frames.

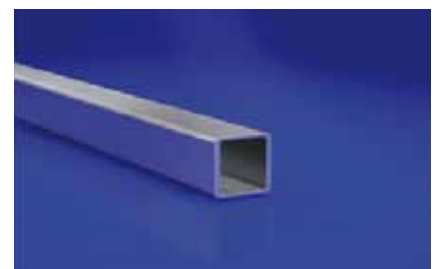
#### Advantages

- higher stability
- higher mesh tension possible
- fast cleaning

Typ	outside dimensions (mm, A x B)	inside dimensions (mm, C x D)	thread distance (mm, G x H)	frame thickness (mm)	edge height (mm)	thread	weight (kg)
68	250 x 185	210 x 145	203.20 x 170.20	19	9.5	M4	0.54
810	302 x 245	255 x 199	273.06 x 215.90	19	9.5	M6	0.78
1010	300 x 300	250 x 250	254 x 254	20	8	M6	1.25
1212	355 x 355	305 x 305	330 x 330	25.5	12.75	M6	1.50
	431.8 x 431.8	381 x 381	406.4 x 406.4	25.0	5	1/4"	3.20
1515	450 x 450	381 x 381	407 x 407	25.0	5	M6	3.35
2020	584 x 584	508 x 508	533 x 533	25.5	6.7	M6	5.20



Table/view 2: Sizes and views of cast aluminium frames



Picture 3: Square profile 30x30x3x1,8mm

Stainless steel sheet for stencils

The stainless steel sheets, which are used for the stencils, have specific properties such as special hardness and tensile strength. Only stainless steel sheets with low material thickness tolerances are used.

Material: stainless steel 1.4301 (full hard)  
Hardness (Hv): min. 370  
Tensile strength (N/mm²): > 1100  
Material thickness tolerance: ± 3 %

**Dimensions of stainless steel materials**  
SMD stencils are available in metal sheet thicknesses of (µm):  
20, 30, 50, 70, 80, 90, 100, 120, 130, 140, 150, 180, 200, 250, 300, 400  
SMD stencils in VectorGuard® tensioning systems are available in metal sheet thicknesses of (µm):  
75, 100, 120, 130, 150, 180, 200, 250  
Maximum thickness of metal sheets: 2 mm  
Maximum machine surface:  
800 mm x 600 mm

Tensioning/screen tension

All standard stencils are manufactured with a screen made of stainless steel with high-precision mesh. The standard stainless steel screen is delivered in 80 mesh (mesh/inch) and is tensioned in a 90° angle. The diameter of the screen wire is 0.1 mm. The SMD stencil is delivered with a tensile strength of 40 N/mm² to achieve optimum printing results. If required, screen filler can be applied to facilitate cleaning (see picture 4).  
Polymer screens, an alternative to stainless steel screens, can be chosen as well. In general, polymer screens have a lower tensioning threshold than stainless steel screens.  
Sefar Pad 1500 32/100 W, a polyester material with a diameter of 0.1 mm, is the default material utilized.

Production process of stencils in frames

Before the tensioning process takes place, the frames are inspected for flatness. If a used frame is to be recycled, a cleaning step for the frame is involved and the surface for the gluing area is roughened afterwards. In a tensioning machine, the frame is mechanical or pneumatically fixed with the screen and then regulated to the required tension. The screen is glued with an adhesive and, after the curing process, the screen is fixed tight to the frame (see picture 6).  
In the tensioned frame, the stainless steel sheet (in the corresponding size) is fixed-in with an adhesive from the squeegee side of the frame. The glue is then cured. In this way, the stainless steel sheet takes-over the tension of the screen. After the curing process, the screen material is cut out. The apertures are cut in strained condition with an aperture accuracy of ± 10 µm.



Picture 4: Stencil with/without screen filler



Picture 5: Frame tensioned with stainless steel screen



Frame with screen and stainless steel sheet



Gluing of stainless steel sheet with screen



Glued stainless steel sheet with screen

Picture 6: Production process for a stencil in frame



Picture 9: Tensioning system with stencil



Picture 10: Coloured stencil corners

### Stencils in tensioning systems

Stencils in tensioning systems are available with different perforations and device carriers. The tension is generated mechanically or pneumatically and is evenly spread over the entire stainless steel sheet. Most stencils in tensioning systems show a lower tensile strength than stencils in frames. In addition, they do not provide sufficient protection from damage (such as bending). Most of the tensioning systems are delivered with an edge protector to avoid risk of injury (see picture 7). Furthermore, by flanging the edges, increased stability is achieved. Tensioning systems are a lower-cost alternative to stencils in frames and are also a space-saving alternative.

LaserJob's first-generation tensioning system LJ 745 was developed in 1999. In 2013, a new "high-stability" frame system was introduced to the market, see picture 8. The high stability is accomplished through the use of aluminium stabilizers which are mounted on the underside of the stencil. By integrating these stabilizers into the stencil, bending & folding of the stencil is prevented, see picture 9.

Stencil foils as thin as 1 mil (25 µm) can be repeatedly pulled to a high tension of 40N/cm, thus guaranteeing the high position accuracies required for ultra-fine-pitch applications. The new "backlight" option acts as a secondary inspection tool which can highlight defects such as anomalies in pad shape and blocked apertures. The tensioning system is available in both sizes 23"x 23" and 29"x 29". Black corner tabs are utilized for standard applications (see picture 10) while optional green corner tabs can be employed for RoHS directives and unique product identification. For further information regarding the tensioning system LJ 745, see [data sheet 1.3](#).

LaserJob is cutting stencils for following tensioning systems

- VectorGuard® (license fee)
- Alpha Tetra/Vector 260/VectorMount® (license fee)
- QuattroFlex/Stencilman
- ZelFlex Z4P



Picture 7: Tensioning system with edge protection



Picture 8: Aluminium profile

### VectorGuard® tensioning system

The VectorGuard® tensioning system is a four-sided spring clamping system for SMD stencils with blue colored frames (see picture 11). It is available in standard sizes of 23"x 23" and 29"x 29". In addition, green edges can be implemented in the blue colored frames to distinguish the products. SMD stencils in the VectorGuard® tensioning system are only available in limited material thicknesses (µm): 75, 100, 120, 130, 150, 180, 200, 250. In mil: 3, 4, 5, 6, 7, 8, 10. Maximum material thickness: 2 mm. Maximum working surface: 800 mm x 600 mm.

### Alpha Tetra tensioning system

The Alpha Tetra tensioning system is a four-sided clamping system for SMD stencils with a specific perforation on all four sides (see picture 12). The system is also suitable for the VectorMount® or Vector 260 perforation. The Alpha Tetra tensioning system is available in 3 standard sizes in all material thicknesses.

### Stencilman tensioning system

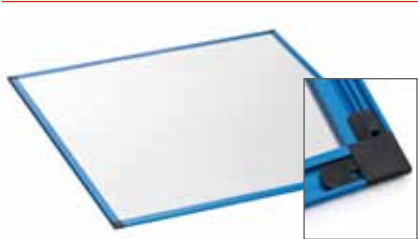
The Stencilman tensioning system with the perforation of a QuattroFlex tensioning system works with a tensile strength generated from compressed air and is deliverable in two sizes (see picture 13). It is available in all material thicknesses.

### ZelFlex Z4P tensioning system

The ZelFlex Z4P tensioning system is a pneumatic system with a patent-protected compressed air system (see picture 14). It is offered in two standard sizes and is available in all material thicknesses.

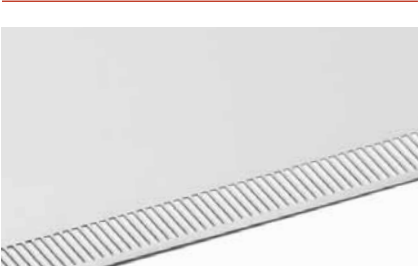
Other systems are available on request.

VectorGuard®	outside dimensions in mm	sheet size in mm
VG 260 standard size: 23" x 23"	584 x 584 (23" x 23")	555.5 x 555.5
VG 265 standard size: 29" x 23"	736 x 584 (29" x 23")	708 x 555.5
Expandable with adapter set to outside dimensions of 736 x 736 mm: 29" x 29"	736 x 736 (29" x 29")	708 x 555.5



Picture 11: VectorGuard® tensiometer system

Alpha Tetra	outside dimensions in mm	sheet size in mm
standard size: 17" x 17" Expandable with adapter set to outside dimensions of: 584 x 584 mm; 23" x 23"	430 x 430 (17" x 17")	404 x 404
standard size: 23" x 23" Expandable with adapter set to outside dimensions of: 736 x 736 mm; 29" x 29"	584 x 584 (23" x 23")	558 x 558
standard size: 23" x 29" Expandable with adapter set to outside dimensions of: 736 x 736 mm: 29" x 29"	584 x 736 (23" x 29")	558 x 711



Picture 12: Alpha Tetra tensiometer system

Stencilman	outside dimensions in mm	sheet size in mm
standard size: 23" x 22,28" 584 x 566 mm	584 x 566 (23" x 22,28")	555.5 x 555.5
standard size: 28,35" x 23" 720 x 584 mm	720 x 584 (28,35" x 23")	709.5 x 555.5



Picture 13: Stencilman tensiometer system

ZelFlex Z4P	outside dimensions in mm	sheet size in mm
standard size: 23" x 23" 584 x 584 mm	584 x 584 (23" x 23")	558 x 558
standard size: 29" x 29" 736 x 736 mm	736 x 736 (29" x 29")	711 x 711



Picture 14: ZelFlex Z4P tensiometer system

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## Quality control

Quality assurance is paramount at LaserJob. Effective quality control starts with incoming inspection of the stainless steel sheets and stencil frames. A thickness measurement instrument controls every stainless steel sheet with an accuracy of  $\pm 0.5 \mu\text{m}$ . The screen tension is measured from each screen printing frame. Directly after the laser cutting process, aperture size and aperture geometry are inspected. The OKM measurement system detects on an area of 400 mm x 200 mm with a precision of  $2.5 \mu\text{m} + L/400$  the position of the apertures. The contour of apertures is controlled with an accuracy of  $0.5 \mu\text{m}$  with a CCD camera with back light. ScanCheckI+ compares the produced stencil with original data and examines the congruency.

### Variations

- NanoWork®-stencil
- PatchWork®-stencil (Step stencil)
- 3D PatchWork®-stencil
- combination PatchWork®-stencil with NanoWork®-coating
- stencil in screen printing frame glued over stainless steel mesh
- in tensioning system LJ 745
- in Quattroflex tensioning system
- in VectorGuard® tensioning system
- in Alpha Tetra/Micromount/Vector tensioning system
- in Zelflex tensioning system
- in Stencilman tensioning system
- in different customer-specific tensioning system

## Service

LaserJob offers a full range of consulting services for layout and design. Our team generates, from your CAD-CAM data, automatic cutting instructions for the laser. Our highly focused laser systems cut with high positioning accuracy the apertures.

### We offer additional

- scaling apertures up and down
- changing aperture design, e.g. home plates and rounding sharp corners
- optimizing apertures (anti tombstone design)
- rotating or mirroring of the whole design or sub-areas
- control of aspect and area ratios
- generation of stencils with multiple panels
- generating layouts from existing PCBs
- generating stencil layouts for adhesive applications
- customer-specific storage for used frames. The frames will be cleaned, re-strung and provided for new orders. Your actual inventory is always retrievable.
- data storage
- test certificates (as well as customer's specifications)
- data for solder paste inspection systems
- Data Matrix Code
- measuring of printed circuit boards
- production of stencils from provided PCBs, stencils, or films

## Shipping conditions

### Shipping time

Standard shipment time ex works is 3 work days  
Order entry before 5 p.m. (= first work day)

24 hour express shipment –  
Confirmed orders will be shipped the next day  
Order entry before 5 p.m.

6 hour express shipment –  
Confirmed orders will be shipped the same day  
Order entry before 1 p.m.

Common carrier: UPS, DHL, GO, FedEx (any shipping service) as well as direct shipments with courier delivery with partner companies.

### Packaging

All LaserJob stencils are shipped in reusable packaging. To avoid damage of stencils, proven packaging materials are used. We deliver stencils in specialty packaging as well as per customer request.  
For tensioning systems, two storage bags are offered (see picture 15).

### Order process

To guarantee fast handling of your order, send the purchase order via

- e-Mail: [mail@laserjob.de](mailto:mail@laserjob.de)
- fax: +49 (0) 8141 52778-60
- post

Please send the gerber files for the stencils via e-mail to [mail@laserjob.de](mailto:mail@laserjob.de)

We are ISO 9001:2008 certified



Picture 15: Storage bag

### LaserJob data sheets

- 1.0 SMD stencil
  - 1.1 NanoWork®-stencil
  - 1.2 PatchWork®-stencil
  - 1.3 Tensioning system LJ 745
  - 1.4 Frames and tensioning systems
  - 1.5 Repair and Re-balling stencil
  - 1.6 Wafer bumping-stencil
  - 1.7 LTCC Via fill-stencil
- 2.0 Laser Material Processing

Auch in Deutsch erhältlich.

