ALPHA® Ultra-high precision stencils for semiconductor manufacturing

**ALPHA® Flux™**
WLCSP Flux deposition stencils

**ALPHA® Sphere™**
WLCSP Ball placement stencils

**ALPHA® Bump™**
Wafer bumping solder paste stencils

**ALPHA® Cut™/Nickel™**
SIP and Fine feature stencils
Alpha Engineers have combined their accumulated knowledge of these processes with the Company’s expertise in electroforming and state-of-the-art laser technology to produce a range of stencils specifically to advance WLCSP manufacturing efficiency.

**ALPHA® FLUX™**
Flux Deposition Stencils

**ALPHA® SPHERE™**
Ball Placement Stencils

**ALPHA® BUMP™**
Wafer Bumping Solder Paste Stencils

**ALPHA® CUT™/NICKEL™**
SIP and Fine Feature Stencils

Alpha has many years experience in the electroforming very flat and highly durable nickel stencils and blanks, controlled to thicknesses measured in microns. This capability, combined with the latest, cutting edge laser technology produces ultra-high precision micro stencils with a proven record of increasing the efficiency of solder ball placement and improving yields in solder paste wafer bumping.
Alpha Flux stencils are typically produced from very thin stainless steel in predetermined thicknesses (25-100µm), or electroformed nickel, where the thickness can be tailored to suit customer requirements. It is, however, essential that in both instances the laser cutting process is optimised to ensure preservation of coplanarity.

Features:
- Very flat stainless steel or nickel materials
- Thickness ranges 25-100µm
- Fully open holes for flux to print through
- High positional accuracy (cpk >2.0 at spec of +/- 25µm)
- Outstanding aperture size accuracy (cpk >1.33 at spec of +/- 7µm)

Using Alpha FLUX stencils in preference to mesh screens offers a range of benefits which includes:
- The ability to reduce deposit footprint but maintain overall volume
- Better consistency of volume deposits
- Better, more consistent deposit release
- No mesh or resist to separate
- Increased durability for longer life

In order to reflow solder spheres successfully and achieve optimum stand-off heights it is essential to print a precise amount of flux in the exact place where the solder sphere is to be placed.

Historically ball placement stencils have been etched while flux deposition has been carried out using mesh screens.

With fine pitch requirements reaching 350µm there is a strong need for the solder spheres to be placed centrally on the flux deposits across the entire wafer. Differential thermal expansion of non similar stencil/screen materials can prove problematic for the process. As wafers increase in size the potential problem becomes heightened.

Only if the flux stencil is produced in conjunction with the ball placement stencil and from the same material, can the positional accuracy of corresponding apertures be guaranteed.

Alpha FLUX stencils are produced in the same way as Alpha SPHERE ball placement stencils, from the same material and using the same technology. In this way, the occurrence of errors are minimized.
For bump heights of 200µm and above solder sphere placement and reflow is considered the most viable option.

Ball placement stencils have conventionally been produced from stainless steel with the underside step etched to avoid contact with the flux deposits. Alpha SPHERE stencils have a composite construction, combining laser cut stainless steel or nickel with durable polymer stand-off pillars or lands providing the under-stencil relief to accommodate the flux deposits.

Alpha SPHERE stencils have apertures with a reverse taper which has been shown to accept the solder spheres more readily and position them with greater accuracy than can be achieved with etched ball placement stencils, using either squeegees or a ball placement head.

The polymer stand-off pillars or lands are designed to produce optimum clearance around the flux deposit while the laser cut aperture reduces variability in the placement. Suitable for current and next generation of pitch/size devices.

**Features:**
- Stainless steel / polymer composite
- Improved positional accuracy (cpk >2.0 at spec of +/- 25µm)
- Improved aperture size accuracy (cpk >1.33 at spec of +/- 7µm)
- Thickness to suit sphere size
- Excellent coplanarity after cutting (Optimised cutting algorithms minimise heat deformation)
- No pillar separation after cleaning
- Fast turnaround

In production, the use of Alpha SPHERE stencils has resulted in the reduced occurrence of “misses” and extra balls and a marked improvement in sphere positioning repeatability which in turn result in significant yield improvement.
Bump heights below 200µm are usually generated directly with solder paste or by the more recently introduced solder cap on Cu pillar technique. Both processes and their variants require precise volumes of solder paste to be printed very accurately over the I/O.

No company has more experience in producing high precision stencils for solder paste printing than Alpha. We are able to design and produce stencils specifically to optimise paste deposition in order to achieve process consistency.

Combining the flatness of a nickel blank with the ultra-high precision of the latest laser technology produces stencils that are responsible for significant yield improvements.

**Features**
- Flat and smooth nickel sheet
- Optimised cutting algorithms minimise heat deformation
- Excellent positional accuracy (cpk >2.0 at spec of +/- 25µm) typically resulting in less than 11µm error
- Excellent aperture size accuracy (cpk >1.33 at spec of +/- 7µm) typically resulting in less than 3µm error on size
- Better repeatability than can be achieved with simple Electroforming
- Optimised custom design of the bump apertures
- Fast turnaround

**Flip chip process**
- Deposit pre-mixed solder paste
- Post reflow

**Cu pillar process**
- Print solder cap
- Post reflow, resist strip and etch of seeded Cu layer
patent pending for ALPHA SPHERE